ECONOMIC ANALYSIS OF
THE LEGAL REGIME FOR AVIATION LIABILITY

Thesis Submitted for the Degree of Doctor of Philosophy

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BENTHAM HOUSE
To the loving memory of my father
To whom I owe most of what I am.
Abstract

Despite phenomenal scientific and technological advances, statistics show that international carriage by air is still plagued by the risk of passenger, surface and environmental damage. If, as experience has demonstrated, aviation risk is inherent and unavoidable, the law of civil liability needs to be so efficiently formulated as to induce, through its financial incentive, all the parties involved to minimise combined accident and environmental costs plus their avoidance costs. And if international carriage by air is a product of joint activity involving various actors, they must as such be made to shoulder their own share of risk for equitable risk bearing. In this regard, existing international legal regime comprised of the *Warsaw* and *Rome Convention* system is piecemeal and far from desirable in terms of both efficient and equitable risk allocation.

In the context of passenger damage risk, the air carrier and aircraft manufacturer should be held strictly liable for actual losses (with the defence of contributory negligence in the case of the carrier's liability). Under strict liability carriers and manufacturers will be forced to take all justified risk-reducing steps, reflect the costs in their prices, and/or take out adequate liability insurance. The negligence rule not only creates uncertainty over the due care level but presents victims with substantial difficulty in proving causal link. Although certain safety/security standards do create an incentive for airlines and manufacturers to take due care, nevertheless, courts do not necessarily adduce compliance with regulatory standards as a conclusive evidence of due care under liability rules. Aircraft operators should also be strictly liable for surface damage with the contributory negligence defence, since persons on the surface can affect risk (e.g. by failure to light at night a tall building below the flight path). The requirement of compulsory insurance has been found efficient, since it will protect risk-averse or even 'irrational' operators from catastrophic losses. In determining the law applicable to heads of damages in respect of both passenger and surface damage, courts should apply lex fori for administrative cost reduction.

In the case of noise and pollution damage caused at airports, it is both efficient and distributionally desirable for airport operators to tax airlines for noise and pollution damage separately. This is because liability rules are not only imprecise for income distribution but ineffective for a large amount of damage thinly spread over a large population. This is also because airport operators are subsidised from public money for the provision of their services. Alternatively, members of international society may agree to tax international airport operators for pollution damage. The charges payable may be related not only to aircraft movements but to other relevant pollution factors. As to the ATC's passenger damage risk, ATC agencies should be taxed on the basis of their relative accident propensity. If passenger damage were caused concurrently by an ATC agency, carriers and manufacturers, respective liability should be apportioned among them on the basis of their relative accident probability or insurance claims record as evidence of their average level of care exercised. This accords with tort law's deterrence goal and with the insurer's experience-based premium-rating practice.
Acknowledgements

Like many other works, great or small, I owe what I am now able to submit to too numerous people and institutions to enumerate. I am indebted to my supervisor, Mr Richard Gardiner who has affected to keep himself aloof but has always been attentive at heart throughout my research period. My thanks also go to Professor Terence Daintith of the Institute of Advanced Legal Studies who, acting as advisor during a final revision of this work, read the revised text carefully and gave useful advice and comments on a range of issues including regulation. Professor Dawn Oliver, Head of the UCL's Faculty of Laws, is entitled to a citation for her role in arranging for my encounter with Professor Daintith.

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Professors Roger Rideout and Maurice Mendelson, incumbent and former Research Directors at UCL Law Faculty, deserve due recognition for their encouragement, academic arrangements and helpful advice on research method and other academic matters. My gratitude extends to Professor William Butler of Comparative Law who contributed to broadening my horizons on international legal issues. Professor Jeffrey Jowell afforded me a grant and arranged a place in a workshop. Formerly Quain Professor of Jurisprudence at UCL, Professor William Twining should be cited for his guidance in research method seminars as well as for his own personal virtues. Moral support from Mr Richard O'Dair, Mr David Hutchinson and Ms Alison Clarke were all a stitch in time.

Thanks are due to the British Council that enabled me to embark on a long journey into academic pursuit, and to the staff of UCL Library, the Institute of Advanced Legal Studies and LSE Library. I am also indebted to the staff of the Korea Social Science Library, Korean Air Library, Seoul National University Library, Korea University Library, Hankook University of Foreign Studies Library, and Soongsil University Library. Any acknowledgements would be incomplete and unsatisfactory without mentioning Ms Lorely Teulon, senior executive officer at UCL Law Faculty, and Ms Marion Mark, secretary to my supervisor, for their part in efficient communication between the Law Faculty and me. Last but not least, without uncompromising devotion and support, both morally and financially, of my wife over an extended stint, this work would neither have borne fruit nor have come to light at all. I was also fortunate to be able to obtain her assistance in relation to French materials, e-mail correspondence and search on the Internet for the latest update on US statutes.
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<td>Adm</td>
<td>Administrative, Administration or Administratif</td>
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<td>aff'd</td>
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<td>Affairs</td>
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<td>ATC</td>
<td>Air Traffic Control</td>
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<td>Air Traffic Control Agency (Agencies)</td>
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<td>esp.</td>
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<tr>
<td>ex p</td>
<td>ex parte (=on one side only)</td>
</tr>
<tr>
<td>ibid</td>
<td>ibidem (=in the same place or book or on the same page)</td>
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<tr>
<td>id</td>
<td>idem (=the same)</td>
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<tr>
<td>IFR</td>
<td>Instrument Flying Rules</td>
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2. Organisations, Proper Nouns, and Court System

2.1 Organisations, Institutions and Publishing Houses

ABA American Bar Association
ALI American Law Institute
ATCA Air Traffic Control Agency or Authorities
CAA Civil Aviation Authority (UK)
CAB Civil Aeronautics Board (US)
EC European Communities
ECU European Currency Unit
EEC European Economic Community
Abbreviation 12

EPA Environmental Protection Agency (US)
Eurocontrol European Organisation for the Safety of Air Navigation
FAA Federal Aviation Administration (US)
HC House of Commons
HMSO Her Majesty's Stationery Office
IATA International Air Transport Association
ICAO International Civil Aviation Organisation
ILA International Law Association
IMF International Monetary Fund
KLM KLM Royal Dutch Airlines
LGDJ Librairie Générale de Droit et de Jurisprudence
NATS National Air Traffic Services (UK)
OECD (OCDE) Organisation for Economic Co-operation and Development
Pan Am Pan American World Airways
SAS Scandinavian Airlines System
SDR Special Drawing Rights
TWA Trans World Airlines
UN United Nations

2.2 Proper Nouns

Ala Alabama
Am American
Ariz Arizona
Ark Arkansas
Brit British
Cal/Calif California
Camb Cambridge
Chi Chicago
Cin Cincinnati
Colo Colorado
Colum Columbia
Conn Connecticut
DC District of Columbia
Del Delaware
Fla Florida
Harv Harvard
Ill Illinois
Ind Indiana
Ga Georgia
Kan Kansas
Ky Kentucky
LA Los Angeles
La Louisiana
Mass Massachusetts
Md Maryland
Mich Michigan
Minn Minnesota
Miss Mississippi
## Abbreviation

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<td>App Div</td>
<td>Appeals or Appellate Division</td>
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<tr>
<td>CA</td>
<td>Court of Appeal(s) or Cour d'Appel</td>
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<tr>
<td>cass</td>
<td>Cour de cassation</td>
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<tr>
<td>CD</td>
<td>Central District</td>
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<tr>
<td>Ch D</td>
<td>Chancery Division (UK High Court)</td>
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<tr>
<td>ch civ</td>
<td>chambre civile</td>
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<tr>
<td>Cir</td>
<td>Circuit Court (US Court of Appeals)</td>
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<tr>
<td>CE</td>
<td>Conseil d'Etat</td>
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<td>Ct Cl</td>
<td>Court of Claims</td>
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<td>DC</td>
<td>Divisional or District Court</td>
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<td>DDC</td>
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<td>JPMDL</td>
<td>Judicial Panel on Multi-District Litigation</td>
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<td>KB(QB) DC</td>
<td>King's Bench Divisional Court (UK High Court)</td>
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<td>WD</td>
<td>Western District</td>
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3. Periodicals, Law Reports and Journals

3.1 Newspapers

FT  Financial Times
Int'l HT  International Herald Tribune
SLT  Scots Law Times
TT  The Times
WSJ/Eur  Wall Street Journal/Europe

3.2 Law Reports, Statute Books and Treaty Series

AC  Appeal Cases (UK)
All ER  All England Law Reports
ALR  American Law Reports: Cases and Annotations
ALR 2d  American Law Reports, Second Series
ALR 3d  American Law Reports, Third Series (1971)
A  Atlantic Reporter
A 2d  Atlantic Reporter, Second Series
AC  Law Reports, Appeal Cases (House of Lords/Privy Council)
A 2d  Atlantic Reporter, Second Series
Avi  Aviation Law Reporter (CCH)
Cal App  California Appellate Reports
Cal App 2d  California Appellate Reports, Second Series
Cal App 3d  California Appellate Reports, Third Series
Cal Rptr  California Reporter
Cal 3d  California Reporter, Third Series
Campbell  Campbell's Reports, Nisi Prius
CFR  Code of Federal Regulations
Cmd/Cmnd/Cm  Command Paper (UK)
CPD  Law Reports, Common Pleas Division
D  Recueil Dalloz
D Chr  Dalloz Chronique
DS  Recueil Dalloz-Sirey
FAR  Federal Aviation Regulations
F 2d  Federal Reporter, Second Series
F 3d  Federal Reporter, Third Series
F Supp  Federal Supplement
Gaz Pal  Gazette du Palais
L Ed  Lawyers' Edition, US Supreme Court Reports
Lloyd's L Rep  Lloyd's List Law Reports
Lloyd's Rep  Lloyd's Law Reports
LNTS  League of Nations Treaty Series
<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>LR</td>
<td>Law Reports (England and Wales)</td>
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<tr>
<td>LR Ex</td>
<td>Law Reports, Exchequer</td>
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<tr>
<td>Misc</td>
<td>Miscellaneous Reports (New York)</td>
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<tr>
<td>NE</td>
<td>Northeastern Reporter</td>
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<tr>
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<td>Northeastern Reporter, Second Series</td>
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<td>NH</td>
<td>New Hampshire Reports</td>
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<td>Northwestern Reporter</td>
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<td>NW 2d</td>
<td>Northwestern Reporter, Second Series</td>
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<td>NY</td>
<td>New York Court of Appeals</td>
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<td>NYS</td>
<td>New York Supplement</td>
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<td>New York Supplement, Second Series</td>
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<tr>
<td>Ore</td>
<td>Oregon Reports or Oregon Supreme Court Reports</td>
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<tr>
<td>P</td>
<td>Pacific Reporter</td>
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<tr>
<td>P 2d</td>
<td>Pacific Reporter, Second Series</td>
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<td>Prod Liab Rep</td>
<td>Products Liability Reports (CCH)</td>
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<tr>
<td>Pub L</td>
<td>Public Law (US)</td>
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<tr>
<td>QBD</td>
<td>Law Reports, Queen's Bench Division (1875-1890)</td>
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<td>S</td>
<td>Recueil Sirey</td>
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<td>S &amp; B AvR</td>
<td>Shawcross &amp; Beaumont Aviation Reports (1991-)</td>
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<td>S Ct</td>
<td>Supreme Court Reporter</td>
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<td>SI</td>
<td>Statutory Instruments (London: HMSO)</td>
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<td>So</td>
<td>Southern Reporter</td>
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<td>Stat</td>
<td>Statutes at Large (US)</td>
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<tr>
<td>SW</td>
<td>Southwestern Reporter</td>
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<tr>
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<td>Southwestern Reporter, Second Series</td>
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<tr>
<td>TIAS</td>
<td>Treaties and Other International Agreements (US)</td>
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<td>UKTS</td>
<td>United Kingdom Treaty Series</td>
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<td>UNTS</td>
<td>United Nations Treaty Series</td>
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<tr>
<td>USTS</td>
<td>United States Treaty Series</td>
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<td>US</td>
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<td>US &amp; CAvR</td>
<td>United States and Canadian Aviation Reports</td>
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<tr>
<td>USCA</td>
<td>United States Code Annotated</td>
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<tr>
<td>USLW</td>
<td>United States Law Week</td>
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<tr>
<td>Wash 2d</td>
<td>Washington Supreme Court Reports, Second Series or Washington Reports, Second Series</td>
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<tr>
<td>WLR</td>
<td>Weekly Law Reports</td>
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### 3.3 Journals

- **AASL**: Annals of Air and Space Law
- **ADMA**: Annuaire de droit maritime et aéro-spatial
- **AJCL**: American Journal of Comparative Law
- **AJIL**: American Journal of International Law
- **Brit J L & Soc**: British Journal of Law and Society
<table>
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<tr>
<td>Can Bar Rev</td>
<td>Canadian Bar Review</td>
</tr>
<tr>
<td>Can J L &amp; Juris</td>
<td>Canadian Journal of Law and Jurisprudence</td>
</tr>
<tr>
<td>Colum LR</td>
<td>Columbia Law Review</td>
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<tr>
<td>Colum J Trans L</td>
<td>Columbia Journal of Transnational Law</td>
</tr>
<tr>
<td>Cur Leg Probs</td>
<td>Current Legal Problems</td>
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<tr>
<td>Eur Trans L</td>
<td>European Transport Law</td>
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<tr>
<td>Fis Stud</td>
<td>Fiscal Studies</td>
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<tr>
<td>Geo LJ</td>
<td>Georgetown Law Journal</td>
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<tr>
<td>ICLQ</td>
<td>International and Comparative Law Quarterly</td>
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<tr>
<td>ILM</td>
<td>International Legal Materials</td>
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<tr>
<td>Indus LJ</td>
<td>Industrial Law Journal</td>
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<tr>
<td>Int Rev L &amp; Econ</td>
<td>International Review of Law and Economics</td>
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<tr>
<td>JALC</td>
<td>Journal of Air Law and Commerce</td>
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<tr>
<td>J Common Market Stud</td>
<td>Journal of Common Market Studies</td>
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<tr>
<td>J Econ Litt</td>
<td>Journal of Economic Literature</td>
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<tr>
<td>J Econ Persp</td>
<td>Journal of Economic Perspectives</td>
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<tr>
<td>J L &amp; Econ</td>
<td>Journal of Law and Economics</td>
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<td>J Leg Educ</td>
<td>Journal of Legal Education</td>
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<tr>
<td>JMLC</td>
<td>Journal of Maritime Law and Commerce</td>
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<tr>
<td>JO</td>
<td>Journal officiel des communautés européennes</td>
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<tr>
<td>J Pol Econ</td>
<td>Journal of Political Economy</td>
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<tr>
<td>J Prod Liab</td>
<td>Journal of Products (and Toxics) Liability</td>
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<tr>
<td>L &amp; Contemp Probs</td>
<td>Law and Contemporary Problems</td>
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<td>L &amp; Phil</td>
<td>Law and Philosophy</td>
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<tr>
<td>LMCLQ</td>
<td>Lloyd's Maritime and Commercial Law Quarterly</td>
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<td>Loyola LA LR</td>
<td>Loyola of Los Angeles Law Review</td>
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<td>LQR</td>
<td>Law Quarterly Review</td>
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<td>L Soc Gaz</td>
<td>Law Society's Gazette</td>
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<td>Mod LR</td>
<td>Modern Law Review</td>
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<tr>
<td>OJ</td>
<td>Official Journal of the European Communities</td>
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<td>Pub Adm</td>
<td>Public Administration</td>
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<tr>
<td>Rev dr int et dr comp</td>
<td>Revue de droit international et de droit comparé</td>
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<tr>
<td>Rev Econ Stud</td>
<td>Review of Economic Studies</td>
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<tr>
<td>Rev int dr comp</td>
<td>Revue internationale de droit comparé</td>
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<tr>
<td>Rev Jur Themis</td>
<td>Revue juridique Themis de l'Université de Montréal</td>
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<tr>
<td>RFDA</td>
<td>Revue française de droit aérien</td>
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<tr>
<td>RGAE</td>
<td>Revue générale de l'air et de l'espace</td>
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<td>Scandinavian Stud L</td>
<td>Scandinavian Studies in Law</td>
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<td>Sol J</td>
<td>Solicitor's Journal</td>
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<td>Stan LR</td>
<td>Stanford Law Review</td>
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<td>Transp LJ</td>
<td>Transportation Law Journal</td>
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<td>Tul LR</td>
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<td>UCLA LR</td>
<td>University of California at Los Angeles Law Review</td>
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<td>Urb L</td>
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<td>YBk Eur L</td>
<td>Yearbook of European Law</td>
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<tr>
<td>ZLW</td>
<td>Zeitschrift für Luft- und Weltraumrecht</td>
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Breyer, S, Regulation and Its Reform (Harv UP 1982).
Calabresi, G & Melamed, A D, Property Rules, Liability Rules, and Inalienability: One View of the Cathedral, 85 Harv LR (1972) 1089.
Drion, H, Limitation of Liabilities in International Air Law (The Hague: Martinus Nijhoff 1954) [Cited as e.g. H Drion, 33, referring to the paragraph number of this work].
Juglart (De), M, Traité de droit aérien (2d ed E du Pontavice, J D de la Rochère & G Miller, Paris: LGDJ, vol 1: 1989 & vol 2: 1992) [Cited as e.g. Juglart, I(100) meaning vol 1, No.100 of this work].
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Shavell, S, Economic Analysis of Accident Law (Harv UP 1987).
INTRODUCTION

Planes do not wander about in the sky like vagrant clouds... The moment a ship taxis onto a runway it is caught up in an elaborate and detailed system of controls.1

Si le grain de blé... ne meurt, il reste seul; s'il meurt, il porte beaucoup de fruit. The Bible2

1. The Scope and Objective of This Work

This work purports to be the first study to apply economic approach to analysis of the entire gamut of the existing legal regime for aviation liability governing passenger, surface and environmental damage caused by an 'accident' or 'incident'3 in the course of international carriage by air. More specifically, this work applies economic approach to existing liability rules and regulatory regimes, criticises or evaluates them, and develops a set of key pointers to be used as the basis for a new, coherent and effective legal regime. By 'accident' is meant such a sudden, non-repetitive and traumatic occurrence as causing personal injury or death and/or property damage (e.g. crash, collision or in-flight fire).4 Insofar as damage resulted from such an 'external' cause, it is immaterial how the damage was caused, i.e. whether it was done intentionally or carelessly. An accident is thus distinguished from an illness or disease developing from natural or internal causes. 'Environmental damage' refers to physical and mental injuries and property damage caused by aircraft operation and results from repetitive and cumulative occurrences of noise, vibration and air pollution (with the possible exception of vibration).5

ICAO statistics report an annual average of 25 accidents involving passenger fatalities from 1986 to 1990 on scheduled international air services and at least 26 fatal accidents on non-scheduled international flights in 1990.6 Although passenger fatalities per 100 million passenger-miles have since 1985 tended to be on the decline on scheduled international services, the number of passengers annually killed nonetheless has been fluctuating, ranging from 440 to more than 1,000.7 This demonstrates that whatever technological innovation may have been achieved in the past, accidents have happened, and judging from

2. "Unless a grain of wheat falls to the ground and dies, it remains only a single seed. But if it dies, it produces many seeds" (St John) 12: 24; Juglart, I(2124).
3. For the meaning of an accident, see ch 2: 3 below.
5. Ch 5: 1.1.2 & 3.1.4 below.
statistical probability, accidents will continue, even though on a diminishing rate. In other words, carriage by air is accompanied by the *unavoidable and ineluctable* risk of accident causing personal and property damage to passengers and subjacent people. Furthermore, carriage by air also causes noise-vibration damage to numerous people living in the vicinity of airports, not to speak of pollution damage to the general public.

Since this work aims to analyse tort liability of actors for accident and environmental damage, it is not directly committed to analysis of property rules. Property-based approaches (e.g. injunctive remedy or trespass) are examined only where necessary and relevant as in environmental damage. *A fortiori*, penal sanctions for transgressing rules on safety or the environment (e.g. fines or imprisonment) are beyond the scope of this work. Again, since this study is concerned primarily with an analysis of civil liability, it does not purport to deal with regulation in general. Nevertheless, in view of the fact that actors are also subject to regulatory obligations, this study undertakes to analyse social regulation of product safety and pollution, economic regulation of monopolistic pricing, and economic instruments applicable to pollution control. By taking account of the relationship between civil liability and regulatory regimes, it will be possible to make recommendations for revising the civil liability regime. Throughout, two major forms of liability, the negligence rule and strict liability, are analysed, except in Chapter 5 on environmental damage. For the purpose of this study, the term negligence rule is used interchangeably with fault liability, while strict liability with absolute liability.

2. Critical Review of the Existing International Legal Regime for Aviation Liability

In the early days of civil aviation when there existed no uniform rules of law applicable to international carriage by air, not only was the substantive content of air law uncertain but the law of international carriage by air was plagued with such procedural issues as choice-of-law problems. In the absence of any legal agreement, international society must have felt the creation of a set of uniform rules to be desirable not only for predictability in business activities and transactions but for efficient risk control and management. The international legal response to aviation risk, however, has been piecemeal and focussed on the air carrier's or operator's liability. This is seen in the separate adoption of the *Warsaw Convention* of 1929 governing the carrier's liability for passenger (and baggage/cargo) damage and then the *Rome Convention* in 1933 and 1952 governing the liability of 'foreign' aircraft operators for damage caused to third parties on the surface.

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8. For the term *unavoidable*, see Posner, 75.
10. See *Grein v. Imperial Airways Ltd.* [1937] 1 KB 50, per Greene LJ (CA), at 74-75.
11. This work is not intended to deal with the liability for baggage or cargo damage.
Although the *Warsaw Convention 1929* (and its succeeding amendments) has achieved uniformity and predictability in many areas of the otherwise complicated rules of law, this on no account means that it has thoroughly removed uncertainty or any room for divergent judicial interpretations by domestic courts of a uniform international regime. The prospect of a runaway success has been afflicted by a flurry of criticism of the rationale of its liability regime. The thrust of attack has been levelled not only against low liability limits but against the principle of liability limitation itself imposed in return for rebuttable presumption of the carrier's fault in case of an accident (the so-called *quid pro quo*). The argument is that the Convention, because of its predilection for the carrier's position, has allegedly tipped the balance of interest in apparent disfavour of passengers or consumers of carriage by air products as a class. Indeed, since the instrumentality involved in an accident is within almost exclusive control of the carrier, presumed fault creates considerable uncertainty and difficulty for victims to prove negligence and to establish causal link between the negligence committed and the damage caused.

Whoever the real culprit for the low limits, American courts often capitalised on various occasions to voice their pronounced dissatisfaction in what one judge termed "judicial treaty-making." This resulted in inventing ingenious case law designed to stave off the uniform Convention limit for personal injury and death. The existing uncertainty also cost international society dearly because of the usually protracted trial process focusing on determination of negligence, causation and choice of law. In particular, despite the Convention's achievement of reasonable uniformity in choice of law questions, the difficulty was still described as an "entry into the wilderness" or as a "veritable jungle" subject to a "reign of chaos". Above all, the overall inefficiency of the present legal regime was aptly illustrated in the litigation of *Lisi v. Alitalia* which took almost 10 years to settle it all.

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As to surface damage, the Rome Conventions 1933 and 1952, unlike their Warsaw counterpart, adopt strict liability with the defence of contributory negligence. But the Conventions' linking of liability limits to aircraft weight attracted cool response from states towards their ratification. Inequity also exists to the extent that the carrier/operator is strictly liable for surface damage, whereas he is liable for passenger damage on the basis of presumed fault. And neither the Rome nor the Warsaw Convention system adequately addressed, let alone redressed, the question of multiple causation in the case of damage caused jointly by two or more carriers or aircraft operators as in a collision. This only adds to the burden of victims and their relatives with respect to establishment of causal link. Furthermore, under the existing international legal regime, most of passenger and surface damage risk is borne by carriers/operators or their insurers, thus raising the question of efficient risk allocation and equitable risk bearing between them and other participants in carriage by air. This is apparent in collision damage caused by multiple injurers including not only carriers but manufacturers and even ATC authorities.

The inefficiency and inequity in the existing legal regime comprising the Warsaw and Rome Convention system have combined with some of their own uncertain features to burden unduly airlines and aircraft operators with compensating passenger, surface and, in some instances, even environmental losses. As a result, victims are often left with insufficient and delayed compensation. It is therefore not surprising to witness that victims or their relatives are increasingly resorting, for due and adequate compensation, to actions against the aircraft manufacturer and component part makers for defective design or manufacture or against the ATC-certifying body for negligence of its employees. Apart from the risk-bearing capacity of the carrier/aircraft operator, the existing law of international carriage by air has thus shoved the carrier/aircraft operator into a position of comparative disadvantage vis-à-vis other participants in the activity.

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25. Airlines world-wide lost $2.7 billion on international services in 1990 alone, while the US airline industry has registered a cumulative loss of $1.4 billion. See The Economist, Too Many Airlines, 19 Oct. 1991, p. 13; id, A Survey of the Airline Industry, 12 June 1993, p. 76ff; Juglart I(300) & II(3432). Pan American Airways, once one of the eight "mega-carriers" and a big name in the history of international civil aviation for more than six decades, went down in history on 3 December, 1991.
The existing uncertainty over the exact scope of liability of various parties to carriage by air no doubt prejudices predictability needed for international transactions and may also unduly deter some of them from engaging in the activity, depriving international society from its benefits. Defining in as precise, unambiguous and uniform a manner as possible respective rights and liabilities of not only the carrier/aircraft operator but all other injurers/polluters and victims will minimise uncertainty and promote predictability, facilitate transactions, contribute to speedy resolution of the otherwise protracted trial process, reduce unnecessary litigation costs, and bring about maximum benefits to all the parties involved. These defects of uncertainty, unpredictability (and thus inefficiency) and inequity in the existing regime can only be resolved by resorting on a sound economic basis to a coherent international legal regime incorporating all the risks and harm caused in the course of carriage by air.

3. Carriage by Air as Teamwork and Joint Activity

For the purpose of this study, we will assume that international carriage by air is essentially a product of co-ordination of such a highly technical nature that it calls for joint activity not only of the carrier and the manufacturer but of the airport operator, the ATC agency and the certifying-licensing body. Indeed, the nature of carriage by air is such that safety cannot be guaranteed by the airline alone but by the pooling of efforts by all the parties involved in carriage by air. Unlike in the early days of carriage by air when safety was almost solely dependent on the pilot's skills, safe voyage is now increasingly dependent on state-of-the-art mechanical and electronic instruments and equipment produced by aircraft manufacturers and component part makers.

As a mere conduit for safe voyage, carriers, or pilots to be exact, are now increasingly relying on the provision of airport facilities, air navigation services (flight and weather information) and computerised ATC services. The carrier is also partly aided by certification and inspection conducted by governmental bodies for aircraft airworthiness or maintenance review. The integrated approach is further justified in view of chronic congestion in major airports and skies, lack of skilled air traffic controllers and resulting

27. See Nilsson, Liability and Insurance for Damage Caused by Foreign Aircraft to Third Parties on the Surface, 193.
29. WSJ/Eur, Air Traffic Control in Europe is a Muddle, 7 Sept., 1989, p.2; FT, 26 Sept. 1989, p.3; id, Airlines Demand One Traffic Control System for Europe, 7 Sept. 1989, p.3.
risk of collision. Indeed, experience has shown that the carrier is neither the sole author of accident nor the sole insurer of safety nor the sole underwriter of aviation risk.\textsuperscript{30}

According to recent statistics, the number of airline passengers killed in accidents around the world in 1994 increased by 25 percent to 1,385, which is comparable to the number of people being killed on British roads every four months.\textsuperscript{31} Pilot error was singled out as the primary cause of crashes, indicating that human beings are the weakest link despite state-of-the-art electronic systems designed to eliminate pilot mistakes. Of the total 76 accidents, 31 were caused at least in part by pilot or crew error, 16 caused by weather problems, 15 caused when the aircraft plunged to the ground for no apparent reason, seven by engine failure, three by structural failure, two by an operational problem, one each by a maintenance fault and by a fire in the cabin. This clearly shows that the cause of accident cannot always be attributed to the carrier or his pilots and that as in the Tenerife collision,\textsuperscript{32} the exact cause of accident could not be known in many cases. Again, as science and technology are advancing, new sources of risk or causes of damage are identified as in passenger damage caused by bird strike\textsuperscript{33} or wake turbulence.\textsuperscript{34}

Furthermore, the risk created by international carriage by air is no longer confined to passenger or surface damage. The increasing demand for air travel necessitated airport construction or expansion and precipitated the advent of a fleet of larger, faster and more powerful aircraft.\textsuperscript{35} But the commissioning of these second generation of jet airliners has caused extensive environmental damage, presaging an era of conflict between the airport operator and his neighbours. Since damage from aircraft noise, vibration and emission is now outside the uniform international control, there exists uncertainty in this area of law. In order to minimise uncertainty and fill these and other gaps in the law, it is necessary to write an integrated and coherent legal regime for aviation liability which encompasses passenger, surface and environmental damage and includes all the actors in international carriage by air.\textsuperscript{36}

4. Use of Simple Economic Models to Answer Predictive and Normative Questions

\textsuperscript{30} Hjalsted, \textit{ibid.}
\textsuperscript{31} TT, 19 Jan. 1995, p.23 (Pilot Error Is the Biggest Killer), quoting the Flight International.
\textsuperscript{32} Ch 6: 5.3.2 below.
\textsuperscript{33} Ch 5: 5.2 below.
\textsuperscript{34} Ch 6: 5.2 below.
\textsuperscript{36} E.g Nilsson, n.27 above, 193: Cheng & de la Rochère. Draft Convention. Neither of them, however, tried to incorporate environmental damage in their proposed integrated system.
As seen from the ICAO and other statistics cited above, it can reasonably be assumed that accident and environmental risk are incidental to, and inherent in, carriage by air and are thus unavoidable, if subject to reduction. Assuming that it may be out of the question to ban carriage by air in toto given enormous benefits derived therefrom, the question is how best society can use civil liability to induce parties to reduce accident and environmental risk. In other words, the question is how best society can formulate or reform liability rules to achieve the economic goal of generating the socially optimal level of safety and pollution. In this connection, two types of questions can be distinguished: one is whether or how a particular rule will actually induce parties to reduce risk, and the other is whether such a rule is really desirable in the interest of international society. The former, a predictive question, is thus about expected effects of employing particular legal rules, whereas the latter, a normative question, concerns the desirability of adopting such rules.

In order to answer both predictive and normative questions, we will use simple economic models, often aided by simple numerical examples or tables. Predictive questions will have straightforward answers in the models, since there will always be given specified legal rules and assumptions about the particular situation involving an accident or environmental risk. For example, it will be specified in the models whether injurers' assets are sufficient to meet their potential liability, whether victims can affect risk or not, whether parties are risk averse or risk neutral, whether the courts have perfect information about parties' behaviour, or whether insurers are capable of monitoring insureds' behaviour. Given such assumptions, we can state the effects of liability rules on parties' behaviour, e.g. the negligence rule in this particular situation creates incentives for the parties to take due care.

In the case of normative questions, however, we need a certain goal and its criteria in order to determine the effectiveness and desirability of legal rules. For these purposes, we will postulate that the social goal of accident and environmental law is to minimise the sum of accident and environmental costs plus their prevention costs. We will also posit two economic criteria, efficiency and equity, by reference to which we can evaluate the desirability of legal rules. For example, a particular legal rule is judged to be effective and desirable if it leads the parties to allocate the efficient amount of resources for risk (loss) avoidance (e.g. by taking out insurance) and/or to take optimal care for its reduction, since such behaviour will result in a lower sum of accident and environmental losses plus their avoidance costs. Since this study aims at evaluating existing legal regime, to this extent it will also present a description or discussion of existing legal rules.

37. For the use of the term 'unavoidable', see Posner. 75.
38. Shavell, 1-2.
5. Organisation of the Work

This work is divided into three parts according to the type of risk and the economic relationship between parties. Part One (chs 2-3) analyses passenger damage risk caused between the parties in contractual/market relationships, Part II (ch 4) assesses surface damage risk, while Part III (chs 5-6) evaluates environmental and passenger damage risk arising from the parties in stranger relationships. These last types of risk is also characterised by the fact that it is caused in the course of public service or regulatory activities undertaken by public bodies. Each part starts with a research design setting out briefly the research focus and direction. Except for Chapter 1, each chapter has the first section mainly devoted to description or discussion of existing regime or identification and delimitation of the topics to be covered in that chapter. This is followed by the application of economic analysis to substantive legal rules to determine their respective desirability.

Since neither the Warsaw nor the Rome Convention system is self-contained or self-sufficient, autonomous system of law in the sense that many of substantive as well as procedural legal issues are governed by domestic laws, their ultimate application is at the hands of domestic courts seized of a particular case. This is all the more so in the case of the liability of aircraft manufacturers and ATCAs for passenger damage and the liability of airport operators for environmental and passenger damage, since there is no agreed international instrument on their respective liability. The utility of domestic laws is also valued in surface damage cases, because only a limited number of states have ratified or adhered to the Rome Convention system. For these reasons, we have chosen three domestic legal systems (English, French and American laws) for assessment of the efficiency of their comparable statutes and judicial decisions applying or interpreting them. Many international agreements on pollution control and a regional arrangement (e.g. EC Directive 1985 on product liability) are cited and analysed where pertinent to support our arguments. This work provides a rather detailed bibliography at the end to be used as a guide to literature on economic analysis, regulation and the law of carriage by air. It is also used as full references to the books or articles cited frequently in this work.

In Chapter 1, basic concepts and tools of economic analysis are introduced and applied as the starting point of our analysis to the Coase Theorem relating to efficient control of environmental harm under no transaction costs. The Coase's model is then adapted to the more realistic situation of positive transaction costs to be applicable to both environmental and accident risk. After the relative efficiency of property and liability rules is compared,

39. See Juglart, I(97).
three major analytical tools of efficiency are derived for application under liability rules: risk/loss allocation, incentive creation and least administrative costs. The relevance and significance of causation in the legal attribution of losses are discussed by reference to these tools, and a comparison is attempted of administrative costs incurred under the negligence rule and strict liability.

In view of the importance of liability insurance in efficient risk (loss) bearing and in measures of social welfare, the issue of how liability insurance under parties' risk aversion allocates risk and contributes to minimising accident risk is discussed. The discussion focuses on how insurers can fix premiums in such a manner as to create maximum incentives for insureds to take risk-reducing steps, while avoiding moral hazard and adverse selection problems. The relationship between tort liability and liability insurance is also discussed. The Chapter concludes with justifications in the public interest for social regulation of product/service safety and quality and pollution and for economic regulation of monopolistic pricing by public firms in the presence of market and private law failure, notably information deficits and bounded rationality, monopolies and externalities.

Economic ideas and analytical tools developed in Chapter 1 are applied in Chapter 2 to evaluating liability rules governing the carrier's liability for passenger damage under the Warsaw Convention system. The Chapter starts with a review of the system and is followed by an analysis of the relative efficiency of alternative liability rules under imperfect information. Then, various rules under the system—presumed fault liability, the rule of contributory negligence, the carrier's defence of all necessary measures, liability limitation and its deprivation for wilful misconduct, and causal provisions— are subjected to critical evaluation in terms of risk allocation and incentive creation. Private international law issues such as cause of action, choice of law and conversion problems are examined from the consideration of administrative cost reduction. Final consideration is given to liability allocation between joint injurers as in the case of collision damage.

Chapter 3 extends our investigation of the efficiency thesis to the law of product liability, drawing on the provisions of the EC Directive, Consumer Protection Act 1987, Consumer Product Safety Act and the Restatement (Second) of Torts. The notion of defect as defined by these instruments and applied by the courts under the negligence rule and strict liability is critically introduced as the basis for evaluation of the efficiency of the alternative liability rules. The deficiency of the causal requirement including the foreseeability test is assessed, especially in relation to vicarious liability of the manufacturer for a defective component part produced by his subcontractor(s). The Chapter concludes with an analysis of efficient loss allocation between joint injurers through indemnity and contribution.
The subject of Chapter 4 is surface damage governed by the *Rome Convention* system. One of the key considerations relates to the requirement of compulsory insurance against surface (and passenger) damage risk imposed on 'foreign' aircraft operators by national licensing-certifying bodies. The role of contributory negligence under strict liability is given due consideration as in the carrier's liability for passenger damage. After evaluating the utility of the causal requirement and examining the efficiency of punitive damages for 'deliberate' damage, this Chapter, as in previous ones, ends with efficient loss allocation between joint injurers in multiple-operator incidents as in collisions.

In Chapter 5, the airport operator's liability for environmental harm (noise, vibration and pollution) and passenger damage caused at airport premises is taken up. The Chapter starts with identifying the noxious substances that are emitted from aircraft operation and thus pollute the air. Different legal approaches are compared and evaluated in terms of the social goal of minimising combined noise and pollution damage costs and their avoidance costs. The Chapter then takes note of the nature of the airport noise and pollution problem which is characterised by a large amount of damage thinly spread over large numbers and which is apt to cause externalities under liability rules. In recognition of public ownership/operation of airports or public funding of airport services, attention is drawn to the efficiency of economic regulation of monopolistic pricing. Standards regimes and economic instruments are compared as a means of controlling noise and pollution. Due account is also taken of distributional goals to reflect the relatively disadvantageous position of general taxpayers vis-à-vis airline passengers in funding airport services and bearing pollution damage costs. Passenger damage caused by accidents at airport premises or by bird strike is finally taken up.

Chapter 6 deals with liability of the ATCA for passenger damage caused by its controllers and considers the notion of public service or public interest and its economic implications. The Chapter starts with liability allocation between the carrier (for acts or omissions of the pilot-in-command) and the ATCA (for the negligent provision of ATC service by controllers). It then attempts to get to grips with whether the rule of immunity (or suability) of the ATCA for the negligent provision of ATC service is efficient. After discussing briefly causation and choice of law problems under liability rules, taxation of ATC risk is justified for both efficiency and equity reasons. The Chapter concludes with the question of efficient allocation of passenger damage caused in a collision by two or more injurers involving carriers, manufacturers and the ATCA.
In the CONCLUSION, the result of economic analysis and evaluation of the existing legal and regulatory regimes, international or domestic, covering the whole gamut of aviation and environmental liability is summarised in the light of the economic objective and themes set out in this INTRODUCTION. The roles played by civil liability, insurance and regulatory regimes in reducing accident and environmental risk to the socially optimal levels are summarised, while a desirable direction for their possible reform is recommended. The constraints on economic analysis are weighed against its utilities to argue in favour of the latter. Finally, certain propositions derived from economic analysis are established and suggested as the valid basis for building a new, coherent and integrated international legal regime for aviation liability.
CHAPTER 1

ECONOMIC APPROACH TO AVIATION ACCIDENT AND ENVIRONMENTAL RISK

For the rational study of the law, the black letter-man may be the man of the present, but the man of the future is the man of statistics and the master of economics.

------ Oliver Windell Holmes

It is indeed the power of ideas, not vested interests that has been making human history inching or jumping forward.

------ John Maynard Keynes

Introduction

In this Chapter, it is proposed to demonstrate how usefully economic reasoning can be used to evaluating the efficiency of existing liability and property rules governing passenger, surface and environmental damage arising from carriage by air. To do this, we will first introduce some basic concepts and tools of economic analysis and then examine the Coase Theorem as the starting point for our analysis of the problem of aircraft noise and pollution harm. The insights gained from the Theorem will be applicable to the analysis of accident law governing the liability for passenger and surface damage. This will be followed by an analysis of causal requirement and by an investigation into the significance of insurance under parties' risk aversion in terms of their incentive to reduce risk. In due recognition of constraints on the proper functioning of tort law in the market setting, we will consider the objectives of regulation of safety and quality in products, professional services and the environment and justify its role under the circumstances where tort law's incentive fails to be inadequate. We will finally examine efficient control of regulatory risks arising from certification of aircraft and from licensing of professional services.

1. The Province of the Economic Approach to Law

1.1 Law and Economics

Broadly defined, economics is a science enquiring into human behaviour chosen between ends and scarce means in a world of uncertainty and limited resources. Thus defined,

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1. The Path of Law, 10 Harv LR (1897) 457.
Economies is a science delving into the implications of purposive behaviour of rational men who seek to maximise their satisfaction through their choices. On the other hand, law is a discipline concerned with reasonable conduct expected of the average man in an order of breakable obligations. Since the law values reasonable behaviour of the average man and regards it as socially desirable, it subjects people to the standard a society imposes on them to command compliance. It is a discipline highly normative in its defining character. Both law and economics, despite their contrasting characteristics, address themselves to human behaviour.

To be more specific, economics is about, and is indeed premised on, rational choice of self-interested individuals. A behaviour is deemed rational when it is conducted voluntarily for the maximisation of one's own benefits. Since such rational behaviour would also increase benefits to society, it will be termed efficient and socially desirable behaviour for the purpose of the economic analysis. Here, rational behaviour in economics has the socially desirable character in common with reasonable behaviour in law. Indeed, unreasonable behaviour is deterred by society and even sanctioned by the law for its anti-social, irrational attributes. A reasonable, prudent man may thus be interchanged with a self-interested, rational man, who, by definition, will respond to financial incentives by changing his behaviour.

1.2 Goals, Values and Assumptions

Obviously, if the economic analysis of law purports to be persuasive in its own right, its goals and assumptions must be reasonable and practicable and must not be subjective in such a way as to make them arbitrary. From this standpoint, the economic analysis assumes the principal goal and function of accident and environmental law to generate the socially optimal level of safety through inducing, primarily, the injurer or polluter to take the socially optimal level of care (due care). This will minimise the aggregate cost of accidents, pollution and their avoidance, and maximise social welfare as measured by the sum of aggregate individual utilities minus corresponding disutilities. Some may

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5. E.g., M'Allister (or Donoghue) v. Stevenson, [1932] AC 562, 580 & 599, per Lord Atkin (HL) (the neighbour test).
7. Cooter & Ulen, 11.
10. See Calabresi, 26ff.
challenge the validity of the wealth maximisation goal as a value or principle, but it would certainly be too much to require unanimity on this. Thus, one prominent author has this to say: "The common law method is to allocate responsibilities between people engaged in interacting activities in such a way as to maximise the joint value, or, what amounts to the same thing, minimise the joint cost of the activities."

1.3 Economic Approach to Law in Historical Perspective

The classical utilitarian tradition had its origin in Adam Smith and his contemporary philosopher David Hume. For the father and founder of modern political economy, the objective of social wealth maximisation can best be attained when each individual is allowed to pursue his own advantage to promote an end which is no part of his intention. Thus, if each member of the community were left to seek to maximise his own gains, he, led by an 'invisible hand', would contribute to the promotion of the common good or the society's interest. A similar line of reasoning was taken by Hume. This individualistic utilitarian approach to social welfare found the most elaborate exposition in Bentham, who, by formulating the theorem of "the greatest happiness of all those whose interest is in question", sought to relate it specifically to legislation. His maxim "Everybody to count for one, nobody for more than one" was construed by Mill as meaning that one person's happiness assumed to be equal in degree to another's is to be counted exactly the same.

As such, in the utilitarian tradition the idea of justice has not been separated out from that of utility. With the single standard of utility as the ultimate criterion of establishing rights or dispensing wealth distribution, there did not arise any priority problem in the law.

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13. See e.g. ch 5: 4.2.2.
16. For the two main aspects of the utilitarian thought— one as a theory of personal morality and the other as a theory of public choice _ and their evolution. See A K Sen & B Williams (eds), Utilitarianism and Beyond (Cambridge UP 1982), Introduction.
17. "He [every individual] generally, indeed!, neither intends to promote the public interest, nor knows how much he is promoting it... he intends only his own gain, and he is...led by an invisible hand to promote an end which was no part of his intention". Smith, Inquiry, Bk IV, ch ii, para 9: id., Theory, 184-85.
18. "...[s]elf-interest is the original motive to the establishment of justice: but a sympathy with public interest is the source of the moral approbation, which attends that virtue" (Italics are original). Hume, Treatise, Bk III, pt II, sec II, pp.499-500: id., Enquiry, sec III, pt I, para 145.
between utility and justice as such. To utilitarians, the important question was whether imposition of disadvantages on a few can be outweighed by a greater sum of advantages enjoyable by others. This situation is changing in recent years, partly as a result of the advance in moral philosophy dealing with the notion of justice as an independent concept to which we will have due regard. For now, suffice it to say that the measure of social welfare depends solely upon the sum of aggregate individual utilities which in turn depend on allocation of goods and services rather than their distribution.

2. Basic Concepts and Tools of Analysis

2.1 Utility and Value

In order to determine which state of society will lead to the socially desirable goal of welfare maximisation, we need to posit a criterion to refer to. Here, the idea of utility is useful, although it is a rather subjective concept used to mean satisfaction, happiness, pleasure or welfare as defined by Bentham. The notion of value, by contrast, is more objective and denotes, in relation to certain goods or services, how much someone is willing to pay for the resources (or, if he already has them, how much he would charge to part with them), and in relation to a certain risky situation, how much he is willing to pay to avoid it. The distinction between these two concepts inevitably leads to two major conflicts with the use of the two terms interchangeably: economical and ethical. Barring such constraints, we may in most cases be allowed to use the two identically.

As was just mentioned, the concept of utility may be subjective in the sense that since an individual is assumed to be the best judge of his own interest, the utility he derives from his

23. Sec 2.2 below.
24. See J A Mirrlees, The Economic Uses of Utilitarianism, in Sen & Williams, n.16 above, at 63. In this vein, the term 'welfare' is taken to mean not a set of governmental programmes designed to aid the less advantaged but rather the aggregate well-being of consumers.
25. "By utility is meant that property in any object, whereby it tends to produce benefit, advantage, pleasure, good or happiness...to prevent the happening of mischief, pain, evil or unhappiness to the party whose interest is considered: if that party be the community in general, then the happiness of the community: if a particular individual, then the happiness of that individual". Bentham, n.19 above, at 2.
27. See Posner (1986) 11-12. One potential conflict is that a risk-neutral party will perceive the expected value of a risk to be almost identical to his utility (subjective satisfaction), whereas a risk-averse party will not (see sec 6 below). Another is that something may be more valuable to the 'rich' in terms of the willingness to pay but may give more satisfaction or happiness to the 'poor'.

choice depends on his preferences. Thus, one may ask how can we calculate and compare the utilities gained to the parties from a certain transaction in order to be confident that the social welfare function as the sum of aggregate individual utilities has improved or not? The answer is that if we assume that rational individuals and firms would have similar, if not identical, preferences over their choice, we can give weights to these preferences in numbers in accordance with their priority order and make interpersonal comparisons of utilities. So if a person prefers the consequence of action A to action B, we can assign a higher number of utility to action A. As such, the advantage of the idea of utility is that under certain assumptions, it can be measured, compared, and increased.

2.2 Efficiency and Equity

2.2.1 Efficiency: In a world of scarce resources, individual human needs have to be satisfied in accordance with the principle of efficiency as the primary rule. For inefficiency begets unnecessary cost, which reduces social wealth defined as the aggregate total of individual utilities. Broadly speaking, the term efficiency is used to describe a state of optimal resource allocation or a state of equilibrium where no further benefits can be derived to either party to a particular transaction, a point maximising total utility or satisfaction. A production process is regarded as efficient if it yields a given level of output at least cost, i.e. if the given level of output cannot be produced at lower cost. Likewise, in a world of uncertain risk and harm, a behaviour is considered efficient if it is conducive to reducing risk arising from an activity and thus minimising accident costs.

As such, the efficiency criterion as a means of gauging the utility maximisation or cost minimisation goal has two elements: resource/risk allocation and incentive creation. Efficient allocation of resources or allocative efficiency means a situation where resources are assigned among the parties to a transaction to their most valuable use through the process of voluntary, mutually advantageous exchanges. For each rational individual as

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28. P J Hammond, Utilitarianism, Uncertainty and Information. in Sen & Williams, n.16, at 85, 87; Cooter & Ulen, 23. This means that an individual's welfare depends only on the goods and services assigned to him.


30. Bentham, n 19 above.

31. Polinsky, 7; Cooter & Ulen, 17-18; Stapleton, Product Liability, 100 & 160.

32. Polinsky, ch 15.

33. This assumes that parties have perfect information and that everyone affected by the transaction must be a party to it, a requirement of no third-party effect. Posner. 11 n.2; id, (1986) 12; id, The Ethical and Political Basis of the Efficiency Norm (1980), at 490; Cooter & Ulen. 17-18; Rawls, A Theory of Justice. 88. Again, free exchange, even though voluntary, may not increase utility. Exchanges only involving the
the best judge of his own interest will act on the theory of expected utility, and such voluntary exchanges will increase aggregate utilities of both, or at least will make neither of them worse off. Even though we do not know exactly how much utility has increased by such exchanges, we can be reasonably sure that aggregate utilities have increased through the exchanges, for the parties would not have entered into the transaction had they not expected it to make them better off. To say that a situation is allocatively efficient is thus to say only that all the potential or actual gains from a trade have been exhausted and that no further exchange will benefit one party without causing disadvantage to the other. Stated differently, a misallocation occurs when a situation can be improved by further bargains or transactions or when costs are externalised.

This allocative efficiency can best be achieved in the market where the price mechanism induces parties to engage in a voluntary, mutually beneficial exchange at the equilibrium price, as reflected in the consumer willingness to pay. A significant advantage of the market mechanism is that it is consistent with equal liberties and equal opportunities by decentralising the exercise of economic power. It is not left to the market to discriminate between individuals or between consumer and producer. Information is equally accessible and available to all, thus incurring least transaction costs. However, given that many of the transactions affected or effected by legal liability rules and legal judgements (including legal entitlements) are involuntary, how can we determine whether such involuntary transactions increase or decrease utility? Although we are not as much sure as in voluntary transactions, it can be fairly stated that if all the gainers of relevant resources agree to the proposed legal change and are willing to compensate the losers for their losses, then the change is regarded as improving efficiency.

2.2.2 Equity and distributonal consideration: Despite the primacy of the market mechanism for achieving allocative efficiency in the welfare maximisation scheme, the problem of the imperfect market may stand in the way of efficient resource assignment. The imperfect market is caused by externality, imperfect information about risk or imperfect competition in the industry, all of which would have adverse impact on parties'
rational judgment and behaviour. Further, we cannot be confident whether the efficient solution also satisfies a society's distributional objectives and whether it is consistent with the socially desirable goal. In this case, initial entitlements and wealth distribution schemes may have to be corrected for reasons overriding the economic calculus, e.g. adequate consumer protection or equitable risk-bearing.

These constraints on the market and considerations of distributional objectives may well justify another goal which is different in kind from efficiency and which respects a minimum content of natural justice and relates to desirable wealth distribution. The secondary goal we thus conceive of concerns the equity aspect of law, i.e. distributional justice, by which is meant fair distribution of benefits and costs between various risk-creators or between injurer and victim. Inefficiency may thus be acceptable if it leads to a more socially desirable or ethically attractive wealth distribution. When a legal rule or regime has been constructed in such a way as to combine the goal of efficiency with that of equity, it may be termed as effective or efficacious.

### 2.3 Transaction Cost, Expected Cost and Externality

#### 2.3.1 Notions of cost, private cost and social cost:

In its ordinary sense in economics, the term *cost* means opportunity cost, i.e. alternative price or benefit foregone by employing a resource in such a way that denies its use by someone else. Opportunity cost is what economists call *social cost* in the sense that it affects resource use and diminishes a society's wealth. For instance, a loss to an individual of his leg in an accident is a social cost, since it necessitates compensation and denies society other uses of the resources, and consequently reduces social wealth. By contrast, purely pecuniary transactions such as transfer payments do not affect resource allocation. Although transfer by taxation of a...

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40. Cooter & Ulen, 45-48. Consider, e.g. such instances of the imperfect insurance market as limited coverage of third-party liability insurance policies, general exclusion of cover for the defendant's liability caused by his wilful misconduct, or the insurance company's inability to monitor exactly the behaviour of his insureds and to adjust premiums accordingly.
42. Hart, n.6 above, 192; Calabresi, 24-26.
45. Both the terms effective and efficacious are defined as "producing the desired result or effect". See Longman Dictionary of Contemporary English (2d ed 1987).
46. Posner, 6-7; Cooter & Ulen. 35 & 45-6. Typical examples of opportunity cost include the Coase Theorem and gratuitous activities such as housework done by a spouse without any pecuniary reward. Sec 3.1 below.
47. Sec 4.1 below.
certain sum of money from A to B would decrease A's purchasing power, this would increase B's by the same amount. This is a *private cost* incurred only to the individual A and not to the society as such. Private cost merely rearranges wealth distribution between individuals and has little to do with social cost.

2.3.2 Transaction cost vs. administrative cost: The term *transaction cost* includes information and enforcement costs incurred for the settlement of a dispute between parties through bargaining.\(^{49}\) Transaction cost would be high and preclude the efficient outcome, if there is a *strategic* behaviour by one party in the bargaining process (e.g. adopting 'hold-out' tactics or threatening to resort to litigation rather than out-of-court settlement).\(^{50}\) When a dispute is up to the court, voluntary transactions are replaced with involuntary judgment. This involves the court's administrative cost incurred in the process of legal proceedings, e.g. information, judgment and enforcement costs.\(^{51}\) Administrative cost thus includes the court's expenditure for gathering information on relevant facts, seeking opinion from experts and assessing relevant risks involved to arrive at efficient decisions. When parties are risk averse, another important aspect of administrative costs relates to those incurred to the insurer.\(^{52}\)

2.3.3 Expected or average cost: The term *expected cost (loss)* means cost of the accident if it occurs, multiplied or discounted by the probability that the accident will occur. Expected cost is most easily understood as *average cost* to be incurred over a period of time long enough for the predicted number of accidents to be the actual number.\(^{53}\) For instance, if the probability of an accident is 0.01 and accident losses if it occurs are £100,000, expected accident losses is £1,000. This is equivalent to saying that if one observes the carriage by air activity for a long period of time, he will notice an average accident cost of £1,000. To illustrate, suppose there occur 100 accidents per every 10,000 flights between London and New York (thus the accident probability on the London-New York route is 0.01). Total cost of these 100 accidents will amount to £10 million (£100,000 x 100) and average cost per flight will thus be £1,000 (the total cost of £10,000,000 divided by the total number of flights 10,000). This amount equals expected cost in this example and matches actuarial equivalent of the risk.

\(^{49}\) Polinsky, 12, 18. Transaction costs include costs of information relating to identifying the parties to negotiate with, assessing the risks involved and (if there are a multitude of people on one side of the disputes) discussing possible solutions available.

\(^{50}\) E.g. Laker (Skytrain) case. See R Baldwin, A British Independent Regulating Body and the "Skytrain" Decision, [1987] Pub L 57. Strategic behaviour may feature in a dispute involving the parties in stranger relationships as in noise/vibration/pollution or surface damage.

\(^{51}\) Sec 5.2 below & sec 2.2.1 above.

\(^{52}\) Sec 6.4 below.

\(^{53}\) Posner, Tort Law _ Cases and Economic Analysis. 1-8. In the long-run equilibrium, average cost equals marginal cost.
2.3.4 Externality: Unlike voluntary, mutually beneficial transactions occurring in the market, involuntary and external (outside-the-market) exchanges bring about harmful economic effect to society (spillover or third-party effect). For example, the airport operator's activity causes to the residents living around the airport harmful effect (noise-pollution harm) or externality defined as a cost that voluntary actions of one party impose on third parties without their consent. To quote Pigou, an externality occurs where "one person A, in the course of rendering some service, for which payment is made, to a second person B, incidentally also renders service or disservice to other persons (not producers of like services), of such a sort that payment cannot be extracted from the benefited parties or compensation enforced on behalf of the injured parties". Externality is a social cost and occurs both in market transactions (where consumers have imperfect information on the quality of service and thus make incorrect decisions on their choice) and in nonmarket transactions (where the producer of goods or service is exempted by error from liability, or where the legal system lacks a device for channelling all small claims for damage).

2.4 Risk Neutrality and Risk Aversion

2.4.1 Assumptions of risk neutrality and risk aversion and their effect on utility: The term 'risk-neutral' is used to denote the behaviour of a party who cares only about the expected value of risk and not about its size. A risk-neutral party is thus indifferent between a certain or uncertain prospect of wealth, as long as both situations involve the same expected cost. To the risk-averse party, however, risk per se is a cost and its elimination a gain, for he dislikes uncertainty over the magnitude of losses. He is not as well off with a low probability of large loss as he is facing a high probability of small loss with the same expected value. A risk-averse party is thus willing to pay more than the expected value of risk to reduce the risk of suffering an even larger loss, since he will derive more utility from risk elimination than a risk-neutral party. This is why a risk-averse party is willing to exchange the possibility of a large but uncertain loss for a small but certain cost known as insurance premium.

2.4.2 Risk aversion, risk shifting/sharing and social welfare: Assuming that social welfare is the sum of aggregate utilities of the parties involved in a transaction, the presence of risk-averse parties means that risk allocation affects the level of social welfare.

54. Cooter & Ulen, 45-47, 343; Posner, 52, 121 & 139.
55. A C Pigou. The Economics of Welfare (4th ed London: Macmillan 1932) 183; Cooter & Ulen, 45-47. 343. Thus, an externality has two essential characteristics: (1) it is an incidental by-product of some other market or productive activity; and (2) its effects are unpriced.
56. Generally Polinsky, 27, 51-53; Cooter & Ulen, 63-64; Shavell. 186.
57. Sec 6.1 below; Cane, 481, 511-12.
just as do the production of goods and services or the reduction in accident losses.\textsuperscript{58}

Proper risk allocation raises social welfare in two ways: directly by reducing the risk borne by the risk-averse, and indirectly by encouraging the risk-averse to engage in a risky but socially useful and desirable business activity.\textsuperscript{59} It follows that the shifting of risks from the risk averse to the risk neutral, or from the more to the less risk averse will raise social welfare.

Social welfare will be raised not only by shifting risk completely from the more to the less risk averse or to the risk neutral, but also by sharing risks among risk-averse parties.\textsuperscript{60} For risk sharing reduces the magnitude of potential losses which any one of them alone might otherwise suffer. This is evident where two risk-averse parties with almost similar levels of wealth will each be better off by arranging in advance to share the risk they face. As such, a risk-sharing agreement between multiple parties will always enhance social welfare, insofar as no substantial transaction costs are incurred for such an agreement. That is why an individual may happily decide to undertake a risky but promising business, inasmuch as he has partners with whom to share the risk.

3. Economic Approach to Noise/Vibration/Pollution

Up to this point, we have introduced basic concepts and tools of the economic analysis of legal problems. We are now in a position to apply these ideas and methods to practical legal issues arising from the carriage by air activity. The first application concerns nuisance cases resulting from incompatible land uses such as noise, vibration or pollution damage engendered by airport operators' activity, a harmful externality to the residents living in the vicinity of airports. We will start with the assumption of no transaction costs, since it would help us understand how, in the presence of positive transaction costs, the efficiency goal prefers one allocation of entitlements to another.\textsuperscript{61}

3.1 The Coase Theorem and No Transaction Costs: The Original Position

3.1.1 Reciprocal nature of the harm and joint costs: One of the central ideas in economic analysis of law has been expounded by Coase in his seminal article.\textsuperscript{62} Although he took his cue from Pigou's example of a polluting factory whose harmful emission of smoke was impinging on neighbouring residents and their property, Coase challenged the

\textsuperscript{58} Shavell. 192.
\textsuperscript{59} Ibid, 191.
\textsuperscript{60} Ibid, 190.
\textsuperscript{61} See Calabresi & Melamed, at 1096. No transaction costs will comprise, among others, perfect information of the parties, the absence of any impediments to bargaining, virtually negligible costs for identifying the parties to negotiate with and so forth.
\textsuperscript{62} Coase. The Problem of Social Cost.
traditional approach which focused on how to restrain the factory. According to Coase, the problem lies in the 'reciprocal' nature of the polluting activity. To illustrate, he gave as examples a confectioner who causes noise and vibration to the neighbouring doctor, straying cattle which destroy crops on the nearby land, and a railway train whose engine sparks cause damage to the crops. In these examples the presence of the residents, doctor or farmer is as much the 'cause' of the disputes as is the presence of the factory, straying cattle or train. The damage caused by the 'harmful' activity is the joint costs of both parties in each case.

3.1.2 Bargaining solution to harmful externalities: The real question in these cases, according to Coase, is whether to allow the factory owner (confectioner, straying cattle or railway operator) to do harm, or allow the residents (doctor, land owner or farmer) to restrain the factory owner's harming activity (thus imposing financial loss on the factory owner). On the basis of this reasoning, Coase argued that under costless market transactions the same resource allocation would result in either case, no matter what the court decides. In other words, on the assumption that transactions affecting the parties are costless, allocative efficiency would be reached without the court's intervention and whether or not externality is permitted under private law. The obvious reason is that the parties can strike a bargain to arrive at the efficient agreement.

3.1.3 Constraints on Coase: Although Coase's two main propositions have provided an entirely new perspective on resolving the disputes over the harmful effects of noise/vibration/pollution, his bargaining solution has formulated on the rather unrealistic assumption of zero transaction costs. But in order for efficient bargaining to come about, the notion of no transaction costs should be understood to involve both the parties' perfect knowledge of the risk and the absence of any impediments to (or costs of) negotiation. The assumption is not directly applicable to cases where a dispute involves a multitude of people and high transaction costs as in the noise/vibration/pollution damage caused by the airport operator's activity. Furthermore, strategic behaviour or hold-out tactics over the division of potential gains from transactions may preclude the attainment of allocative efficiency under zero transaction costs.

63. The traditional approach suggested that harmful externalities such as noise, vibrations and pollution can be corrected by imposing liability on the factory's owner, placing a tax on the externality-creating activity equal to its marginal external costs, or excluding such a factory from residential areas. See Coase, ibid, at 1-2; Pigou, n.55 above, at 192-94 & 381.
64. Coase, n.62 above, at 2 & 32.
65. This may not be consistent with the way the law and the courts use the language of causation. See R. Epstein, A Theory of Strict Liability, 2 J Leg Stud (1973) 151. 164-6.
67. Ogus & Veljanovski, 83.
68. I.e. the reciprocal nature of harmful externalities and no effect of the choice of legal rules on allocative efficiency under zero transaction costs.
69. Calabresi & Melamed, at 1094-95.
efficiency. Nor did the Theorem properly address the incentive aspect of efficiency and distributional effects of different legal rules.

3.2 Positive Transaction Costs

3.2.1 Distributional considerations and allocation of entitlements: In order to overcome these problems, Calabresi and Melamed undertook to relax Coase's key assumption of zero transaction costs and introduced distributional considerations into the analysis. The rationale is that the choice of a legal rule in nuisance/pollution disputes depends largely on parties' relative wealth and that it would in the end affect wealth distribution between the parties (wealth effects). For example, if an entitlement to make noise is given to the polluter, it would make him 'richer', and the victim's willingness to accept noise, buy it off or move out of the place will largely be dependent on his wealth. If on the other hand an entitlement to silence is given to the victim, he will be better off and the polluter's willingness to pay compensation, negotiate an acceptable level of noise or remove its factory to another place is also dependent on his wealth. As such, settlement of a nuisance dispute will have not only the efficiency aspect but distributional implications.

On the basis of these reasoning, a noise/vibration/pollution dispute under positive transaction costs can be resolved in two steps: society must first choose an entitlement as to who, the injurer or the victim, is entitled to prevail and then decide on the method and scope of the entitlement for enforcement. The entitlement approach can be justified on three grounds. First, the setting of entitlements will create certainty as to the resolution of disputes, induce the parties to behave efficiently and reduce transaction costs (in the case of bargaining). Second, it will reduce administrative cost of enforcement (in case of the court's judgment). Third, society can build a desirable wealth distribution structure it wishes to achieve, depending on its wealth distribution preferences.

3.2.2 Protection of entitlements by property and liability rules compared in terms of efficiency: When leaving aside administrative regulation of noise and pollution damage,
an entitlement is protected by either property rules or liability rules. Property rules such as the injunctive remedy are used where the law enforces entitlements in a specific way, and they invite less societal intervention. Once the original entitlement is chosen as to who will prevail, the state does not intervene to value it, and within the extent of the entitlement its holder is free to sell it or hold it in a voluntary transaction. Liability rules, on the other hand, restrict the entitlement usually to an approximate monetary value and may thus involve an additional state intervention. A nuisance whose public utility is sufficient enough to avoid an injunction is thus given the right to take property in return for compensation. Transfer of an entitlement under liability rules may be allowed only at a value predetermined by a state organ (collective valuation usually by courts) rather than by the parties

It may well be asked why society cannot simply enforce property rules, leaving the transfer of the initial entitlement to voluntary transactions between the parties involved? The reason is that since property rules involve a collective decision only on who is going to have the initial entitlement and not on its value, the process of valuing it via voluntary transactions would be costly or inefficient under property rules. This is so where one of the parties adopts hold-out tactics or where there is a free-rider problem in a situation involving a large amount of damage thinly spread over large numbers as in the case of airport nuisance-pollution. The result is that a transfer may not occur at all and the market valuation of an entitlement may not be available under property rules, even if such a transfer would benefit all the parties involved. For the essence of property rules lies more in its exclusivity and less in transferability or universality.

3.2.3 Liability on the cheapest cost avoider for both efficiency and distributional goals: Apart from the difficulty in achieving efficiency under property rules, they are not likely to promote distributional goals better than liability rules. This is because property rules involve voluntary transactions of the parties on the market which neither discriminates

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78. At 1092. The third method of protection, i.e. through inalienability rules, involves a greater degree of societal intervention than the other two rules, and will not be taken up here. See F Michelman, Pollution as a Tort: A Non-Accidental Perspective on Calabresi’s Costs, 80 Yale LJ (1971) 647, 670-72.
79. Calabresi & Melamed, at 1105; Coase, n.62 above, at 25.
80. This aspect of liability rules accompanies with it a 'forced' sale of property rights and may thus raise constitutional issues in American law as to the proper function of the state and to the method of quantifying the damages. See F Michelman, Property. Utility and Fairness: Comments on the Ethical Foundations of "Just Compensation" Law, 80 Harv LR (1967) 1165; E Rabin. Nuisance Law: Rethinking Fundamental Assumptions, 63 Va LR (1977) 1229, 1302-09.
81. Calabresi & Melamed, at 1106, 1109-10; ch 5: 2.3.1 below.
82. See Posner, 29-31.
against nor favours a particular party or a particular class of people.\footnote{Calabresi & Melamed, at 1106 & 1110. Consider the value of a house in the vicinity of an airport whose value is affected by aircraft noise/vibration/pollution caused during aircraft take-off and landing.} Even if property rules can achieve society's distributive goals as well as liability rules, they can do so only at the sacrifice of the efficiency goal.\footnote{Calabresi & Melamed, 1110 & 1121 & n.61.} By contrast, collective valuation of nuisance-pollution costs with an external, objective standard under liability rules would promote a combination of the efficiency (through facilitation of mutually beneficial transfers)\footnote{Calabresi & Melamed, at 1096-97 & n. 18. In the absence of information as to who the cheapest cost avoider is, nuisance costs should be borne by the party who can be induced in the market to correct with the least transaction costs externalities arising from the activity (best briber). Sec 4.2.3 below.} and distributional goals (through an increase or decrease in the 'objective' damage awards according to a given society's preferences).\footnote{Rylonds v. Fletcher (1868) LR 3 HL 330 (establishing the principle that one who collects dangerous substances on his land should bear the risk of their escape whether he was at fault or not).} Under liability rules, the efficient and distributionally favourable solution is to place the costs on a party who is better positioned to make assessment of the risk involved in the given activity\footnote{See Birnie & Boyle, International Law and the Environment, 109-10, 292 & 396; Ogus, 35 & 249.} and to avoid it most cheaply (cheapest cost avoider).\footnote{See Calabresi & Melamed, 1110; Ogus & Veljanovski, 89.} This will induce the risk creator to allocate the efficient amount of resources for nuisance-pollution abatement, as reflected in the 'polluter-pays' principle developed and adopted in international environmental law, notably in marine pollution.\footnote{Calabresi & Melamed, 1110 & 1121 & n.61.}

4. Economic Approach to Accident Law

In the previous section, while discussing harmful effects of noise/vibration/pollution, we argued for the imposition of liability rules rather than property rules on the polluter for reasons of efficiency and distributional considerations. We will now apply the economic approach in the context of passenger/surface damage risk and see what insights can be obtained.

4.1 Economic Valuation of the Life and Limb

Aviation accidents necessarily bring to the fore economic questions of valuing the life and limb. Obviously, this may not be entirely and exclusively an economic question and may well be intertwined with social and moral evaluation of the life and limb. Nevertheless, if the social goal lies in minimising the sum of accident and its avoidance costs, then decisions of individuals and firms like how much to spend on safety measures and whether to risk an accident are clearly bound up with economic considerations. Although the
Economic approach to such questions may seem far from ideal, it is doubted whether there exists any better approach to improving or even replacing it. And it should be noted at the outset that property rules would have little application to situations involving air accidents, since it would be quite inconceivable, from the victim's standpoint, to sell voluntarily his entire life or part of it in return for a certain price and, from the injurer's, to buy it on the market as is the case with property rules.

4.1.1 Assumptions and approaches: For the purpose of valuing collectively the life and limb, it is assumed that it would be socially undesirable to prohibit *in toto* the carriage by air activity in view of its benefits but that the law does not protect victims of aviation accidents. It is also assumed that injury from or death in an aviation accident incurs only two types of loss, i.e. pecuniary and non-pecuniary and that non-pecuniary loss (e.g. mental pain or suffering) is difficult or costly to assess in economic terms. It is further assumed that information available to consumers about accident risks is imperfect and that bargaining for the resolution of disputes between injurers and victims would be costly. On these assumptions and barring penal sanctions (e.g. fines or imprisonment), which are beyond the scope of this study, there can be two main approaches to controlling aviation risk and settling disputes arising from an accident: 1) administrative regulation (e.g. safety standards regimes or licensing and certification) and 2) civil liability combined with market insurance, or taxation accompanied by a compensation fund with the contributions collected from risk creators.

4.1.2 Liability rule-based control of risk: We now turn to the civil liability remedy on the grounds of efficiency, since bargaining between the parties under property rules would be costly because of transaction costs or strategic behaviour. A liability rule can avoid the strategic holdout problem and promotes relatively prompt resolution of disputes through

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90. Hammond, Utilitarianism, Uncertainty and Information, n.28 above, at 97.
91. See Posner, 151-52; ch 2: 4.1.3 below.
92. Consider a collision of two jumbo jets involving hundreds of victims and multiple tortfeasors.
93. At common law penal sanctions do not, as a matter of general rule, affect civil liability. See G Williams, The Effect of Penal Legislation in the Law of Tort, 23 Mod LR (1960) 233, 259; *Restatement (Second) of Torts*, s 287 (Effect of Provisions for Penalty): "A provision for a penalty in a legislative enactment or administrative regulation has no effect upon liability... unless the penalty is found to be intended to exclude it".
95. Regulation of safety does not necessarily take into proper account the cost minimisation objective. If regulators are not equipped with correct information about risk, regulation will not induce parties to exercise optimal care and to allocate an appropriate amount of resources for risk reduction. Ehrlich & Posner, An Economic Analysis of Legal Rule-making, 264-65 & 269-70: sec 7.3 & 8 below.
96. See ch 6: 4.3 below.
97. Even in this case, statutory rules are generally considered to have more direct effect on the parties' behaviour. Posner, An Economic Approach to Legal Procedure.
the court's judgment. More importantly, liability rules create proper incentives towards safety,98 and in the absence of liability injurers may spend even nothing on avoidance. The possibility of insolvency under liability rules, which is often cited as grounds for favouring penal sanction or administrative regulation of safety, is in practice overrated and indeed can be remedied by the requirement of compulsory insurance.99 It would, however, be worth adding that most law and economics authors believe that a combination of administrative regulation and civil liability would produce the desirable outcome.100

4.2 The Utility of Accident Law: The Restatement of Torts

4.2.1 Dual functions of accident law: It has been held that tort liability in general, as distinguished from penal sanctions to punish the wrongdoer, is imposed for dual purposes: compensation of harm caused and deterrence against future recurrence.101 Some writers place emphasis on the compensatory function,102 while others stress the deterrence role.103 Both the arguments have their own limits to their logic, since compensation may also be made through social insurance, while the deterrence goal can be achieved through criminal sanctions. In any case, moral blameworthiness or condemnation may not take the primary role,104 since tort law does not address itself to every harm and the amount of damages is often related not to the degree of fault but to the extent or effect of the harm inflicted.105

We will postulate for purposes of this work that the primary goal and function of tort law lie more in the reasonable adjustment of economic risks in society and less in the expression of certain absolute moral principles.106 It is to control efficiently the behaviour of those engaged in risky activities. As long as liability rules induce those who can avoid accidents to take adequate care, the compensatory goal of accident law can be regarded as secondary.107 Indeed, liability rules do affect safety levels108 and can economise on

98. Shavell, 297.
99. Landes & Posner, Tort Law as a Regulatory Regime for Catastrophic Personal Injuries, at 434; ch 4: 2.4.1 below.
100. Shavell, Liability for Harm Versus Regulation of Safety, 365; id, 285-86; Cane (1993) 368-69 (in the context of the driver's incentives to wear seat belts); sec 7.4.4 below.
101. G Williams, The Aims of the Law of Tort. 4 Cur Leg Probs (1951) 137; Winfield & Jolowicz (1989), 1-2; Cane. 5.
102. Cane, 518; Salmond and Heuston, On the Law of Torts, 29. They saw torts law as having a regulatory and distributional character aimed at shifting and spreading the costs of injuries.
103. E.g. Drion, paras 9-12; Shavell, 298.
105. A certain level of noise or pollution is taken for granted. Holmes, 144-45; Cane (1993) 149.
107. Shavell. 297. Even in the absence of accident liability, the compensation goal can be achieved by private or social insurance.
different transaction cost factors.\textsuperscript{109} This line of arguments is further substantiated by the increasing scope of applicability of strict liability and by the widespread availability of liability insurance.\textsuperscript{110} This is why some authors argue that the function of tort system can be reduced to that of private insurance markets.\textsuperscript{111}

4.2.2 Cost minimisation through efficient risk/loss allocation, incentive creation and least administrative costs: In competitive markets where transactions costs are small, efficiency is achieved when resources are assigned to their best value as measured by the willingness to pay. In involuntary transactions as in court judgements, the efficiency of a liability rule is assessed by its ability to promote efficient risk/loss allocation, incentive creation and administrative cost reduction.\textsuperscript{112} Viewed from this perspective, tort law in general and aviation accident law in particular are no more than a conduit for internalising accident costs in the cheapest way possible by attributing them to the parties involved.\textsuperscript{113} Thus, a distinguished author in accident law argues that the principal function of accident law is to minimise the sum of accident costs and accident avoidance costs.\textsuperscript{114} Stated differently, the proper and principal function of tort law is to promote optimal resource assignment and optimal deterrence by setting rational standards of conduct.\textsuperscript{115} As such, risk shifting and spreading through governmental or societal intervention will not be the efficient allocation of resources and would vitiate the deterrence goal.\textsuperscript{116} It should, nonetheless, be noted that to say that the goal of the law of torts is deterrence is not the same as saying that it actually does deter.\textsuperscript{117}

4.2.3 Liability on the cheapest cost avoider: From the above, it should be clear that the efficient resource allocation can best be achieved when assigning the losses to the party who can better assess the risk and avoid it at least costs (cheapest cost avoider).\textsuperscript{118} If the risk is allocated to the cheapest cost avoider, he will allot his resources to their best value to minimise accident costs. He will be induced to spend on appropriate precautions to reduce expected losses until reaching the point where the cost of taking an additional unit

\textsuperscript{110} James, Accident Liability. Indeed, there is no point in aiming at retribution against the insurer. Cane, 471; B S Markesinis, La perversion des notions de responsabilité civile délictuelle par la pratique de l'assurance, 35 Rev int dr comp (1983) 301.
\textsuperscript{111} Danzon, Tort Reform and the Role of Government in Private Insurance Markets; Epstein, Products Liability as an Insurance Market; \textit{id}, The Legal and Insurance Dynamics of Mass Tort Litigation.
\textsuperscript{112} Secs 2.2.1 & 3.2.3 above.
\textsuperscript{113} Posner, 179; Calabresi, Some Thoughts on Risk Distribution, at 505-06 & n.24.
\textsuperscript{114} Calabresi, 24, 26-31.
\textsuperscript{115} See Calabresi & Hirschhoff, Toward a Test, at 1081-82.
\textsuperscript{116} See \textit{Goldberg v. Kolssoum Instrument Corp.}, 12 NY 2d 432, 191 NE 2d 81 (1963), per Burke, J (dissenting) (dismissing strict product liability based on "risk spreading" rationale).
\textsuperscript{117} Williams, n.101 above, at 149.
\textsuperscript{118} Sec 3.1 above; Calabresi, 6-7, 22-23, 150, 156, passim.
of care would outweigh the reduction in expected harm or loss.\(^{119}\) In this way, he will reflect expected cost in the price of his service and adjust his activity to the efficient level, while passengers will be led to buy the efficient amount of air travel (price deterrence mechanism). In cases where it is not easy or costly to identify the cheapest cost avoider, the risk/loss allocation issue cannot be determined and the preferred legal rule depends on whether a rule gives the parties an adequate incentive to take optimal care. Still, if the rule which creates proper deterrence is not identifiable, the desirable legal rule would be the one which minimises the administrative costs of determining it, given the high costs of administering the tort system.

5. Liability Rules, Causation and Administrative Cost Consideration

5.1 Efficiency of the Negligence Rule and Strict Liability Compared

Whether in the case of passenger-surface or environmental damage risk, if transaction costs are relatively small, liability rules have little effect on efficient resource allocation. The reason is that the parties can negotiate the efficient agreement. Efficient resource allocation based on rational behaviour, however, is often obstructed by transaction costs and imperfect information about risk. In this situation, the efficient outcome depends on whether the given liability rule creates adequate incentives for parties to take optimal care and whether it can be determined at less administrative cost. Here, discussion will focus on the cases of parties' risk neutrality. No liability will not be considered here, since it will not induce the injurer to take care.

5.1.1 The notion of negligence: Although the concept of negligence cannot be reduced to one single fixed definition, it can be used to mean a behaviour or conduct which is in breach of recognised community standards and which unreasonably increases the risk of causing harm or loss. In English law negligence is used as synonymous with breach of duty of care,\(^{120}\) while in the French law of delictual liability (responsabilité civile délictuelle), fault (faute) is seen as departure from the standard.\(^{121}\) In American law negligence is defined as a "conduct which falls below the standard [of due care]... for the protection of others against unreasonable risk of harm".\(^{122}\) Determining the standard of due care often

\(^{119}\) Under positive transaction costs, the cheapest cost avoider can be identified by reference, among others, to who: 1) can better evaluate the risk involved; 2) can insure most cheaply against liability; or/and 3) is less likely to shift the loss in such a way as to reduce the incentives to avoid the losses. G Calabresi, Fault, Accidents and the Wonderful World of Blum and Kalven, 75 Yale LJ (1965) 216, 230; Calabresi & Melamed, 1096-97.

\(^{120}\) M'Alister (Donoghue) v. Stevenson, n.5 above.


\(^{122}\) Restatement (Second) of Torts, s 282.
requires the courts to weigh the magnitude of risk of a conduct against the cost of a more careful conduct.\textsuperscript{123}

5.1.2 Correct negligence standard and constraints on the negligence rule: Since under the negligence rule the injurer will be liable for the losses caused by his negligence, he will be induced to take optimal care in order to avoid liability. This is true as long as the courts make no error in determining the optimal level of care in a particular situation. Thus, the question is why a negligence is often determined by reference to 'objective' (e.g. notably reasonable or average man), rather than 'subjective', standards which take into account variations in the behaviour of different individuals.\textsuperscript{124} The Learned Hand test,\textsuperscript{125} for example, does not draw a distinction between variations of temperament and intellect,\textsuperscript{126} and is not applicable in situations where parties are risk averse or where the court has imperfect information about risk.\textsuperscript{127} Thus, the difficulty with fault liability is that of defining the exact nature and scope of the duty of care. The negligence standard may be an elusive goal to fix in the context of the law of carriage by air, given high technicalities involved in aircraft operation, manufacture and air traffic control service. If as a result the court fails to set the correct standard, the injurer will not adequately be induced to take due care corresponding to the efficient outcome. It is nevertheless important to note that the incidence of judicial errors in determining the optimal level of care are problematic only insofar as such errors are asymmetrical, that is to say, courts make errors consistently on too much care or too little care.

Another defect in the negligence rule is that there often exists little correlation between the degree of fault committed and its contribution to the consequence (or compensation due). A slight lapse may well cause a disastrous consequence, whereas a gross negligence may cause a negligible outcome. The consequence of a negligent behaviour is thus often out of proportion to the fault giving rise to it.\textsuperscript{128} From the risk allocation viewpoint, if the parties are risk averse, the insurance component of the negligence rule may produce an inefficient result.\textsuperscript{129} For under the negligence rule, risk is allocated to the consumer and if in this case he has imperfect information about risk, he would not be motivated to purchase the efficient amount of first-party insurance.

\textsuperscript{123} Shavell, 19.

\textsuperscript{124} Shavell, 76.

\textsuperscript{125} United States v. Carroll Towing Co., 159 F 2d 169, 173 (2d Cir 1947). "The defendant is guilty of negligence if the loss caused by the accident, multiplied by the probability of the accident's occurring exceeds the burden of the precautions that defendant might have taken to avert it": Restatement (Second) of Torts, § 291-93.

\textsuperscript{126} Restatement (Second) of Torts, § 283B.

\textsuperscript{127} Posner, id; id, Tort Law _ Cases and Economic Analysis, 1-8.

\textsuperscript{128} Cane, 415; id, (1993) 149.

\textsuperscript{129} Priest, The Current Insurance Crisis; Landes & Posner, The Economic Structure of Tort Law, 82.
5.1.3 Incentives of the negligence rule: A common belief or presumption that the negligence rule will create the deterrent effect better than strict liability, may not sound convincing enough to justify its superiority over strict liability. For if this were really the case, all highly dangerous activities must have been subject to the negligence rule. But the contrary is true as can be seen in the *Rome Convention 1952* on surface damage and other international regimes governing such activities. Further, the carrier or manufacturer has already a clear financial interest in accident prevention, and to imagine that the carrier/manufacturer might become careless in his products, clearly glosses over the financial impact of an accident on the injurer (e.g. loss of an aircraft and liability for passenger and/or surface damage). In addition to the disastrous financial blow, subsequent investigation and legal proceedings may also reveal a hitherto unknown defect in his safety system, causing a further adverse effect on his public image as safe carrier or manufacturer.

In addition, a collision caused by multiple injurers creates substantial uncertainty as to the exact degree of fault to which the respective tortfeasor contributed. Thus, if as a result the court commits errors in calculating the level of due care, parties are likely to take more or less than the optimal care to avoid being found negligent and liable by mistake. Particularly, given the esoteric features of an aircraft, determination of a defect in the design, manufacturing or certifying process would obviously entail highly technical issues for the court to tackle. If the court fails to assess correctly the level of due care applicable to each injurer, he will be induced to take excessive or insufficient care, since he will be misled into thinking of the court-decided level of care as adequate. A further consideration in disfavour of the negligence rule is administrative costs associated with proof of fault and establishment of causal connection.

5.1.4 Strict liability: Many of the problems with the negligence rule can be avoided under strict liability where the behaviour of the injurer is not examined. The only relevant issue is whether the injurer's act was the proximate and probable cause of the victim's harm. The injurer must pay the victim regardless of whether he was at fault or whether the burden of care is greater or less than expected cost, thus forcing him to take all justified

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130. Ch 4 below. For the examples of highly dangerous activities regulated internationally under strict liability, see Cheng, *A Reply to Charges et al.*

131. Drion, 11-12.

132. Ch 2. 6 below.

133. Shavell, 56 & 79. For a discussion of uncertainty over the determination of negligence standards, see A Tunc (ed), *International Encyclopaedia of Comparative Law.* vol 2, ch 1, paras 141-46.

134. Shavell, 56-57.

135. Shavell, 4.
steps to reduce risk. If the injurer's cost of engaging in the carriage by air activity should go up as a result of internalising accident losses he caused, these cost will be passed onto fare-paying passengers or the injurer's insurers without being externalised. Accordingly, passengers will be forced to buy the efficient quantity of carriage by air products. As the fare hike means loss of competitive edge in the market, his activity or output level will soon fall reflecting his liability payments. Thus, continual pressures will be applied for the injurer to develop new technologies and safety measures that will reduce expected losses. Strict liability generally incurs less administrative costs than the negligence rule.\(^\text{137}\)

5.1.5 Strict liability and enterprise liability: The basic idea underlying the notion of enterprise liability is that enterprises as the undertaker of risky activities should bear the losses as well as the gains its employees may cause, as expressed in the maxim "Activities should bear the costs they engender".\(^\text{138}\) Thus, from the efficient risk allocation viewpoint, the carrier or the manufacturer equipped with more accurate information than the passenger (information asymmetry) is in a better position to assess and bear the risk by purchasing liability insurance (internalisation of accident costs). Carriers or manufacturers, as the undertakers of risky businesses, can then pass the losses on to passengers by raising fares or aircraft prices or by taking out liability insurance on the market, which is the efficient risk allocation. This is not necessarily because they represent a better conduit for distributing risk among beneficiaries of their products and services.\(^\text{139}\) If loss distribution is the only justification, a state accident compensation system or social insurance may better serve the purpose and may be more desirable. A more convincing rationale can therefore be found in the fact that carriers and manufacturers can better be induced to reduce risk by taking safety precautions than consumers of the carriage by air service can.\(^\text{140}\)

As such, in determining the liability of various injurers, the decision to engage in a risky activity should be left to the undertaker of a risky enterprise. Where expected benefits from the activity outweighs expected costs plus costs of care, the activity may be allowed to continue. The undertaker of the risky business as a rational subject will weigh up the risk and expected losses involved, take necessary safety measures or take out adequate

\(^\text{136}\) Thus, an increase in air fares would impel the carrier to take appropriate precautions to reduce the probability or magnitude of losses. Otherwise, the carrier's high fares will soon become uncompetitive in the market, which will bring down consumers' demand for his products and the fares. Ch 2: 2 below.

\(^\text{137}\) See 5.3 below.

\(^\text{138}\) See Morris. Hazardous Enterprises, at 1173; C O Gregory, Trespass to Negligence to Absolute Liability, 37 Va LR (1951) 359, 382-83; F James, Social Insurance and Tort Liability: The Problem of Alternative Remedies, 27 NYU LR (1952) 537, 538.

\(^\text{139}\) For the loss- or risk-spreading justification of enterprise liability, see Fleming, The Law of Torts (1987) 9; Smith. Frolic and Detour, at 718; Douglas, Vicarious Liability, at 586.

\(^\text{140}\) Morris, Enterprise Liability. at 554, 595 & 600. Morris. however, is in support of the risk-spreading rationale.
insurance on the market to cover his potential liability. If the sum of expected costs should far exceed the gains from the activity, the undertaker would withdraw from it. And if avoidance costs are well above expected accident losses, it would be efficient for the enterprise not to take care.

5.2 Causation

Up until now, we have taken it for granted that once an accident occurs, one or another liability rule would apply automatically. But almost every legal system restricts liability to a certain category of harm and usually requires a certain connection between the wrong and the harm, or between the cause-in-fact and its consequence. This also raises the question of the scope of liability in connection with foreseeability of harm or losses. In what follows, we introduce the notion of causation (causalité) in tort law and attempt to reformulate causal requirement from an economic approach. It is assumed that passenger damage risk created by carriers and manufacturers can be expressed via probability statements in a world of statistical control.

5.2.1 The notion of causal link between a behaviour and resulting harm: Causal connection or causal link (lien de causalité) in the law refers to the likelihood that a certain behaviour will result in a harm in the future and consists of two requirements: 1) that a behaviour (act or omission) to which liability is attributed must be a necessary cause of the injury (necessary cause; causa sine qua non); and 2) that the behaviour has to be related proximately to the injury sustained (proximate cause; causa causans).

A case may illustrate the point. In *Payne v. Railway Executive* where plaintiff, injured by defendant's negligence, was invalided out of the Royal Navy which awarded him a disability pension, the court held the amount of the pension not deductible from the

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141. In general, at common law the injurer is liable for negligent act or omission or for breach of statutory duty (*Donoghue v. Stevenson*, n.5 above). In French law, liability is imposed on the injurer for delictual acts or omissions. Thus, *force majeure* and *Act of God* at common law and *cause étrangère* in French law are usually excluded from the scope of liability. See Miller, ch 3; *Code Civil*, art 1147.


143. Calabresi & Klevorick, *Four Tests*, at 597; Hart & Honoré, 110; *Cane*, 102-03. In French law, although the term *cause* is used in each of arts 1382-1386 of the *Code civil*, it is not of much help in elucidating what is meant by the causal link, nor has any theory of causation achieved general acceptance. See J Herbots, *Economic Loss in the Legal Systems of the Continent*, in M Furmston (ed), *The Law of Tort*, 137, 145.

144. In addition to the term 'proximate' cause, such terms as 'real', 'material', 'effective', 'adequate', 'sufficient' or 'probable' cause are also used: *Palsgraf v. Long Island RR. Co.*, 248 NY 339, 162 NE 99 (1928); *Cane* (1993) 101; Prosser & Keeton, *Torts*, sec 42.

damages awarded to him, because it was the consequence not of the tort, but of his service in the Navy. According to the court, the naval service was the 'causa causans' of the receipt of the pension and the injury a mere 'causa sine qua non'.

5.2.2 Necessary cause: A behaviour or event is defined as a necessary cause of its consequence relative to another if the effect or consequence would have been different had the second action been taken. On the face of it, the but-for test appears useful, at least theoretically, in weighing up various possible causes and eliminating non-causal factors. However, there will usually exist many factors which form an unbroken chain of events to cause or contribute to the occurrence of a harm. Certainly, but for the presence of oxygen in the air, a fire will not occur. Likewise, a passenger who was able to arrive at the airport in time for departure because of the cab driver's speeding would not, but for the speeding or even but for the passenger's boarding of the aircraft, have been killed in a subsequent crash. In this sense, the presence of oxygen and the driver's speeding or the passenger's boarding may be described as a necessary cause of the fire or the passenger's death.

But no one would, as a matter of the law or otherwise, single out, as a legal cause of the fire or death, the presence of oxygen, the driver's speeding or the passenger's boarding. They are not directly or proximately connected to the occurrence of harm. The legal cause of the passenger's death would rather be ascribed e.g. to failure to comply with some fire safety regulation, to the pilot's negligence, or to the manufacturer's marketing of a defective aircraft. The reason is that in the causal inquiry, only some out of numerous but-for factors are, because of their abnormality, singled out to explain the cause of harm or the connection between an act (or omission) and the resulting harm. The but-for test is not necessarily concerned with factual connection, nor will every necessary cause of a harm count as a causally relevant factor in law. The test simply ascertains if defendant's act was one necessary cause of plaintiff's injury without explaining exactly how the harm occurred and why the cause of an injury is ascribed to a particular factor.

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146. Ibid, at 36 per Cohen LJ.
147. Shavell, 106; Restatement (Second) of Torts, s 432; Hart & Honoré, 110.
148. The presence of oxygen may be described as a mere condition, rather than a cause. See Hart & Honoré, 12 & 112-13.
149. Stapleton, Product Liability, 121.
150. See Donbeck v. Chicago, Milwaukee, St. P. & Pac. R.R., Co., 24 Wis 2d 420, 129 NW 2d 185 (1964) (speed of train is not a legal cause of its collision with a car "merely because the train arrived at the crossing the instant it did while if it had been going slower the car might have safely crossed ahead of it"); Baker v. Herman Mutual Insurance. Co., 17 Wis 2d 597, 602, 117 NW 2d 725, 728 (1962).
151. See Hart & Honoré, 340.
154. Hart & Honoré, lxxi-lxxii & 114; G Calabresi, Concerning Cause, 71.
155. Cooter & Ulen, 333.
This is well illustrated in certain cases of 'coincidence' where but for the negligence of the injurer, the injury would not have happened but, nevertheless, he is found not liable.\textsuperscript{156}

5.2.3 Proximate cause: While a factor must satisfy a but-for relationship to the causal chain of necessary conditions to be regarded as a legal cause, that is not usually sufficient. In order to attribute legally the occurrence of a harm to an act or omission, certain arbitrary limits must be set\textsuperscript{157} and the 'proximate' cause must be selected from among an infinite sequence of necessary causes.\textsuperscript{158} The proximate cause, construed as meaning the most immediate, direct\textsuperscript{159} consequence of a wrongful act, requires proximity of harm to a behaviour and employs various tests such as directness-remoteness or foreseeability of harm.\textsuperscript{160} In determining foreseeability, one essential factor was held to be whether the damage is within a reasonably expected category of causation and consequence.\textsuperscript{161} However, it will soon be noticed that the foreseeability test is subject to difficulties in establishing a directness in certain cases of an independent intervening cause.\textsuperscript{162} This is also the case of multiple proximate causes as in a collision where each of two or more aircraft contributed, 'successively' or 'simultaneously', to the occurrence of harm.\textsuperscript{163} Directness or proximity of cause to effect is indeed a matter of degree and in this sense the test of 'directness' may not help very much in solving causal problems.\textsuperscript{164}

5.2.4 Constraints on causal requirement: As we have already seen, the but-for test does not explain the ascription of liability to a particular necessary cause. The importance of the test is again somewhat diminished by the application of the doctrine of res ipsa loquitur\textsuperscript{165} under the negligence rule or by the imposition of the 'absolute' liability in cases of so-called 'ultra-hazardous' activities.\textsuperscript{166} Nor can the but-for test explain the rationale of vicarious liability of a master for his servant's wrongs (e.g. the carrier's liability for damage his pilot caused or the ATCA's liability for the controller's act or omission), where there exists no

\begin{thebibliography}{99}
\bibitem{156} Calabresi & Klevorick, Four Tests, 597; Hart & Honoré, 78-80.
\bibitem{157} \textit{Atlantic Coast Line Railway Company v. Daniels} (1911) 8 Ga App 775, 70 SE 203.
\bibitem{158} Hart & Honoré, 114-15.
\bibitem{159} See Re Polemis [1921] 3 KB 560, 570 (per Bankes LJ) & 576 (per Scrutton LJ).
\bibitem{160} Hart & Honoré, at 149-50, 178. The notion of "direct consequence" has been discredited in England, but retains an important place in French law and is seen as an element of the necessary cause requirement between the injurer's fault and the resulting losses. Honoré, n.142 above, vol xi, ch 7, paras 71-73; Herbots, n.143 above, 144.
\bibitem{161} "[T]he essential factor is ... whether the damage is of such a kind as the reasonable man should have foreseen". \textit{The Wagon Mound}, (No.1) [1961] AC 388. 426 & (No.2) [1967] 1 AC 617.
\bibitem{162} Hart & Honoré, 178-79 & 278.
\bibitem{163} Shavell, 109 n.3. Consider collision damage caused jointly by carriers, manufacturers and air traffic controllers. Ch 2: 6, ch 3: 6 & ch 6: 5 below.
\bibitem{164} Hart & Honoré, 179; Cooter & Ulen, 334.
\bibitem{165} See Hart & Honoré, 418ff; ch 2: 3.1.3 below.
\bibitem{166} \textit{Restatement (Second) of Torts}, ss 519, 522 (1965); Hart & Honoré, 288. No distinction will be attempted in this study between strict and 'absolute' liability, ch 2: 2.3, Example 2.1 below.
\end{thebibliography}
factual connection between the behaviour of the person liable and the harm caused. The same can be said of an insurer's liability for losses incurred or sustained by his insured and of a guarantor's liability for indemnification of debts owed by the guarantee.

Moreover, what is 'likely', 'probable', or 'foreseeable' that is often employed by courts as a test of proximate cause, is relative to limited knowledge or information. What is perceived to someone as a remote possibility may be understood to another as highly probable. So what is meant by 'foreseeable' anyway and whose knowledge is to govern in determining foreseeability? And are we talking about knowledge that the liable party actually had or that he ought to have had? Again, the extent or gravity of harm needs not to be foreseen in order to hold the wrongdoer liable. Once the type of harm caused meets the criterion of reasonable foreseeability, the injurer will be liable for the full extent of the loss within that category, as found in the 'thin-skull' or 'eggshell skull' principle. As such, the foreseeability test has a limited role to play in the determination of proximate cause, raises more questions than it answers, and adds little to the weighing of various factors such as the probability or magnitude of harm, the burden of precautions, and the value of defendant's activity. It is thus not surprising that one author even declared that "[t]he law would lose little by jettisoning the concept of foreseeability altogether".

It is on this line of reasoning that many law and economics authors argue that there is no reason to look to actual causation or the causal concept itself other than the concept of probabilistic linkage in accordance with the principle of civil liability that one must be held liable for the 'probable' consequence of his act or omission. Indeed, the fact that one has been held liable for a harm does not necessarily imply that he actually did or caused the harm, as already seen in the vicarious liability context. Nor is the nature of causation in law strictly and necessarily a factual issue. It is rather an 'attributive' question,

167. Hart & Honoré, 64-65; ch 3: 3.2 below.
169. Hart & Honoré, 165.
170. This is why the foreseeability test has been described as even arbitrary. Hart & Honoré, 256-57; Prosser, Handbook of the Law of Torts, 267.
172. In French law, the foreseeability test is confined to contract. Where liability lies in delict, the injurer is always liable for all direct damage. See Herbots, n.143 above, 144.
173. See Cane, 114-15. Imposing liability in full in thin-skull cases will balance nonliability in 'rock skull' cases so that total damages awarded will equal the victims' total injury. Posner, 131.
175. Ibid.
177. Harris, Remedies in Contract and Tort, 209.
as seen in the fire and plane crash examples introduced above\textsuperscript{179} and in joint tort cases where there usually exists uncertainty over the exact degree of contribution by the respective tortfeasor to the occurrence of harm. For these reasons, the idea of causation can largely be dispensed with in an economic analysis of torts\textsuperscript{180} as in that of intentional torts.\textsuperscript{181} Given these constraints on causation in tort law, it will be necessary to make a restatement of the purpose of the causal requirement from the economic analysis.

5.2.5 Legal attribution of proximate cause on the basis of accident record under strict liability: If the primary objective of imposing liability for past actions is to affect future behaviour of causally relevant actors and to achieve the socially optimal level of safety, causal attribution must be used to induce potential injurers to make correct future assessments of the risks and to allocate resources efficiently when they choose between safety and risk.\textsuperscript{182} Imposing liability on a party whose behaviour does not increase the probability of a particular injury's occurrence (e.g. the cab driver's speeding in the plane crash example\textsuperscript{183}) will not foster correct assessments, even if the behaviour in question was a but-for cause of the injury.\textsuperscript{184} The question in the causal requirement is therefore who can better be induced to reduce risk by allocating an optimal amount of resources to safety and care and how the law can promote such behaviour.\textsuperscript{185} Thus, assuming that the purpose of tort law is to promote efficient accident avoidance, the cause of an injury should, as a general rule, be ascribed to the injurer as the consequence of his conduct whenever to do so promotes efficient resource allocation and incentive creation.\textsuperscript{186}

To achieve this objective, tort law should be formulated in such a way as to concentrate on the long-term consequences and experience of the injurer's conduct rather than the cause per se in a particular situation. Thus, if an injurer's failure to comply with safety regulation increased the risk of a fire or an accident, such behaviour can only be known and sanctioned by reference to its wrongful consequences as expressed in his past accident record.\textsuperscript{187} This is because an injurer's accident record is the evidence of past decisions he

\textsuperscript{179} Cane (1993) 102; sec 5.2.2 above.
\textsuperscript{180} Landes & Posner, Causation in Tort Law, 110; Posner, Tort Law: Cases and Economic Analysis, 585-88; Cooter & Ulen, 343. As science advances, the concept of causation tends to be formulated in mathematical terms.
\textsuperscript{181} See Ch 2: 4.2.2 below.
\textsuperscript{183} See 5.2.2 above.
\textsuperscript{184} Calabresi & Kleverick, Four Tests, 599.
\textsuperscript{185} Lowenfeld & Mendelsohn, 559. If parties are risk averse, the issue of causation turns simply into a question of how the insurer can properly induce injurers to take proper risk-reducing actions for premium reductions. Robinson, Multiple Causation in Tort Law, 737.
\textsuperscript{186} Landes & Posner, Causation in Tort Law, 110.
\textsuperscript{187} This accords with insurance premium-setting practice. Cane, 233; \textit{id} (1993) 205.
made between accident and avoidance costs and can thus be used as a most probable and reliable guide to his accident propensity. Indeed, the absence of any deleterious effect will make it difficult for the court to assess correctly the risk involved and to determine properly the optimal deterrence level applicable to each injurer.

Obviously, in attributing to the injurer's conduct the cause of a particular accident, statistics on average accident frequency provides a useful, proximate barometer of assessing the risk each injurer creates through his activity. Again, when statistics on accident record (based on e.g. insurance claims already made) are properly classified and maintained, they will provide a proper actuarial basis for the insurer to set the premiums and for the injurer to decide whether to invest in liability insurance or to take risk-reducing actions. As such, the key factors in the economic analysis of causation are not cause per se but the objective accident probability and administrative costs of courts. From this viewpoint, the causal requirement in tort law can best be understood as a device to allocate accident costs to the cheapest cost avoider, while proximate cause can best be determined by comparing relative accident probabilities of risk creators.

5.2.6 Apportionment by the relative probabilistic causal contribution in joint and multiple torts: Inasmuch as accident probabilities are used to apportion liability, they are irrelevant when only one proximate cause was operating. The probability or improbability of a harm occasioned by only one cause is irrelevant to allocating liability; the entire actual losses caused should be attributed to the sole proximate cause. If losses were caused by multiple, proximate concurrent or contributing causes, the courts should not arbitrarily choose the most proximate as the sole cause for purposes of determining liability but should look instead to the various acts or omissions which proximately caused the harm. Such losses should be apportioned between them on the basis of their respective accident record as a token of relative riskiness of their activities. Imposing heavier liability on the high-risk creator will in the longer run compel him to invest relatively more in the development of better and cheaper avoidance technologies to bring down his relatively

188. Calabresi, Concerning Cause, 85.
189. Robinson, Multiple Causation in Tort Law, 738.
190. Wittman, n.77 above, 202; ch 2: 4.3.2 below.
191. Landes & Posner, Causation in Tort Law, 109-10 & 134. Some authors even go so far as to argue that foreseeability or reasonable expectation is more related to fairness than efficiency. See Morris, Enterprise Liability, 534 & 600 n.97.
196. For the concept of probabilistic marginal product, see Rizzo & Arnold, ibid, 1406 nn.39 & 41.
high accident probability. Consequently, there will occur greater reduction in accident probability in general and greater enhancement of safety if in multiple torts, liability is imposed in proportion to the injurers' accident record.

In a system that does not apportion liability, allocation of the entire losses to the highest-risk creator will produce the efficient solution, because it will minimise expected accident costs. Under a system of apportioning losses between joint injurers, on the other hand, liability should be allocated in proportion to the relative riskiness of their activities to make each injurer (or his activity) bear the costs he has caused. This will force each of the joint injurers to engage in the socially optimal level of activity. In multiple and joint tortfeasor cases, scaling liability in proportion to the relative accident probability in passenger damage cases is equivalent to assigning liability in proportion to their relative total output in environmental harm cases. The consequence in both cases will be the same: the more risky or harmful an activity is, the more deterred it will be, and each will be deterred in proportion to its relative riskiness.

5.3 Liability Rules and Administrative Costs

Since we have evaluated the efficiency of the negligence rule and strict liability and analysed causal requirement from the economic approach, we will now consider administrative costs of liability rules incurred for the trial process. These costs can be termed *involuntary* transaction costs incurred by the courts for information and judgment. To analyse the relationship between liability rules and administrative costs, it is assumed that the level of damages will match actual or average losses. In other words, if expected damages should exceed the victim's expected costs of resorting to an action, he (or his next of kin) will have incentive to bring an action.

5.3.1 Notion of total administrative costs: When a victim suffers damage and he (or in case of his death, his next of kin entitled to compensation) has decided to make a claim, he (or his next of kin) would have two choices to recover his damages: to settle with the injurer or to go to trial. In the former case, since the number of out-of-court settlements and their respective costs are not exactly known in aviation disputes, total transaction costs associated with settlement are not available. We will therefore confine our discussion to administrative costs incurred for the litigated solution. Here, total (litigated)

\[ \text{Equation} \]
administrative costs are defined to equal combined total costs incurred for all litigated claims. This is equivalent to the total number of litigated claims multiplied by the average costs per litigated claim.

5.3.2 Simple model for least administrative costs: If the parties are risk neutral, total administrative costs to be incurred under liability rules will depend on two factors: the number of claims brought to the courts and average judgment costs per claim including information costs.\(^{201}\) If the parties are risk averse, an obvious component of total administrative costs is the expenses incurred to liability insurers.\(^{202}\) In this simple model, the efficient outcome calls for discouraging victims' incentive to resort to litigation and reducing courts' administrative costs for determining the injurer's liability.

5.3.3 Administrative costs under the negligence rule and strict liability compared: As to the number of actions, under the negligence rule the injurer's incentive to bring an action will not be dampened, as long as he believes that he can prove that he satisfied the standard of care applicable to him. Under strict liability, both the victim's and injurer's incentives for resorting to action will be diluted, for the question would rather be centred on the magnitude of damages than on the issue of liability itself. And insofar as the amount of damages awarded approximates actual damage, the victims would have little incentives to resort to costly actions. Strict liability therefore enhances the prospect of prompt and less expensive trial, compared with the prolonged proceedings under the negligence rule.

With regard to judgment costs, information costs are usually high under the negligence rule because of the questions relating to the identification of negligence applicable to the injurer.\(^{203}\) Under negligence the court needs to know not only the victim's damages and the injurer's benefits matching different levels of his care,\(^{204}\) but also how the injurer behaved, to determine whether he has met the standard of care. Under strict liability, the court needs to know only the victim's damages. Again, proof of negligence and causal link will incur considerably high costs under negligence, particularly in joint and multiple injurer cases.\(^{205}\) Thus, if there exists uncertainty over causation as in a collision and if the court commits an error in determining each injurer's exact degree of fault, it would tend to give one or more of the joint injurers (or their insurers) to have recourse actions under the negligence rule, thus increasing the number of actions. This is why the economic theory of litigation

\(^{201}\) Shavell, 264.
\(^{202}\) Shavell, 263: 6.4 below.
\(^{203}\) M Kahan, Causation and Incentives under the Negligence Rule, 10 J Leg Stud (1989) 427, 443; Posner, 441-42.
\(^{204}\) The court will need information about the injurer's benefits at different levels of care to decide on the standard of care that corresponds to the efficient outcome.
\(^{205}\) Sec 5.2, above.
predicts that litigation and appeal are most likely where the law is uncertain and where damages awarded are biggest.\footnote{Landes & Posner, An Economic Analysis of the Courts. 14 J L & Econ (1971) 61.} Therefore, consideration of administrative costs reduction points to strict liability as the preferred rule.

5.3.4 Estimate of administrative costs of the tort system: Although an estimate of administrative costs incurred for aviation accident-related litigation is not available, those incurred in the context of general tort litigation have been made public. The Pearson Commission estimated that administrative expenses of the tort system accounted for 85 percent of the value of total compensation payments, or about 45 percent of the total costs of the system including legal costs and the general administrative costs of the insurers but excluding the costs of running the courts.\footnote{Pearson Report, para 1(261): Cane, 449; \textit{id} (1993) 338.} The social security scheme, by contrast, operates at a cost of about 11 percent of the total payments.\footnote{Ibid, para 11(158).} The Commission, taking note of different modus operandi and philosophies of the two systems, proposed a balanced approach to personal injury/death compensation for efficient control of risk and improved protection of victims.\footnote{Ibid, paras 1(1732) & (389). See A I Ogus \textit{et al.} Pearson: Principled Reform or Political Compromise?, 7 Indus LJ (1978) 143.} Towards this goal, it recommended that the law should be reformed in such a way as to reduce incentives for tort claims and to boost the comparative attraction of social insurance benefits.

6. Aviation Insurance

Analysis so far of liability rules governing aviation risk and harm has been premised on parties' risk neutrality which means that such a party cares only about the expected value of risk and not about its size.\footnote{Sec 2.4 above.} But as attested by the prevalence of insurance, risk aversion is indeed quite common in the behavioural pattern of individuals and corporate bodies. We will thus examine the relationship between liability rules and insurance and the implications of risk-aversion for social welfare maximisation.

6.1 Risk Allocation and Risk Reduction

One of the most important behavioural implications of the assumption of risk aversion is that a risk-averse party will be willing to pay to avoid an uncertain risk. Airlines and aircraft manufacturers, for example, usually dislike having to face a large, uncertain risk of causing passenger damage in their conduct of business. Although a risk-averse party may choose to self-insure or install safety devices to minimise the probability of an uncertain risk
materialising, one of the most common method of avoiding such risk is to purchase insurance from someone else.²¹¹

6.1.1 Notion of insurance: Insurance is an agency or institution whereby the insurer acts as a conduit for pooling risks and spreading losses among risk-averse parties (premium-paying insureds) for their ultimate elimination.²¹² To be more specific, insurance means an arrangement or agreement (insurance policy) concluded between the insurer and the insured whereby the insurer, in consideration of a premium, agrees to indemnify the insured against the insured's own loss or his liability vis-à-vis third parties when the loss materialises.²¹³ An insurance policy thus converts an uncertain risk of loss into a certain, calculable cost (actuarial risk), that is the present value equivalent of the risk (insurance premium).²¹⁴ By shifting their risks to the insurer who is in theory the better risk taker, risk-averse insureds can eliminate risk entirely. If the number of insureds are sufficiently large and premiums charged equal aggregate actuarial risks, the probability that the insurer covers his loss will approximate to 100 percent by dint of a mathematical theorem known as the law of large numbers (la loi des grands nombres).²¹⁵

6.1.2 Risk reduction/elimination: Insurance turns insureds' uncertain risk of ruinous loss into a certain, calculable cost and eventually eliminate it. Insurers do this by pooling insureds' accident risk with other risks (which are often not directly related to accident risks) and spreading losses over a group of premium payers and through them, over a broad segment of society. Insured airlines are thus allowed under the insurance arrangement to shift risk to the insurers by paying a certain premium, which increases insureds' utility. The substitution and ultimate elimination of uncertain risk will protect the risk averse from falling prey to financial bankruptcy and benefit society because it removes fears holding individuals back from engaging in a risky but socially useful activity.

As such, insurance is an appropriate strategy where parties cannot exercise control over risk at reasonable cost but where in the absence of such strategy economic activity would be suboptimal.²¹⁶ Because of the existence of insurance, the insured can choose between

²¹¹ Cooter & Ulen, 63-65.
²¹³ See Arrow, Essays in the Theory of Risk-Bearing, chs 5, 8 & 9; Shavell, 192.
²¹⁴ The Insurance Companies Act 1982 (s 36) provides that an insurance contract under which the insurer undertakes an uncertain or unlimited amount of liability will be void. Calabresi, 247-49.
²¹⁵ Shavell, 192 n.10; Cooter & Ulen, 65; Priest, The Current Insurance Crisis, at 1544; Juglart, II(3409). The underlying principle is that the larger the sample the more dependable the probabilities are.
²¹⁶ Arrow, Essays in the Theory of Risk-Bearing. 134-143.
insurance and loss prevention.\textsuperscript{217} A risk-averse party will choose prevention if he can avert it by an expenditure smaller than the expected value of risk, whereas he will choose insurance if the opposite is the case. Although total costs of spreading losses are increased because of the insurer's costs of calculating and predicting risks, those of selling the polices and other expenses, insurance can offset these additional costs because the premium is still smaller than the magnitude of disutility a risk-averse party attaches to the risk.\textsuperscript{218} This is why liability insurance is still attractive to insureds despite the fact that premiums are above the expected value of loss because of the insurer's administrative costs.

6.1.3 Risk assessment and premium-setting practice: The insurer pools in his sample of risks as much uncorrelated risks as possible on the basis of the law of large numbers (aggregation of risks) in order to be certain of the probability of the occurrence of insurable events and to offer competitive premiums for the same level of coverage.\textsuperscript{219} The insurer then identifies, classifies and predicts high- and low-risk members of the sample and thus defines risk pools narrowly to avoid adverse selection (segregation of risk pools).\textsuperscript{220} Differential premiums are charged between high-risk and low-risk insureds as determined by their accident or claims record. Members of the high-risk pool are made to pay more than those of the low-risk pool because they are more prone to incur losses for certain characteristics which the insurer statistically associates with higher accident rate.\textsuperscript{221} These classification will apply continued pressures for high-risk insureds to reduce their accident record and will make market insurance more attractive. In this way, insurers induce insureds to reduce their risk level and maximise expected utility of insurance policies.\textsuperscript{222}

6.2 Liability Insurance and Tort Law

The evolution of liability insurance has changed the role and function of tort liability as a mechanism for compensation and safety promotion.\textsuperscript{223} It may be arguable that liability insurance may dilute incentives for the potential injurer to avoid losses. Thus, when liability insurance was first introduced, it was greeted with opposition that insurance would derogate from the deterrence role of tort law usually associated with the negligence

\textsuperscript{217} Posner, 75.
\textsuperscript{218} Posner, 76.
\textsuperscript{219} Priest, The Current Insurance Crisis, at 1540.
\textsuperscript{220} Sec 6.3.3 below. By the term 'narrowly' is meant 'with small variance' or 'concentrated around the average'. Priest, The Current Insurance Crisis, at 1542-43; Calabresi, 251 & n.8, 257-58, 287 n.2; id, Concerning Cause, at 85-86.
\textsuperscript{221} Cane, 453.
\textsuperscript{222} Priest, Compensation for Injury, at 129.
\textsuperscript{223} B S Markcsinis. La perversion des notions de responsabilité civile délictuelle par la pratique de l'assurance, 35 Rev int dr comp (1983) 301; Drion. 23 in fine.
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rule.224 As it happened, however, the practical operation of liability insurance has, far from taking away the incentives of taking care, directly contributed to their promotion by changing the person who has the most direct and significant interest in accident avoidance.225 As such, the insurance mechanism creates financial incentives for insurers to work out accident avoidance measures and to perform necessary research.226

6.2.1 Compensation and risk allocation through insurance: In the absence of insurance, tort liability performs the dual function of compensation and deterrence. But once insurance is taken into account in the accident problem, the entire outlook on the tort process is bound to change. Insurance takes the place of tort law as the primary vehicle for compensation, while tort law is relegated to a position of subsidiary part of the compensation process.227 Thus, tort liability functions as a mechanism for allocating losses to potentially liable parties and linking the victim's entitlement to indemnity to liability insurance taken out by tortfeasors.228 Indeed, tort liability has been transformed into a system imposing on prospective injurers a duty to take out insurance against their potentially disastrous liabilities and pay premiums, thus reducing tort liability to a mere sanction against failure to insure.229

Although insurance shifts losses to the insurer and as a result distributes losses widely, it is important to note that insurance is not merely for risk distribution, for a state or international relief scheme may better serve the objective of risk distribution and compensation.230 In this process of risk allocation and ultimate distribution, tort liability gives way to the insurance mechanism in its dual function and degenerates merely into a form of insurance. Since it is now the insurer who has to pay out to victims in the last analysis, it is he who must take all necessary measures (e.g. change in conditions of cover or adjustment of premiums) in order to induce insureds who are by assumption responsive to financial incentives, to change their behaviour towards minimising risk and avoiding losses. Indeed, insurance has removed the chance of insolvency on the part of those liable, since the actual injurer often lacks substantial assets to meet his potential liabilities.231

6.2.2 Loss avoidance and deterrence through insurance: Since insurance involves pooling of risks, the insurer is in a superior position to accumulate information about the

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224. Drion, 9.
225. James, Accident Liability, at 559-62.
227. Priest, Compensation, at 128; Cane, 226, 394.
229. Ch 4: 2.4 below.
230. See Cane, 477-79.
231. James, Accident Liability, at 564; ch 4: 2.4 below.
risks involved and the claims made. From this vantage point of risk assessment and
drawing on his accumulated information, the insurer can deter his insureds from loss-
incuring behaviour and can thus reduce actual risk levels. Insurers do this largely through
premium rating techniques and changes in the conditions of cover. They may thus refuse
to underwrite certain risks or to provide cover for certain types of loss, require insureds to
adopt remedial precautions as a condition to any renewal of contract when a pattern of
losses becomes apparent, or impose 'penal' premiums on insureds' fraudulent behaviour.
The effect is similar to that derived from the doctrine of respondeat superior. Since the
insurer has direct financial interest in avoiding or minimising the materialisation of the risk
insured against (for it is he who has to pay for the insured's loss), it is in his interests to
induce his insureds to avoid loss or to take cost-effective steps. Although tort liability
still retains its deterrence role in this process, it does so merely by attributing the losses to
defendant who is deemed a better conduit for risk bearing than the victim and the
deterrent effect of tort liability is in reality enforced by the insurer.

6.3 Utility-Maximising Insurance Policies under the Imperfect Aviation Insurance
Market

If the insurance market operates competitively, insurers can acquire perfect information
about insureds' behaviour at negligible cost and will be able to link the terms of insurance
policies to insureds' actions and set premiums in such a way as to induce them to take
appropriate risk-reducing actions. Such policies will yield maximum expected utility for
insureds. Insureds will thus be induced to buy the efficient amount of insurance products
or allocate efficiently the money available to them between insurance and loss
avoidance. But since there is a limited number of commercial aircraft compared with a
great number of ships insured against maritime risks or properties insured against the fire
risk, the aviation insurance market is inherently limited. This limited market conditions
are further aggravated by the usual severity of aviation accidents which involves almost a
total loss of passengers and valuable goods even in the case of a runway accident because
of fire or explosion. Since aviation liability insurance is against 'detrimental' rather than

232. James, ibid, 560-61.
233. Ch 3: 3.2 below. Just as the doctrine is justified mainly by the financial incentives it creates for the
employer to oversee his employees' conduct, liability insurance creates incentives for insurers to take
necessary steps to minimise risks and avoid losses that may be caused by his insured.
234. It is in this context noteworthy that some of pioneer aviation safety work has been claimed by
insurance companies and that fire brigades in England were originally established and maintained by
individual insurers. See James, Accident Liability, 561 & Cane, 500-01, 506.
235. Robinson, Multiple Causation, at 737 n.92.
236. See Polinsky, 85 for the notion of the competitive market.
237. Priest, Compensation for Injury, at 131; Abraham, Distributing Risk, 12.
238. Juglart, II(3409). For the functioning of the London aviation insurance market, see Margo, ch 4.
239. Ibid, II(3412).
'beneficial' risk, the issue here is how much money a risk-averse party (airline, manufacturer) is willing to pay in order to obtain maximum utility from buying insurance policies against passenger damage risk created in parties' contractual/market relationships (carrier-passenger or manufacturer-passenger).

6.3.1 Constraints on accurate risk assessment and on full coverage: These characteristics of the aviation insurance market present a major obstacle for the insurer to adjust premiums by relying on the law of large numbers and the fully competitive market conditions. If the aviation insurance market does not operate competitively and insurers are unable to obtain perfect information about insureds' behaviour, they will generally be unable to link premiums and other policy terms closely to insureds' actions. Insurers can neither reward insureds with premium reductions for their risk-reducing actions nor punish them by premium increases or by denial of indemnification for failing to take recommended actions. And if in this case insureds have full coverage, their incentives to reduce risk or avoid losses will be diluted (moral hazard). The result would be that the premiums charged will be high, while insureds' utility will be low.

Thus, if insurance is overpriced, a risk-averse party will buy less insurance than optimal and overallocate to avoidance. If insurance is underpriced, on the other hand, a risk-averse party may buy more insurance than optimal and underallocate to loss avoidance. In general, the level of coverage yielding maximum expected utility depends on how best to strike a right balance between benefits and costs of lowering coverage from complete or between incentive creation for risk reduction and increased exposure to risk. Stated differently, under the imperfect market and insurers' imperfect information, two typical problems — moral hazard and adverse selection — prevent the insurer from calculating the individual risk correctly and offering insurance policies yielding the maximum expected utility.

6.3.2 Insureds' moral hazard: The term moral hazard refers to the general tendency of insureds to change their behaviour and underallocate resources to loss avoidance after taking out insurance, which may result in increase in the probability or severity of losses. Moral hazard occurs mainly because it is not possible or costly for insurers to monitor

240. See Polinsky, 53. A 'beneficial' risk is a risk which a risk-averse party would voluntarily accept. For such a risk, a risk-averse party is willing to settle for less than the expected value of the risk. A 'detrimental' risk is an undesirable risk which a risk-averse party would not voluntarily accept and would thus be willing to pay more than the expected value of the risk to avoid it.


242. Arrow, Essays. 142, 202-03; Milgrom & Roberts, 167. 195; Priest, Compensation for Injury, at 130-31; Cooter & Ulen, 65-66; Abraham, Distributing Risk, 14-15; Polinsky, 55; Robinson, Multiple Causation, at 737 nn.91-92.
insureds' behaviour and link premiums to it. If insurers can observe insureds' necessary precautions, they can specify in the insurance policy which behaviour insureds should adopt. The presence of moral hazard reduces insureds' incentives to take precautions for avoiding or minimising losses, and in extreme cases insureds may deliberately cause losses or even make false or exaggerated claims (claims larger than actual losses caused). Although moral hazard is not necessarily a sign of moral dereliction and can be expected from rational, utility-maximising individuals, it nevertheless increases the risk level, impairs parties' ability to enter into mutually beneficial agreements, imposes otherwise unnecessary cost to the insurer and thus affects the efficient control of risk.

6.3.3 Insurers' adverse selection: If the insurer has imperfect information and fails to identify and group into a risk pool those insureds causing a sufficiently narrow range of exposure to risk, there will occur a wide divergence in risk levels between high- and low-risk insureds within the same pool. Those insureds who create higher risk than average will have an incentive to buy insurance by paying the premium set against the average risk, whereas those with a record of lower than average may perceive their premium rates to be too high. This will result in the concentration of high-risk insureds in the given risk pool and in higher premiums which those carrying a lower-than-average risk may find not worth paying, since a uniform premium within the same pool will have the effect of forcing low-risk members to subsidise high-risk ones. If, therefore, differentiation (segregation) between high- and low-risk insureds is not optimal and the disparity between the low- and high-risk becomes big enough, low-risk members will probably drop out of the pool to seek an alternative, cheaper means of protection, leading to the unravelling of the pool.

6.3.4 Accident/claims record as the substitute for direct monitoring: Although moral hazard and adverse selection problems can best be avoided through direct monitoring of insureds' behaviour, this means increased resources devoted to monitoring and verification. The insurer would thus rather check his insureds' care level by observing their respective claims record over a certain period of time. This method of individual risk rating with the premiums linked to each insured's occurrence/claims record would also reduce insurers'

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243. Priest, Compensation for Injury, ibid, at 130.
244. Pauly, Overinsurance and Public Provision of Insurance, at 47.
245. Cooter & Ulen, 66.
246. H Gravelle, Insurance Law and Adverse Selection, 11 Int Rev L & Econ (1991) 23; Priest, The Current Insurance Crisis, at 1546 n.117. As such, there is always some redistribution of wealth or income in any risk pool from low-risk to high-risk members because of the difficulty with perfect segregation of risks. Market insurance will still prove attractive to the low-risk member if the level of such redistribution is less than his relative risk aversion.
Economic approach

6.3.5 Partial coverage and risk sharing between the insurer and insured: Moral hazard can also be minimised through partial coverage such as coinsurance, deductible or premium reduction provisions, all of which are less attractive to high-risk insureds than to low-risk ones. An applicant's willingness to accept such provisions may serve as an indication of which risk class he belongs to. Under a coinsurance provision the insurer indemnifies the insured for a percentage of the latter's loss and the insured bears the remaining difference of losses; under a deductible, the insured retains part of the risk so that he shoulders a fixed amount of his loss, while the insurer pays for all remaining losses beyond that amount in case of loss. A form of this is known as 'aggregate excess cover', under which the insured agrees to accept a larger-than-normal amount of deductible and thus bears himself all the claims up to a certain aggregate figure. The insurer will therefore be liable for the amount over and above the deductible level up to the limits of the policy.

Since under both types of partial coverage insureds will be made to bear a portion of losses and retain part of the risk, they will have incentives to reduce losses. Especially, policies with a deductible not only create incentives for insureds to reduce risk but also reduce insurers' administrative costs, since insureds will not make claims falling below the deductible and insurers need not process such claims. Although this may not be the ideal risk allocation, policies with a deductible will protect insureds against the major portion of big losses, which risk-averse insureds want to avoid. By subjecting insureds to a scheme of risk sharing, both coinsurance and deductibles will induce them not to change their behaviour after the purchase of insurance. Insurers can also induce insureds' safer

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249. Abraham, Distributing Risk, 51; James, Accident Liability, at 561; Milgrom & Roberts, 187.

250. Margo, 7 & 72; Abraham, ibid, 15 nn.11-12; Cooter & Ulen, 66; Milgrom & Roberts, 186; Juglart, II(3409).

251. A deductible is often called an 'excess', since insureds are indemnified only for the excess of their loss over and above the deductible amount. Cane (1993) 246.

252. Margo, 108.

253. Shavell 198.
behaviour by rewarding them with premium reductions for some easily established acts, e.g. installing a smoke ventilation or fire detection device in the aircraft.

6.4 Insurers' Administrative Costs

We have assumed that premium rates are set to equal the value of expected losses. Normally, however, what an insured pays as premium includes his share of the insurer's administrative costs called *loading costs*. Analytically speaking, insurance costs consist of measurement and transaction costs.\(^{254}\) Measurement costs cover the costs of calculating the expected value of losses, i.e. costs for 1) estimating the probability that the risk insured against will materialise and 2) estimating the magnitude of the loss if the risk actually materialise. This estimation is conducted on the basis of the aggregation of different risks and the segregation of risk pools and provides for the actuarial basis for fixing premiums. Transaction costs mean the insurer's running expenses incurred to sell policies, buy reinsurance and process claims. Insurers will reflect measurement and transaction costs into premium rates and spread these costs among premium-payers. For simplicity, we will here call these two categories of costs simply as the insurer's administrative costs.

Insurers' administrative costs constitute an important factor in the supply of cheaper insurance on the market, since risk-averse parties will be willing to pay only for such competitive insurance policies as providing maximum cover and utility at lowest possible premiums. In the context of tort liability in general, insurers' administrative costs have been estimated to account for about 20% of the total damages paid out, which stands in stark contrast to the corresponding figure of 65% for the administrative expenses of the tort system as a whole including legal costs and excluding insurers' administrative costs.\(^{255}\) This is because, compared with the tort process which is adversarial in nature, insurers adopt relatively simple procedures for investigating the cause of losses or injurers' behaviour and for assessing and verifying the magnitude of insureds' claims.\(^{256}\) In the context of aviation insurance, one writer estimated insurers' administrative costs to be 5 to 10 percent of each premium dollar\(^{257}\) and contrasted this with the average liability awards of 15-20 percent of the total insurance premiums spent, indicating high costs of running the tort system.

\(^{254}\) Posner, 77.
\(^{255}\) Cane, 450; *id* (1993) 339; Shavell, 263; sec 5.3.4 above.
\(^{256}\) Cane, 449-50; *id* (1993), 338-39.
\(^{257}\) A J Chalk, A New Proposal for the Reform of Commercial Air Crash Litigation, 50 JALC (1985) 219, 247. This estimate, however, was criticised as unrealistic. See S D Sugarman, Right and Wrong Ways of Doing Away with Commercial Air Crash Litigation: Professor Chalk's "Market Insurance Plan" And Other No-Fault Follies, 52 JALC (1987) 681, 702 n.62.
7. Liability for Harm and Regulation of Safety and Quality in Products, Professional Services and the Environment

As the efficiency analysis above has shown, liability rules do create an incentive for parties to take care to generate the socially optimal level of safety and, to a lesser extent, of pollution. This, however, is conditioned upon the proper functioning of the market system and upon individual autonomy, both of which have their own limitations as explained below. These limitations may make out a prima facie case for some sort of collective intervention to remedy the problems and to maximise social welfare. We thus examine social regulation of product safety/quality, professional services (e.g. pilot's service, airport and ATC services) and the environment, which is conducted ostensibly in the public interest. We also consider economic regulation of the monopolistic pricing of airport and ATC services.

7.1 Market Failure, Private Law Failure, and Regulation in the Public Interest

Precisely what is meant by the public interest is not easy to define and is subject to variation depending on the specific values and preferences held by a particular society. Nevertheless, in the context of carriage by air, the public interest will be better served by providing a maximum possible degree of safety in, and minimum restriction on, civil aviation and by ensuring the availability of adequate and efficient services. Such services should be responsive to the interests of consumers of various carriage by air services (public needs) and be provided under market competition, the main virtues of which can be found in its role as a mechanism promoting efficiency and innovation.

7.1.1 Market failure and private law failure: Tort liability (and market insurance) is not without its drawbacks emanating from market failures _ externalities (spillovers), information deficits and imperfect competition _ that are so basic and costly as to justify certain regulatory intervention. Liability in tort for defective products or negligent

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258 Ogus, 26; Vickers & Yarrow, 27; Breyer, 15.
260 49 USC Appd s 1302(a)(1)-(12) (1988); ch 6: 1.1.1 below.
261 Airports Act 1986, s 39(2)(a)-(d); ch 5: 4.1.2 below.
262 Vickers & Yarrow 45. 51 & 67.
263 E.g. problems of adverse selection, insurance coverage disputes and subrogation claims. See P S Menell, The Limitations of Legal Institutions for Addressing Environmental Risks, 5 J Econ Pers (1991) 93, 101 & 103; Asch, 58; sec 6.3.3 above; Ogus. 49.
264 S Breyer, Regulation and Deregulation in the United States: Airlines, Telecommunications and Antitrust, in G Majone (ed), Deregulation or Re-regulation?, 7, 10-11; id, Analyzing Regulatory Failure:
professional services provides a good example. Even in the presence of damage, it would not be easy for a victim to furnish adequate evidence on the existence of a defect or negligence, which is essential to the success of his claim. Information deficits affect the decisions of not only passengers but courts as well in most of accident situations. Given highly technical safety features of aircraft or high technicalities involved in ATC service, courts will be constrained in determination of defect or negligence. The adversarial nature of court proceedings will also act as constraints on the information otherwise available or accessible to courts. Tort liability is particularly ineffective in a public interest situation involving pollution.

Furthermore, private law remedies are plagued by high transaction (under property rules) or administrative costs associated with litigation, collective valuation of actual losses and its enforcement (under liability rules). The problem of high costs incurred under liability rules will be aggravated where there are involved high technicalities and complicated issues of causal link between defect or negligence and resulting harm as in the operation, design or manufacture of aircraft and in the provision of ATC services. The same can be said of pollution. Again, apart from the general delay in litigation proceedings, a large share of the compensation payable are paid as legal expenses in the adversarial process of the tort system. Nor will tort law's sanction adequately induce the managers of a firm to take optimal care where the possibility of incurring the sanction is very low and yet its amount very high. These constraints on the proper functioning of tort liability often deny victims access to court-enforced justice. Tort liability has thus a limited role to play in the control of product safety and pollution caused by a public firm operating under natural monopolies.

7.1.2 Information deficits and bounded rationality: Since information deficits constitute one of the main causes of market failure, provision of adequate information is essential to the market model. Information is costly to produce and supply, and perfect or complete

Mismatches, Less Restrictive Alternatives, and Reform, 92 Harv LR (1979) 547, 552-60; id, 23 & 26; J Kay & J Vickers, n.259 above, 225ff; Asch, 43; Ogus, 29.
265 Ogus, 28.
266 Sec 7.2.2 below.
268 Ch 3: 3 below.
269 See Ogus, 28.
270 P S Menell, n.263 above. 100-01; P Danzon, Medical Malpractice: Theory, Evidence, and Public Policy (Harv UP 1985).
271 See sec 8.1.4 below.
272 R Hirshhorn, Regulating Quality in Product Markets. in D N Dewees (ed), The Regulation of Quality, 55, 61; sec 7.2.3, ch 3: 2.4 below.
273 Generally, A I Ogus, Limits of Liability for Compensation, in M Furmston (ed), The Law of Tort 211; sec 7.2.2 & ch 5: 2.3.4 below.
274 Sec 7.2.4 & ch 5: 4.1.2 below.
information is no more attainable than zero risk. The relevant question is therefore not whether information markets yield perfection but rather whether they provide tolerably efficient outcomes or whether the information supplied by the unregulated market is prone to produce sub-optimal results. Rational passengers will react to what is perceived as 'inadequate' information by searching more and will continue to do so up to a point where the marginal costs of searching exceed its marginal benefits. If information markets allow consumers to search out appropriate information, public intervention would not be necessary; only where markets produce and distribute a sub-optimal level of information, there may be a justification for intervention. Nevertheless, there is in reality always the problem of information asymmetries between consumers and producers.

In addition to the problem of information deficits, there are also constraints on the assumption of rational choice of individuals. Many economists now accept that individuals may not always act rationally in the sense of economic efficiency (bounded rationality). Some individuals are unable to assess the risk properly and are liable to overestimate or underestimate the risk involved. Nor should rationality be identified with omniscience or superior analytical powers; hence the adoption of compulsory insurance or legal compulsion of seat belt use. As such, given the constraints on the proposition of regarding individuals as the most competent judge of their own welfare (human failure), there must be some room for regulatory interventions replacing individuals' own decisions for their protection from product and environmental risks. In a related but somewhat different problem is that individually rational private behaviour may produce collective or public irrationality. This problem, referred to as the collective action problem, is the case with public goods such as clean air (sec 7.2.2 below).

7.1.3 Monopoly: Competition is a crucial assumption and premise of the market model formulated on productive and allocative efficiency. But in certain industries, technical conditions and investment costs are such that it is more economical to allow a single firm

276. Ibid.
277. Ogus, 40.
279. Asch, 50.
280. Ogus, 190; Asch, 53.
281. Sunstein, 53; Ogus, 38 & 152; Asch, 54-55.
282. Asch, 43.
283. Ogus, 38, 49-50 & 152; ch 4: 2.4 below.
284. Asch, 78; Sunstein, 51.
285. Asch, 150.
rather than many to produce and supply the goods or services in question.\textsuperscript{288} In a competitive market, firms will expand output to the point where price equals incremental cost, i.e. the cost of producing an additional unit of their product.\textsuperscript{289} By contrast, a monopolist tends to raise the prices of his products higher than competitive prices. Although higher prices mean less demands, the monopolist, if unregulated, willingly curtails production and sales to the extent that he can more than recoup the lost revenue from reduced sales by raising the prices on the units being sold.\textsuperscript{290} Monopolists may thus lack an adequate incentive to keep production costs at lowest possible levels.\textsuperscript{291} Where competition is seriously impaired by monopoly power, there will be allocative inefficiency and there may be a prima facie justification for regulatory intervention for the redress of market failure.

7.1.4 Distributional goals: The economic criteria and goals of productive and allocative efficiency are centred around the maximisation of social welfare and as such are not so much concerned with how that welfare is distributed between different members or groups within society.\textsuperscript{292} And it is generally accepted by many, regardless of their ideology, that society needs to guarantee, by constitutional means or by regulatory intervention if necessary, minimum individual rights to public health and safety for the protection of human development and dignity and a decent standard of living.\textsuperscript{293} This is partly because individual workers may compete with each other to their collective harm.\textsuperscript{294} Certainly, liability rules affect the post-injury wealth of individuals and can be used to promote distributional goals,\textsuperscript{295} since, for example, an entitlement to make noise and pollute will make the airport operator (and passengers and taxpayers) better off at the expense of airport residents.\textsuperscript{296} Nevertheless, modern tort liability, which is targeted mainly on those who can better distribute the loss within the society (enterprise liability) through market insurance or the price mechanism of the market,\textsuperscript{297} has its own limitations, as already seen in the problems of market and private law failure.\textsuperscript{298} Nor does the market favour or discriminate against a particular class of people to guarantee a just distribution of wealth.

\textsuperscript{288} M Friedman, Capitalism and Freedom, 128.
\textsuperscript{289} Breyer, 15.
\textsuperscript{290} Posner, 253; Breyer, 15-16; Ogus, 23.
\textsuperscript{291} Breyer, 16.
\textsuperscript{292} Ogus, 46.
\textsuperscript{293} A I Ogus. n.273 above, 215: \textit{id}, 47 & 50-51.
\textsuperscript{294} Sunstein, 55.
\textsuperscript{296} Breyer, 176-77; Ogus, 48; ch 5: 4.2 below.
\textsuperscript{297} Sec 5.1.5 above.
\textsuperscript{298} Ogus, 49; sec 7.1.1 above.
7.2 Social and Economic Regulation

Where market failure is accompanied by private law failure as described above, there is a prima facie, though not a conclusive, case for regulatory intervention in the public interest.299

7.2.1 Regulation for public interest grounds: Regulation for public interest grounds may be justified in terms of economic and non-economic (distributional)300 goals. Economic goals have been suggested because important goals of an organisation, public or private, are allocative301 and productive302 efficiency, although allocative efficiency should not be regarded as the exclusive and overriding goal for public corporations.303 Social regulation deals with a huge spectrum of activities ranging from information deficits, health and safety to environmental and consumer protection. It may be conducted directly by the regulatory agency (typically through standard-setting) or by delegation to the private sector.304 Most of social regulation is underpinned by criminal law in the sense that failure to comply with such a coercive command may trigger penal sanctions upon conviction of a regulatory offence (hence command-and-control regulation).305

7.2.2 Justifications for social regulation of environmental risk: Pollution damage is characterised by such a large amount of damage thinly spread over large numbers that only a small loss is imposed on each individual right-holder.306 Here, it is obvious that liability rules are not a proper legal device for channelling so many small claims. Since the harmful effects are diffuse and scattered, the costs to any one victim of bringing an action on his own for recovery of a small loss will exceed the benefits or will at least be very high relative to the compensation payable.307 If individual claims were not worth bringing, no action would follow even if the victims' aggregate benefits exceeded the total costs accruing to the polluters.308 This, coupled with difficulties in the establishment of causal link between pollution and harm, will deter afflicted parties with legitimate claims from pursuing the polluter even if they were successful in their actions and were fully

300. Sec 7.1.4 above.
301. I.e. satisfaction of consumer needs as indicated in voluntary transactions at mutually agreed prices reflecting the costs of production or provision. See sec 2.2.1 above.
303. Ogus, 281.
304. Sec 8.2.3 below in the context of certification and licensing.
305. Ogus, 79.
307. Ogus, ibid; ch 5: 2.3.4 below.
308. See Calabresi, Some Thoughts, at 535 & 541; Posner, 46-47.
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compensated for their losses. The usual time lag between exposure to pollution and any occurrence of health problems or diseases causes further difficulties for victims to discharge their burden of proof.

Accordingly, each individual victim would lack sufficient financial incentives to act collectively by co-ordinating an effective group action through the conduit of someone willing and able to pursue an appropriate remedy (free-rider problem). As a result, many pollution victims with legitimate claims will, quite rationally, forego any legal action against the airport operator who would thus have no incentive to reduce pollution. Even if all the victims did sue the operator to hold him liable, the costs of bringing so many diffuse claims plus the court's administrative costs of assessing the respective damages would far outweigh the benefits derived from inducing the airport operator to abate pollution. This is akin to a public interest situation involving public goods (e.g. clean air) in which tort liability would have little impact on optimal risk reduction. Although these externalities and resource misallocations may be mitigated by allowing class actions, the true social cost of pollution will not be fully internalised into the market prices of airport services under liability rules. In this case, there can be an argument for complementing a private right with a public target standard.

7.2.3 Justifications for social regulation of product and service quality and safety: Given information asymmetries between producers and purchasers or consumers, product safety regulation can be defended primarily because it will be conducive to raising quality standards. A design or manufacturing defect in an aircraft is quite difficult for the court to identify because of high technicalities involved. In the absence of regulation, a poor-quality aircraft may inflict damage on third parties (passengers and people on the surface)
and the consequences of poor-quality aircraft may not always be borne by its manufacturer because of the limitations of liability rules.\footnote{Asch, 46; Ogus, 190.} Although tort liability for defective products has recently been strengthened,\footnote{R A Epstein, Products Liability Litigation: The Gathering Storm, 1 Regulation (1977) 15-20; \textit{id}, Modern Products Liability Law (Westport: Greenwood Press 1980); Asch, 138.} civil liability or other private law remedies cannot be a satisfactory answer to the problem. Liability arises only where a 'defect' in the product, i.e. aircraft in our context, causes damage to passengers, which means that poor quality as such is not covered under liability rules.\footnote{Ogus, 190.} In addition, liability rules involve difficulties for plaintiff to establish causal link between a defect and resulting damage\footnote{See ch 3: 2.5.3 below.} and difficulties with determining the duration of the post-sale duty to warn of latent danger.\footnote{Asch 57.}

Obviously, if passengers were fully informed of different characteristics of aircraft and were always to act rationally in accordance with their preferences, no regulatory intervention would be required or justified. But this will not always be the case with the carriage by air products. An aircraft is a sophisticated product whose quality and performance can only be ascertained through use for a considerable period ('experience' goods).\footnote{Ogus, 190 & ch 3: 3.1 below.} And information as to the quality of technologically complex aircraft ('experience' goods) or of such highly technical and professional services as air traffic control will be more costly to supply and process than information as to price.\footnote{Ogus, 132-33 & 190; Asch. 48 n.31.} Passengers with insufficient information on the risks caused during an international carriage by air will not be led in their decisions to buy the efficient amount of air travel.\footnote{Asch 48; Ogus, 41.} This is because passengers poorly informed of product or ATC risks will be constrained in their capacity to express their appropriate demands for air travel or for insurance.\footnote{See C G Veljanovski, The Employment and Safety Effects of Employers' Liability, 29 Scot J Pol Econ (1982) 256; Ogus & Veljanovski, 132 n.3.}

\subsection*{7.2.4 Economic regulation:}

At the other extreme from social regulation is an economic theory of regulation according to which regulation, as a rule, is a response to the demands of, and is designed and operated primarily for the benefit of, interest groups representing producers within an industry who will benefit therefrom.\footnote{Asch 57.} Economic regulation is mainly concerned with \textit{natural monopolies} (regulation of prices, profits, output and quality) which refer to a situation where it is cheaper to society for one firm, rather than several or
many, to undertake production in that industry. A natural monopolist such as the airport operator or the ATC agency can increase its profits by reducing output and charging higher than competitive prices. Despite the undesirable consequences arising under natural monopolies that goods or services tend to be overpriced and underproduced relative to their true social value, the remedy lies not in competition but in some form of economic regulation. Economic regulation thus aims to control the monopolist's dominant market power and to induce it to provide services at somewhat competitive prices by means of profit control, entry control and control over price structure. 

7.3 Forms of Social Regulation and Their Constraints

Depending on the extent of public controls on freedom of activity, social regulation can be divided into three types: information (as to quality or price) regulation (low intervention) including certification, (quality) standards regimes (medium intervention), and prior approval (high intervention) such as licensing of professional occupation (flight crews, air traffic controllers, air operators and maintenance engineers, etc.).

7.3.1 Information regulation and its problems: Information regulation usually takes the form of disclosure of certain information which neither restricts individual choice nor regulates output, price, or production processes, etc. Most of safety and environmental regulation are designed to protect people against unreasonable risk and understood as a public response to the absence of information. Manufacturers of quality products or services have an incentive to provide voluntarily, through advertisements, buyers and consumers with information as to their quality or even dangers. Market competition may also force them to do so about positive qualities of their products but not about negative ones. Nevertheless, if the problem is about the insufficient amount of information, requiring disclosure of appropriate information as to the risk (and thus quality) of products (e.g. through notice or warning of dangers inherent in them) will help alleviate the problem

330. Ogus, 30-3 & 267; Kahn, II: ch 4. For a sceptical view of the validity of this argument, see Vickers & Yarrow, 108-09.
332. S Breyer, Regulation and Deregulation in the United States, n.264 above, 10.
333. Ogus. 30.
334. Sunstein, 48.
335. Posner. 254.
336. Ogus. 150.
337. See sec 8.1 below for regulation through certification and licensing.
339. Sunstein, 53.
340. Asch, 52; Ogus. 137.
341. Ogus, 40-41.
of consumers' information deficits, improve allocative efficiency and their welfare. Greater reliance on disclosure rather than government specification of appropriate risk levels will also protect high quality products from being forced to disappear from the market.\textsuperscript{342}

At the same time certain constraints on information regulation must be stated. Most claims to high quality can only be expressed in subjective or non-verifiable language which will inevitably constrain rational consumer choice.\textsuperscript{343} Unless information is communicated to consumers in a simple, assimilable form, information regulation will not effectively redress market failure.\textsuperscript{344} Even mandatory disclosure may not greatly help the people unable to assimilate information as to the highly technical features of aircraft.\textsuperscript{345} Disclosure may also prove problematic given consumers' general attitude towards low-probability events.\textsuperscript{346} Consumers tend to overestimate risks of low-probability events and underestimate risks of higher-probability events.\textsuperscript{347} This limitation on human ability to perceive and assess risk accurately, referred to as bounded rationality or human failure,\textsuperscript{348} will constrain rational consumer choice. Thus, if the rub is the poor capacity of consumers to process information in a way maximising their own utility, producing more information which they are unable to interpret properly will prove futile.\textsuperscript{349}

7.3.2 Standards regimes in general: The principal economic justification for standards regimes applicable to both product safety and environmental regulation is that they can rectify market failure arising from externalities.\textsuperscript{350} Setting product safety standards will assist consumers in their correct choice and increase their welfare, but the improvement may also incur a loss by restricting the choice of risk-neutral or risk-preferring consumers.\textsuperscript{351} The most important factors affecting the correct choice of different standards are the costs of being informed of the technological means of achieving the regulatory goals and the administrative costs of devising appropriate standards and monitoring compliance.\textsuperscript{352} Standards regimes are divided, depending on the degrees of intervention, into target, performance and specification standards.\textsuperscript{353} Target standards which render unlawful the causing of certain harms (e.g. nuisances) are generally regarded

\textsuperscript{343} Ogus, 38, 41 & 137.
\textsuperscript{344} Breyer, 161 & 163.
\textsuperscript{345} Asch 48.
\textsuperscript{346} Sunstein, 53.
\textsuperscript{347} Asch, 76-78; Stapleton, 113; Ogus, 152 & 190.
\textsuperscript{348} Asch, 53 & 150; Ogus, 41; sec 7.1.2 above.
\textsuperscript{349} Breyer, 175; Asch, 54 : Ogus, 38.
\textsuperscript{350} Ogus, 152.
\textsuperscript{351} Asch, 54.
\textsuperscript{352} Ogus, 166; Breyer, 105-06.
\textsuperscript{353} Ogus, 151 & 208-10.
as the most cost-effective option of the three, since they are easy to formulate and allow firms to choose freely the cheapest means of avoiding the prohibited consequence. Performance standards are more costly to formulate than target standards, since the standard-setter is required to relate different levels in the quality of performance to the regulatory objectives. On the other hand, performance standards will incur less enforcement costs than target standards, since the regulator can monitor compliance at the firm's place of business and causation issues rarely arise.

As to the relative efficiency of a performance and a specification (design) standard, the former is generally regarded as more cost-effective. A performance standard permits flexibility and change, since it writes the obligations of firms to be fulfilled in terms of ultimate regulatory goals and the firms are free to achieve those goals in a method of their choice. However, determining an appropriate sanction for violation of a performance standard is difficult because of the 'deterrence gap'. Specification standards may have advantages over performance standards in administrative costs involving monitoring and prediction of compliance costs, but the prohibition of inputs other than the specified under specification standards would create little incentives for firms to develop cheaper and better technology. Indeed, they may stifle technological innovation by firms towards developing cheaper means of satisfying regulatory goals, and the time lag needed to reflect technological changes in the standards will make the existing standards obsolete rapidly.

7.3.3 Problems of standards-setting: In an ideal world of rational policy- or rule-making, a regulator delegated with statutory authority will first identify the adverse effect, such as pollution, he seeks to regulate, use a preliminary cost-benefit analysis to achieve the great improvement at a lowest cost in the specific part of the problem, then obtain relevant information, design a final standard, enforce it, and finally monitor and evaluate the standard's effectiveness for possible revision. This, however, grossly ignores the actual standard-setting process where various pressures from the industry members (e.g. obstruction of the agency's access to the information available to them, threat of political retaliation or legal action, and false arguments that the proposed standard would increase

354 Ogus, 166 & 205.
355 Ogus, 166-67.
356 Ogus, 167.
358 Breyer, 105.
359 Ogus, 93 & 167.
360 Ogus, 167 & n.73.
361 Breyer, 105.
362 Ogus, 167-68 & 200.
363 Breyer, 98.
costs or cause job losses) and from consumer groups act as constraints on the rational standard. The regulatory agency also has to choose between greater control and involvement through detailed regulations and administrative simplicity and greater flexibility through a more general rule.

More importantly, the specific goal of regulatory standards should be distinguished from the general aims of public intervention designed to remedy information deficits and externalities, and should, in principle, be targeted on the social benefits of a given standard exceeding its costs. And given that the state of zero risk is neither desirable because of prohibitive costs nor possible because of human failure, etc., regulatory policy-making will inevitably involve some form of cost-benefit analysis. Regulatory standards should, in theory, be set at a level where they can yield the greatest amount of total benefits minus total costs and where the marginal benefits equal the marginal costs (the goal of optimal loss abatement). However, such a 'rational' assessment (especially valuation of the benefits of standards) would be particularly difficult because it involves a cost-benefit calculation of various factors and assumptions in the absence of regulation. This is not to speak of difficulties with obtaining data and of the costs involved in evaluation.

Even the discovery of a violation marks only the beginning of administrative or penal sanctions in court proceedings, not to speak of the agency's burden of proving a violation and of defending the validity of the standard. Upon detection of a violation, the firm may attempt to bargain for reduced penalty by means of a threat of a legal action. Given these constraints of standards regimes, the regulatory agency may have to rely on voluntary compliance of the standard from the industry. Moreover, the standard formulated can have various anticompetitive effects of favouring existing firms and setting up entry barriers for new entrants or of freezing technological innovation. A rational analysis may also reflect distributional preferences of the regulator. The formulation of the final standard is thus described as a process of persuasion and negotiation, rather than

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365. Breyer, 104.
367. Ogus, ibid.
368. Ogus, ibid.
369. Baldwin & Veljanovski, n.357 above, 54-55; Asch, 116; Sunstein, 75-76.
371. Breyer, 267-68.
373. Breyer, 94.
375. Ogus, 159-61.
command and confrontation, for voluntary compliance, thus sacrificing and deviating from the rational standard and catering to political expediency.\textsuperscript{376}

7.4 Regulatory Failure and Joint Use of Civil Liability and Regulation

One of the underlying assumptions of regulation is that government may be better suited to the task of promoting the public interest goal than traditional legal controls on individuals and firms transacting on the market.\textsuperscript{377} However, just as the unregulated market fails to work perfectly and to satisfy economic and distributional goals (market and private law failure), so do limitations exist on the regulatory rule- or decision-making (regulatory failure)\textsuperscript{378} for the following reasons.

7.4.1 Information asymmetry between producers and regulators: The basic constraints on regulation stem from the fact that regulators are not better informed than the firm's owners and managers about the conditions of the industry regulated and that they cannot monitor their behaviour precisely.\textsuperscript{379} Accurate and relevant information required by the agency may be obtainable only from the regulated producers who may threaten it with costly, time-consuming appeals, should it fail to be co-operative.\textsuperscript{380} Managers of a firm may also have an incentive for strategic behaviour designed to influence regulatory review which will incur productive and allocative inefficiency,\textsuperscript{381} while producer groups with better resources and organisation may attempt to influence the regulator in such a way as to prevent new entries into the industry.\textsuperscript{382} The result is the alleged capture of regulators which occurs where the public interest is equated with the interests of the industry.\textsuperscript{383} There is even the possibility of collusion between the regulator and firms.\textsuperscript{384} In addition, there is the problem of regulatory lag, since standards are typically set for a period of time, and a review designed to reflect any change may not occur until before a specified time.\textsuperscript{385}

7.4.2 Accountability of regulators and the principal-agent problem: The institution of regulation necessarily gives rise to the problem of accountability, notably financial accountability of regulators, which arises from the principal-agent relationship and results

\textsuperscript{376} Breyer, 107-08; Ogus, 97 & 206.
\textsuperscript{377} See Vickers & Yarrow, 27.
\textsuperscript{378} Ogus, 11 & 54-55.
\textsuperscript{379} Vickers & Yarrow, 99.
\textsuperscript{380} Kay & Vickers, n.259 above, 232; Ogus, 58; Asch, 116; Breyer, 102-03.
\textsuperscript{381} Vickers & Yarrow, 87.
\textsuperscript{382} Vickers & Yarrow, 108.
\textsuperscript{384} Vickers & Yarrow, 107.
\textsuperscript{385} Breyer, 48; Vickers & Yarrow, 85.
from a divergence in objectives between the owners or principals of the regulatory agency
(politicians and citizens) and regulators.\textsuperscript{386} Since regulators (agents) possess higher
expertise than their principals who employed them, they may in the performance of tasks
exercise their discretion to pursue not the public interest but their own interests. Regulators,
unless constrained properly, also tend not to be so much interested as the
managers of private firms in minimising administrative costs (productive efficiency) and
allocating resources to their best use.\textsuperscript{387} In private transactions, any problem of financial
accountability of the managers of a private firm can be mitigated by market competition
and legal constraints such as contractual terms, fiduciary duties and tort remedies,\textsuperscript{388} but in
a public institutional setting there are no comparable legal restraints. There exists no
homogeneous group of principals interested in monitoring regulators' performance, nor is
monitoring of their performance easy.\textsuperscript{389} This may cause instability and unpredictability of
regulatory performance.

7.4.3 Constraints on the cost-benefit and command-and-control approach to regulation:
Although many regulatory statutes, e.g. health and safety legislation and partly anti-
pollution legislation, have been enacted to address efficiency directly, not all regulatory
statutes aim to promote it.\textsuperscript{390} And it has been argued that British governments have
traditionally placed a less prominent role and place on regulation than US governments;\textsuperscript{391}
that English judges were reluctant to examine economic factors;\textsuperscript{392} and that radical
institutional changes in judicial and civil service attitudes as well as in the nature of rule-
making must be introduced in order for a cost-benefit approach to regulation to work in an
open and accountable fashion.\textsuperscript{393} The traditional coercive, confrontational command-and-
control approach may also backfire and cause implementation failure, if the industry
resorts to strategic behaviour and fails to co-operate and comply with it.\textsuperscript{394} Regulation
should thus be directed from the traditional command-and-control approach as embodied,
e.g. in specification standards and rigid technological directives for pollution control
equipment, to more flexible, market-oriented and incentive-based target standards or
economic instruments.\textsuperscript{395}

\textsuperscript{386} Kay & Vickers, n.259 above, 231-32; Ogus, 111.
\textsuperscript{387} Ogus, 111.
\textsuperscript{388} Ogus, 17-18.
\textsuperscript{389} Ogus, 112.
\textsuperscript{390} C R Sunstein, Cost-benefit and the Separation of Power, 23 Ariz LR (1981) 1267, 1274-75; Baldwin
& Veljanovski, n.357 above, 58.
\textsuperscript{391} Baldwin & Veljanovski, \textit{ibid}, 61.
\textsuperscript{392} See e.g. Bromley v. GLC, [1982] 1 All ER 129; Baldwin & Veljanovski, \textit{ibid}, 62; Ogus, 274.
\textsuperscript{393} Baldwin & Veljanovski, \textit{ibid}, 64 & 67.
\textsuperscript{394} Sunstein 97 & 103.
\textsuperscript{395} Sunstein, 87 & 109.
7.4.4 Joint use of civil liability and regulation: As we have seen, liability rules enforced by courts have proved inadequate to control effectively the problems of pollution, poor quality in products and professional services and natural monopolies. In these areas of the law, since aggrieved parties are, to a considerable extent, denied access to the court, some form of regulatory intervention will fill in the gap. But even if safety regulation is generally regarded as preferable to a purely private system of risk/safety decisions in view of market and private law failure, it is never an easy task and is quite another matter to design the appropriate mode and level of intervention. At the same time, regulatory intervention is not without its constraints; hence allegations of regulatory failure. Nor is regulation without costs such as administrative costs (costs of formulating standards and those of enforcement and monitoring) and compliance costs. These constraints of both private law instruments and regulation partly explain why no civilised society has ever relied exclusively on a system of private law general principles, emanating from judicial decisions or statutes.

8. Economic Approach to Regulatory Risks

Since we considered regulation in general in the previous section, we now examine regulation of aviation safety through certification of aircraft and equipment and through licensing of professional skills and services. One of these regulations relates to compliance of aircraft design with relevant safety standards relating, e.g. to an airworthiness or type certificate prescribed by the regulatory body. The questions here are whether certification and licensing by the regulatory body are economically justified (sec 8.1) and whether it should be held liable for the consequences of the negligent discharge of its regulatory functions (sec 8.2).

8.1 Certification and Licensing and Optimal Deterrence

8.1.1 The notion of certification: Certification of airworthiness, aircraft, aircraft emissions or validation has dual attributes: information regulation and prior approval

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396 Breyer, 177.
397 Breyer, ibid.
398 Asch, 48, 141 & 148-49.
399 Ogus, 54-56 & 309; Breyer, 25.
400 Baldwin & Veljanovski, n.357 above, 54; Ogus, 155; Breyer, 98.
403 We are therefore not concerned here with professional regulation by a private self-regulatory agency. See Ogus. 107ff.
equivalent to licensing. As a means of avoiding market failure arising from information deficits, a system of registration or certification requires applicants to satisfy certain minimum standards of quality of a product or service. A certification system does not control the conduct of actors, but simply provides information, leaving passengers with the freedom of choice. Certification thus functions to remedy information deficits just as licensing does, and yet it still retains the additional advantage of freedom of rational choice. Certification should thus be distinguished, at least in theory, from a licensing regime which prohibits those without a license from practising the given trade or profession. One potential constraint on a certification regime relates to how the information disclosed as such can effectively be communicated to individual passengers who have no direct contact with the certifying authorities.

8.1.2 The notion of licensing: Licensing or prior approval of professional occupations (e.g. licensing of flight crews, air traffic controllers, air operators and maintenance engineers) means a regulatory technique whereby the applicant for a license or permit is required to satisfy certain minimum and uniform quality standards to qualify for a license or permit enabling him to practise in the given trade. Under a licensing system, the sanction against those applicants failing to meet the specified minimum qualifications is severe prohibition from practising the given profession. The ostensible purpose of licensing is thus to ensure that all practitioners competing in the market will satisfy and maintain certain required minimum standards in the provision of the given services and to prevent ex ante the occurrence of what is regarded as socially undesirable consequences. As such, licensing is not, in principle, to limit competition, although in practice it sometimes has the de facto effect of creating barriers for prospective entrants and thus limiting competition.

Certification may effectively turn into de facto licensing where there is little market demand for uncertified products or services. It is indeed inconceivable that an air operator will purchase an aircraft not duly certified to put it into service, given the high risk involved and the sanctions that may be incurred. More importantly, since no aircraft is

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404. For certification and licensing regime in general, see M Trebilcock, Regulating Service Quality in Professional Markets, in D N Dewees (ed), The Regulation of Quality, 83, 92ff; Ogus, 215.
405. Ogus, 124, 38-41 & 152.
406. Ogus, 217.
407. See Ogus, 122 & 152.
408. Ogus, 214.
410. Ogus, 318.
411. Ogus, 215 & 221.
allowed to fly without a valid certificate of airworthiness, certification of aircraft should be seen as de facto licensing of aircraft. A possible distinction between certification and licensing may be found in different subject-matters each aims to regulate. Certification usually relates to minimum technical standards required for aircraft or equipment to satisfy in inspections, tests or experiments. Licensing, on the other hand, is mainly concerned with certain minimum professional qualifications to be met by relevant persons, whether natural or artificial. Such qualifications include professional skills, experience or knowledge for prospective practitioners to satisfy (e.g. successful completion of training courses, or passing of examinations including medical check-ups).

8.1.3 Justifications for licensing in the public interest: In order to justify on public interest grounds licensing representing high intervention in the market, it should be demonstrated that private law remedies and other less restrictive regulatory techniques are not effective enough to induce relevant parties to take optimal care to reduce risk or to minimise externalities. Indeed, licensing, unlike certification, shifts to the authorising agency information costs relating to the quality of skills and expertise required of flight crews, air traffic controllers, air operators, etc. and reduces the risk of passengers making faulty decisions on poor-quality products. Given the technical complexities of aircraft and the technical expertise required for its operation, it would be virtually impossible for passengers to identify sub-standard aircraft.

A second public interest justification for licensing is found in the fact that use of an aircraft or provision of air traffic control service may cause externalities. A poor-quality aircraft or poor air traffic control service may cause damage to third parties, i.e. passengers and people on the ground. Even the adverse publicity resulting from a disastrous accident and the consequent need for restoration of public confidence may be

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412. Sec 8.1.5 below.
413. For this reason, it is not surprising that one writer refers to the granting of product license, not product certificate, in relation to aircraft. See Ogus, 234.
414. E.g. certificate of airworthiness, certificate of validation, noise certificate, aircraft certificate or aircraft engine emissions certificate, with the possible exception of e.g. air operator's certificate. For minimum uniform criteria for certifying airports, see 49 USC Appd s 2204(d)(4) (1988).
415. E.g. licensing of air operators, flight crews or air traffic controllers, maintenance engineers and the operator's operating or route licence. See ICAO, Definitions.
416. T Moore, The Purpose of Licensing, 4 J L & Econ (1961) 93, 103ff; M Friedman, Capitalism and Freedom, 144-49.
417. This does not necessarily mean that licensing does not serve the private interest of the licensed. Ogus, 219. For the notion of the public interest, sec 7.1 above.
418. Ch 1: 7.3 above.
419. Ogus, 28, 218 & 228.
420. Ogus, 234-35.
421. Ogus, 234.
regarded as a form of externalities under tort liability,\textsuperscript{422} since such hidden costs are not usually reflected in the price of aircraft or ATC service. A third factor justifying licensing is the time lag between the marketing of aircraft and the occurrence of harm,\textsuperscript{423} which will reduce the effectiveness of other regulatory techniques such as standards regimes.\textsuperscript{424} Standards regimes may be a less effective solution to poor-quality professional services than a licensing system where the latter can relatively easily and cheaply exclude \textit{ex ante} manifest incompetence that may cause high social costs.\textsuperscript{425} Finally, the licensing system has an advantage of reducing substantially enforcement costs of apprehending the offender and establishing the link between the licensed activity and crime.\textsuperscript{426}

8.1.4 Certification/licensing and optimal deterrence: Certification or licensing is regarded as a device for securing the safety and welfare of the flying public as a class (public interest). For example, in the absence of any regulatory control on the minimum quality of aircraft, there is greater possibility of a sub-standard (i.e. defectively designed or manufactured) aircraft being commissioned into service. This means that passengers will be deprived of the chance to make a rational choice of aircraft in the absence of any information provided through certification on the performance of a particular aircraft. By setting out minimum standards and qualifications of entry or practice, regulation through certification and licensing controls possible unfair, fraudulent or deceptive practices, responds to the needs of the public and thus protects the general public from poor, unsafe or improper services.\textsuperscript{427} And if licensing has the effect of limiting competition, some corrective steps imposing little restriction may be devised.\textsuperscript{428}

Under a system of certification or licensing, prospective entrants as well as existing practitioners will be forced to stick to the regulatory requirements and to maintain a certain standard of quality or service through the continuing pressure of regulatory (e.g. suspension or revocation\textsuperscript{429} of certificates or licences for violation of, or non-compliance with, the safety or registration\textsuperscript{430} requirements) sanctions. Under a certification or licensing regime, the threat of a certificate or license being suspended or revoked may create a more effective incentive for the certified or licensed to reduce risk than a

\begin{footnotesize}
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\item\textsuperscript{422} Ogus, \textit{ibid}.
\item\textsuperscript{423} Ch 3: 2.5.3 & 3.1.5 below.
\item\textsuperscript{424} Ogus, 234.
\item\textsuperscript{425} Ogus, 218.
\item\textsuperscript{426} Ogus, 229.
\item\textsuperscript{427} 49 USC Appd s 1302(a)(5) & (7) (1988); Kahn, II-114 n.2, I/20-21 & I-2.
\item\textsuperscript{428} \textit{Civil Aviation Act 1982}, s 68(1)-(2): 49 USC Appd s 1302(a)(7) (1988).
\end{enumerate}
\end{footnotesize}
monetary sanction (civil liability) applied *ex post*.^31^ The only constraint is that these sanctions may not adequately induce a firm to take optimal care where the possibility of incurring the sanction is very low with its cost very high.^32^ This is because the managers of a firm may rationally decide to gamble on the tiny risk (revocation) materialising and may simply declare the firm insolvent should the risk does materialise.^33^

8.1.5 Certification and licensing under domestic laws:^34^ In English law regulation of civil aviation is effected to secure safety and efficiency.^35^ An aircraft shall not fly in or over the United Kingdom unless it is duly registered.^36^ No aircraft registered in the United Kingdom is allowed to fly for carriage for reward without a valid certificate of airworthiness and certificates of validation and maintenance review.^37^ The CAA is responsible for certifying (and renewing or validating) aircraft airworthiness,^38^ aircraft operators (air operator's certificate or licence),^39^ It is also charged to license air traffic controllers^40^ and aerodrome flight information service officers,^41^ maintenance engineers^42^ and flight crews.^43^ As the regulator of carriage for reward and as the supervisor of safety of air navigation, the CAA is empowered to grant or refuse to grant, make valid, renew, vary, suspend or revoke^44^ any of air transport-related licences or certificates.^45^ In carrying out its air transport licensing functions, it is under duty to ensure

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^31^ Ogus, 229.

^32^ Ogus, 228.

^33^ Ogus, ibid.

^34^ On the requirement of certification and licensing on the international level, see the *Chicago Convention 1944*, arts 29, 31-33 & 39-40 and Annex 8; Shawcross, V(14); Juglart, I(584)-(585).

^35^ *Civil Aviation Act 1982*, s 60(3)(h).


^37^ *Civil Aviation Act 1982*, s (60)(3)(b); *Air Navigation (No.2) Order 1995*, ibid, arts 8-10; Shawcross, V(15)-(17). If any part of the aircraft or its equipment has been overhauled, replaced or modified, a certificate of release to service must also be obtained.

^38^ *Civil Aviation Act 1982*, ss 64(1)(a); *Air Navigation (No.2) Order 1995*, art 6; Shawcross, IV(45) & (53). An 'operator' is a person who has the management and control of one or more aircraft. *Civil Aviation Act 1982*, ss 105(1) & 88(9); *Air Navigation Order 1989*, ibid, art 106(3).

^39^ *Civil Aviation Act 1982*, s 85; *Civil Aviation Act 1982*, s 21(c); *Air Navigation Order 1989*, ibid, art 20(1) & (7); Shawcross, IV(79).

^40^ *Civil Aviation Act 1982*, ss 60(3)(n) & (p), 66(2) & (3); *Air Navigation (No.2) Order 1995*, ibid, arts 71-72; *Air Navigation Order 1989*, ibid, art 70(1); *Civil Aviation Authority Regulations 1991*, SI 1991/1672, reg 6(4); Shawcross, V(15), III(14), III(58)-(59) & VI(24). For revocation and suspension of an operating licence and of an air transport licence, Shawcross, IV(58) & (63).
that British airlines compete effectively with other airlines serving on international routes and impose as little restriction as possible on the industry and services.\textsuperscript{446}

The CAA issues an aircraft with certificate of airworthiness after it has conducted necessary inspections, tests, experiments and flight trials and the aircraft has satisfied the standards of design, construction and maintenance.\textsuperscript{447} Certificates of maintenance review or of release to service may be issued by the CAA-authorised persons after an aircraft has been overhauled or repaired.\textsuperscript{448} Any person applying to the CAA for an air operator's certificate must be able to prove, on the basis of his past conduct and experience, his equipment, organisation, staffing, maintenance and other arrangements, that he is competent to operate his aircraft safely on the specified or intended flights.\textsuperscript{449} In the case of licensing, an applicant for a licence is required to prove his qualifications in terms of his knowledge, experience, competence and skill in aeronautical engineering, and physical and mental fitness by taking prescribed courses of training and undergoing examinations and tests including medical examinations (for maintenance engineers,\textsuperscript{450} flight crews\textsuperscript{451} and air traffic controllers\textsuperscript{452}).

The French \textit{Code de l'aviation civile 1967} has subjected commercial air transport to a regime of strict regulation\textsuperscript{453} which is characterised by prior authorisation of international air transport activities,\textsuperscript{454} technical control by the Minister of Civil Aviation to ensure safety,\textsuperscript{455} administrative approval of exploitation, conditions and tariffs of transport performed by aircraft exceeding a certain tonnage,\textsuperscript{456} and sanctions against infractions of the rules.\textsuperscript{457} A 1982 law on the direction of domestic transports also attempts to serve the public service objective of transport in general by providing: "[l]e système de transports intérieurs doit satisfaire les besoins des usagers dans les conditions économiques et sociales les plus avantageuses pour la collectivité".\textsuperscript{458}

Certificates are issued largely in two categories: certificate of airworthiness (\textit{certificat de navigabilité}: CdN) and certificate of limitation of nuisance (\textit{certificat de limitation de

\begin{footnotesize}
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\item \textsuperscript{446} Civil Aviation Act 1982, s68(1)-(2); Shawcross, IV(48).
\item \textsuperscript{447} Civil Aviation Act 1982, s85(1); Shawcross, V(15)-(16) & II(58)-(59) & V(16).
\item \textsuperscript{448} Air Navigation (No 2) Order 1995, \textit{ibid}, art 10; Shawcross, V(17)-(18).
\item \textsuperscript{449} \textit{Ibid}, art 6; Shawcross,IV(53).
\item \textsuperscript{450} \textit{Ibid}, art 13.
\item \textsuperscript{451} \textit{Ibid}, arts 21-22; Shawcross, IV(80).
\item \textsuperscript{452} \textit{Ibid}, art 81; Shawcross, V(24)
\item \textsuperscript{453} Juglart, I(465).
\item \textsuperscript{454} Code, art L.330-2.
\item \textsuperscript{455} \textit{Ibid}, art L.330-6.
\item \textsuperscript{456} \textit{Ibid}, art L.330-8; Juglart, I(352).
\item \textsuperscript{457} \textit{Ibid}, art L.330-9.
\item \textsuperscript{458} \textit{La loi d'orientation des transports intérieurs du 30 décembre 1982 (LOTI)}, art 1-1; Juglart, I(351).
\end{itemize}
\end{footnotesize}
The former includes type certificate of airworthiness (certificat de navigabilité de type), and licenses and certificates for flight crew (brevets, licenses et certificats de tous les membres de l’équipage). The certificate of airworthiness is an official document guaranteeing that the aircraft is fit for flight and consequently authorising it to engage in air navigation. No aircraft may be used for air traffic, unless it is provided with a valid certificate of navigation, it is fit for flight and its use is in conformity with the rules promulgated to ensure safety. Certificate of airworthiness may be renewed for an equal duration after inspection by the competent authority, and since the State has entrusted such a function to a company of authorised classification, le Bureau Véritas, the company therefore conducts corresponding controls on behalf of the State. Certificate of airworthiness may be suspended in certain cases, and use of aircraft without valid certificates will incur penal sanctions against the aircraft owner, the commercial operator and the pilot (e.g. fines and imprisonment).

In America a comprehensive regulatory scheme has been provided by the Federal Aviation Act 1958 and the Department of Transportation Act 1967 authorising the Secretary acting through the FAA Administrator to promulgate regulations and minimum standards designed to promote safe flight of civil aircraft. The Administrator is charged to prescribe such minimum standards required in the interest of public safety for appliances and for the design, material, workmanship, construction and performance of aircraft, aircraft engines and propellers. The Administrator is also under duty to prescribe, in the interest of safety, regulations and minimum standards governing inspection, servicing, and overhaul of aircraft, aircraft engines, propellers, and appliances.

In accordance with its function of regulating and promoting safety, the FAA issues air carrier operating certificates, airport operating certificates, airman certificates.
(flight crew including pilots, air traffic controllers, and aircraft mechanics and repairmen). The FAA also issues airworthiness, type and production certificates for aircraft, aircraft engine, propeller, or appliance specified in the regulations, upon tests of their design, manufacture and performance and upon their satisfaction of minimum standards.\(^{473}\) It is unlawful for any person to operate any civil aircraft without a valid airworthiness certificate, airman certificate or air carrier's operating certificate.\(^{474}\) The FAA may suspend, modify or revoke such certificates upon re-inspection, re-examination or re-investigation, if public safety so requires.\(^{475}\) The FAA also prescribes for licensing purposes a minimum level of equipment and services applicable to each class of airports.\(^{476}\)

### 8.2 Regulatory Activities and Discretionary Function Exception

In the previous section, we have shown that certification or licensing is designed to achieve minimum safety or quality standards and that its objective is basically to induce actors to take optimal care, even though various regulatory constraints involved may hamper the achievement of optimal deterrence in practice. In any case, do negligent regulatory activities give rise to a cause of action to victims or their relatives? In other words, should the regulatory body be subject to liability for the negligent discharge of its regulatory functions?

**8.2.1 Constraints on efficient regulatory activities due to lack of adequate information and expertise:** Obviously, the success or failure of regulatory activities will largely depend on accurate information, technical competence and expertise of certifying or licensing personnel.\(^{477}\) But regulatory bodies are usually operating under inadequate staffing because of financial constraint\(^{478}\) and under legal and administrative constraints on their mandate (e.g. subject to parliamentary scrutiny or judicial review).\(^{479}\) Because of this lack of information, resources and technical expertise, any regulatory body will have to rely on 'experiment and discretion' and learn from experience based on trial and error.\(^{480}\) The regulatory body thus turns to promulgation of minimum standards for entry and practice, conducts periodic inspections of compliance with the standards, issues orders for

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\(^{473}\) Ibid, s 1423(a)-(c); 49 USC s 44704 (1996); D W Madole, Improving Aircraft Type Certification, 17 Forum (1981-82) 627, 637.

\(^{474}\) Ibid, s 1430(1)-(4); J S Jodice, Airmen Certificates and Enforcement Procedures, 37 JALC (1971) 281.

\(^{475}\) Ibid, ss 1371(a) & 1429; 49 USC ss 44709-10 (1996); Juglart, I(562).

\(^{476}\) Ibid, s 1432 (1988); Juglart, I(806).

\(^{477}\) D W Madole, n. 473 above, 633 & 635; ch 1: 7.4.1 above.

\(^{478}\) Kahn, xxii.

\(^{479}\) Ibid, II/93.

correction, or simply delegates much of its functions to airlines and manufacturers, as explained below.

8.2.2 Incentives of imposing liability on regulators for regulatory risk: It is admitted that one of the purposes of a regulatory statute was to promote air travel safety; and that once the regulatory agency has decided to regulate the flight and repair and modifications of aircraft and licensing of pilots, etc., it becomes responsible for the care with which those activities are conducted. But these facts alone hardly create a legal duty to provide a particular class of passengers with particular protective measures. Since certification or licensing is designed to establish minimum standards for prospective practitioners to satisfy in the interest of the travelling public, regulatory activities per se do not create a duty of care to individual air travellers who incidentally derive benefits as the result of regulatory activities. And given practical constraints on technical competence or expertise of regulators in aircraft design, manufacturing, maintenance or operation, imposing liability on regulators may not induce them to devise efficient regulatory techniques. Nor does the failure by the regulatory agency to inspect add significantly to the risk.

If nevertheless courts were allowed to readjudicate on certification or licensing and to hold regulators liable for negligent regulatory functions (erroneously imposing sub-optimally low safety standards), this will expose regulators to a unduly high level of strain on their initiatives. Imposing liability on regulators may not necessarily make the government an insurer of losses caused by defectively designed, manufactured, maintained or operated aircraft. This is because it is "subject to the same requirements of negligence and causation as would affect the liability of a private person in the same circumstances". Nevertheless, it will make taxpayers bear the risk of negligent regulatory decisions, which may not be distributionally desirable. And given the limited technical competence of judges in the industry regulated, judicial readjudication may not adequately induce regulators to take optimal care to reduce risk in exercising their functions or discretion. Again, since certification or licensing is designed to establish minimum safety standards, which may also be the optimal, it is not intended to guarantee,

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481 See Kahn, 1/22.
482 Clemente v. US, 567 F 2d 1140, 1150 (1st Cir 1977).
483 Ibid, 1144.
484 Ibid, 1145; Restatement (Second) of Torts, s 323(a).
487 Clemente v. US, n.482 above, 1150; sec 8.2.4 below.
488 Ch 5: 4.2.1 & ch 6: 4.2 below.
nor does it actually guarantee, the safety of aeroplanes. Indeed, imposing liability on the regulatory agency for negligent certification or licensing will not greatly reduce the risk caused by defectively designed, manufactured, maintained or operated aeroplanes.

8.2.3 Delegation of regulatory functions to the private sector: In America the Secretary of Transportation must employ inspectors charged with the duty of making inspections of aircraft, aircraft engines, propellers and appliances during manufacture to decide whether they are in safe condition and maintained properly. In addition, the Secretary may, in discharging the regulatory functions vested in him, delegate to any properly qualified private person any work relating to inspection, examination and testing necessary for the issuance of certificates. This is mainly because the FAA's certification and inspection staff are not only outnumbered by engineers and scientists employed by manufacturers and airlines but may be less qualified in their technical competence. The quality of aircraft design and manufacture is nevertheless ensured mainly by dint of the manufacturer's proficiency in technical and engineering expertise ('self-policing' of regulatory risk).

8.2.4 Certification as a discretionary act under domestic laws: Although it is not clear what the position of English law is in respect of negligent certification or licensing, it is submitted that any liability arising from erroneous aircraft design or manufacture must be initiated not against the regulatory agency but against the manufacturer. In French law certificates of airworthiness merely create a rebuttable presumption of safety, and the grant of certificates or licences does not necessarily relieve the carrier of liability for accident losses.

In American law the federal government may be held liable under the Federal Tort Claims Act (FTCA) for personal injury or death or loss of property caused by negligent or wrongful acts or omissions of its employees. This waiver of governmental immunity, however, is subject to the discretionary function exception which is designed to protect regulatory activities from judicial review of administrative initiatives in the guise of tort suits. Certification of aircraft is a form of regulatory adjudication and the performance of a

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490. See Kahn, I/22-24.
491. Ibid, s 1425(b); 49 USC s 44713(b) (1996).
492. 49 USC s 44702(d) (1996); 49 USC Appd s 1355(a) (1988).
493. See D W Madole, n.473 above, 629.
494. See ch 3: 2.4.5 below.
495. Juglart, l(509).
496. 28 USC ss 1346(b), 2671, 2680 (1988).
497. Ibid, s 2680(a).
discretionary function, and an erroneous certification is an unintentional 'misrepresentation' for which immunity is still retained.\textsuperscript{498} Again, the \textit{Federal Aviation Act of 1958}\textsuperscript{499} is a regulatory statute which is designed not to establish a legal duty to the individual but to secure the safety and welfare of the flying public as an entity, and as such does not afford an independent basis of liability for alleged negligent inspection or certification.\textsuperscript{500}

As to the applicability of the discretionary function exception to particular cases of negligently inspection or certification, the First Circuit in \textit{Clemente v. US}\textsuperscript{501} made a correct distinction between service activities and regulatory functions. The \textit{Federal Aviation Act} is a regulatory statute and is designed to ensure general safety and welfare of the travelling public as a class and not to establish a duty of care in favour of a particular class of individuals.\textsuperscript{502} Regulatory functions of the government discharged through certification and inspections are intended to ensure compliance with minimum safety standards and benefit the body politic and not to render the government liable for negligent performance of these functions.

The Supreme Court has restricted the scope of governmental liability involving the FAA's inspection and certification process in its broader interpretation of the discretionary function exception in \textit{US v. Varig Airlines}\textsuperscript{503} and \textit{US v. United Scottish Insurance Co}.\textsuperscript{504} which was later joined with \textit{Varig}. \textit{Varig} involved a decision not to inspect, whereas \textit{United Scottish} involved a mandatory inspection negligently implemented. Discarding its previous distinction between \textit{planning} (policy-making) discretion and \textit{operational} (policy-implementation) activities,\textsuperscript{505} the Supreme Court drew a new regulatory-nonregulatory distinction,\textsuperscript{506} the validity of which remains to be seen. By so doing, the Supreme Court extended the scope of the discretionary function exception and barred any wrongful death action from being brought under the FTCA against the federal government for the FAA's negligent certification of aircraft.\textsuperscript{507} The court also ruled that holding the United States

\begin{itemize}
\item \textsuperscript{498} Harrison & Kolczynski, n.485 above, 28.
\item \textsuperscript{499} Act of Aug. 23, 1958, as codified at 49 USC Appd ss 1301-1557 (1988).
\item \textsuperscript{500} C Hatfield, The Non-liability of the Government for Certification of Aircraft, 17 Forum (1982) 602, 608-09.
\item \textsuperscript{501} N.482 above.
\item \textsuperscript{502} Ibid, 1144.
\item \textsuperscript{503} \textit{US v. SA Empresa de Viao Aerea Rio Grandense (Varig Airlines)}, 18 Avi 17,960; 104 S Ct 2755, 2765-68 (1984) (A smouldering cigarette stub put in a lavatory trash receptacle causing 135 deaths against FAA regulations requiring that any such fire should have been contained in the disposal unit). See ch 3, Example 3.3.
\item \textsuperscript{504} 104 S Ct 2755 (1984). (A modified heater in a DeHavilland Dove aircraft leading to a mid-air fire and crash allegedly because of an FAA inspector's negligent checking of its installation).
\item \textsuperscript{505} \textit{Indian Towing v. US}, 350 US 61, 68-70 (1955) (a case involving the Coast Guard's negligent maintenance and operation of a lighthouse which caused a ship to run aground); ch 1: 5.1.2.
\item \textsuperscript{506} \textit{US v. Varig Airlines}, n.503 above, at 2764-65.
\item \textsuperscript{507} At 2765-68; M E F Plave, Case Note, 51 JALC (1985) 197, 222; Shawcross, I(111).
\end{itemize}
liable would have the effect of making it the insurer of air transportation risk,\textsuperscript{508} which is not necessarily correct as already explained.\textsuperscript{509} A more reasonable analysis can be found in the Ninth Circuit decision in \textit{United Scottish}, where the court held that manufacturers and operators of aircraft had the primary duty to design, manufacture and maintain the aircraft in such a manner as to ensure its safety and that inspection merely supplements another's primary duty.\textsuperscript{510}

**Conclusion**

Summing up, although carriage by air benefits international society as a whole, it exposes passengers and subjacent people and their properties to the risk of passenger and surface damage and environmental harm. Assuming that the goal of the law of carriage by air is to generate the socially optimal level of safety which will minimise the sum of accident and environmental costs plus their avoidance costs, liability rules putting a collective valuation on their costs have been found to be more efficient than property rules in achieving this goal under positive transaction costs. This is because under property rules based on parties' voluntary transactions, strategic behaviour may well obstruct allocative efficiency and market valuation of these damage is often costly or unavailable.

In the case of noise and pollution harm, transaction costs for bargaining may well be much higher than in contractual relationships, not to speak of the possibility of strategic behaviour of the parties. Even in this environmental harm, efficiency remains the primary criterion by reference to which we can assess the desirability of a legal rule and attribute the losses. Hence those risk creators should, in principle, be made liable for the harm they create in the course of their activities. As such, the efficiency norm does not necessarily conflict with the notion of equity, since the polluter derives benefits from his activity and he therefore should be liable for any losses caused to third parties by his activity.\textsuperscript{511} In the case of passenger damage risk, it is necessary to impose liability on business enterprises, since they have more accurate information about risk than victims and are better positioned to assess the probability and gravity of the harm caused by their activities. They

\textsuperscript{508} At 2769. See Hatfield, n.500 above, at 607. For an article in support of governmental liability, see G Tompkins, The Liability of the United States for Negligent Certification of Aircraft, 17 Forum (1982) 569, 586-89.

\textsuperscript{509} Sec 8.2.2 above.

\textsuperscript{510} \textit{United Scottish Ins. Co. v. US}, [15 Avi 17.846] 614 F 2d 188, 193-94 (9th Cir 1979); C S Hatfield, n.500 above, 613.

\textsuperscript{511} Posner, 185; Polinsky, chs, 2, 14 & 15, where he put forward the possibility of tradeoffs between efficiency and equity if they are in conflict.
are thus better capable of reducing or avoiding losses by allocating the efficient amount of resources or by buying adequate insurance for accident avoidance.\textsuperscript{512}

Although the negligence rule induces the injurer to take optimal care, it may induce the parties to take a higher or lower than optimal care to the extent that there exists uncertainty over the exact degree of fault in single injurer cases and over causation in multiple injurer cases. If the court makes errors in assessing the optimal level of care applicable to each injurer, it may induce him to allocate too much or too little resources to accident avoidance. It should nevertheless be noted that the incidence of judicial errors in determining the optimal level of care are problematic only insofar as such errors are asymmetrical, i.e. courts make errors consistently on too much care or too little care. As regards administrative costs, the negligence rule creates incentives for the injurer to bring an action to defend his case, increasing the number of actions. The negligence rule also incurs higher information costs than strict liability because of the difficulty in determining a negligence and establishing causal link between the behaviour in question and its consequence. This is the case if the injurer were to be held liable only for 'foreseeable' accidents, since the court must figure out the distinction in each case. Again, if the parties are risk averse and the victim is not fully informed of risk, the negligence rule is liable to produce inefficiency, since he will not buy adequate first-party insurance.

On the other hand, strict liability creates powerful incentives for the injurer to internalise accident costs and take all justified steps. And there exists little valid ground for excluding 'unforeseeable' losses from the scope of liability whether for deterrence purposes or otherwise. Strict liability can also be applied with less administrative costs than the negligence rule because of relative ease with which to establish causal link. Under strict liability, the but-for cause can best be explained as a device for allocating accident costs to the cheapest cost avoider, whereas proximate cause of an accident can best be determined by reference to the relative accident probability of risk creators. In single-injuror cases, the injurer alone should be held liable for the loss, for there can be no other but-for cause to which to attribute the losses. In multiple-injuror cases as in a collision, the injurers should be liable in proportion to their relative accident probability registered over a given period of their activities. Liability allocation in this way is equivalent to liability assignment in proportion to the relative output and will induce the high-risk creator to invest more resources to reduce the risk or to adjust his future activity to the optimal level by taking account of the probable losses he may cause. Taking note of administrative costs incurred

\textsuperscript{512} A report drawn up by the German Airspace Users Association estimated that the inefficient European air traffic control system cost 4 billion pounds in 1988 alone. FT, 9 Aug. 1989, p.2; id, 26 Sept. 1989, p.3; WSJ/Eur, 7 Sept. 1989, p.2; id, 4 Sept. 1989, p.2.
to run the tort system, however, we have argued for a balanced approach between tort liability and social insurance scheme.

In view of widespread availability of insurance, we introduced the assumption of risk aversion and examined how proper risk allocation will affect parties' own expected utility and social welfare in general. Social welfare defined as the sum of aggregate individual utilities will be raised by shifting risk from the more to the less risk averse or from the risk averse to risk neutral. Again, risk sharing between equally risk-averse parties will also increase their aggregate utilities and social welfare. The existence of insurance has transformed the nature and role of tort liability in such a significant manner that insurance forms an indispensable part of the tort process as the mechanism of performing the dual functions of compensation and deterrence. Although tort liability retains its deterrence function in this process, it does so merely by allocating losses to the responsible party and by linking the victim's entitlement to indemnity to liability insurance taken out by tortfeasors. Since it is now the insurer who ultimately pays out damages, he has direct financial interest in deterring his insureds from causing losses and inducing them to take risk-reducing steps, thus contributing to the enhancement of safety.

Insurance performs the deterrence function mainly through its premium-setting techniques. If insurers have perfect information about insureds' behaviour, they can offer insurance policies which provide complete coverage yielding maximum expected utility without incurring the insured's moral hazard problem. If, however, insurers are unable to do so, they generally cannot provide full coverage nor can they link premiums to insureds' actions (moral hazard and adverse selection). In this case, insureds' accident record or claims data can be used as the most reliable substitute for direct monitoring of insureds' behaviour for premium-fixing purposes. Partial coverage and risk sharing (through coinsurance or deductibles) between the insurer and the insured will also increase expected utility and enhance social welfare.

Although liability rules create an incentive for parties to take care and to reduce risk, the problem is that the deterrent effect of tort liability can be achieved only when the market functions properly (e.g. the optimal supply of relevant information, competition, and proper functioning of the insurance market, etc.) and when individual consumers are possessed with the ability to assess information in their best interest. Tort liability is particularly ineffective in eliminating externalities associated with difficulties in the establishment of causal link, while the tort process is expensive to run for many small, diffuse claims as in the case of airport noise and pollution.513 Nor is the market considered

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513. Ch 5: 2.3.4 below.
suitable for promoting distributonal goals, since the market neither discriminates against nor favours a particular party or a particular class of people. Furthermore, airports and ATC agencies are often operated by public corporations with general taxpayers' money on a monopoly basis.

Where there occurs a market and private law failure as described above, there is a prima facie case of regulatory intervention in the public interest in the operation of the market and private law. At the same time, since regulators generally lack accurate and relevant information on the behaviour of industries and on the technical complexities involved in the manufacture and operation of aircraft, they are generally less qualified to forge coherent, consistent and effective standards. Especially, standards regimes based on command and control may, often but not always, incur strategic and other less cooperative behaviour from managers of firms, stifle technological innovation, and tend to have anti-competitive effects and to discriminate against new entrants. These deficiencies in social regulation may be mitigated through the increasing use of information regulation through certification and economic instruments.

Although the lack of an appropriate mechanism for taxpayers to supervise the accountability of regulators may act as a constraint on efficient regulatory activities, there is an increasing sign that consumers and taxpayers are organising various groups and actions for effective monitoring of regulatory performance. On balance, given the utility and disutility of regulatory intervention, a joint use of civil liability and regulation has been suggested as a desirable, mutually complementary solution to the market and private law failure in controlling aviation and environmental risk in the public interest. Finally, imposing liability on regulators for their negligent certification and licensing (i.e. for imposing sub-optimally low safety standards) may be neither efficient nor distributionally desirable. This is because regulators are usually equipped with inadequate information and limited competence and because taxpayers will be made to bear regulatory risks without comparable benefits.

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514. Sec 3.2.3 above.
515. Breyer, 95.
PART ONE

PASSENGER DAMAGE RISK ARISING FROM
THE PARTIES IN CONTRACTUAL/MARKET RELATIONSHIPS

Introduction to Part One Research Design

Since we have introduced basic notions and tools of economic analysis, we can now apply them to assessing the efficiency of existing legal rules governing various types of risk and harm arising from carriage by air. In order to do this, a distinction will be made between two types of risk relationships: risk created between the parties in contractual/market relationships and those in 'stranger' relationships. The former refers to passenger damage risk caused by carriers or manufacturers. The latter means surface damage risk caused by aircraft operators, environmental risk caused by airport operators and passenger damage risk caused by airport operators and ATC agencies. This differentiation is based on the existence or absence of externality and on the relative ease or difficulty for bargaining between the parties. In the former case, little externality is caused, since rational passengers will voluntarily pay for carriage by air service on the market only when its utility exceeds its full price. Thus, the choice of a desirable legal rule will entirely depend on efficiency without the need to take into account distributional justice.

Discussion which follows will be conducted on certain assumptions. It is first assumed that carriage by air makes up a co-ordinated joint activity of a highly technical and sophisticated nature but that passenger-surface damage risk is primarily created by air carriers and manufacturers. This means that passenger damage risk caused by airport operators and ATC agencies is lower in its frequency than, albeit as much severe in its magnitude as, passenger damage risk created by airlines and manufacturers. Nevertheless, without auxiliary activities of those in 'stranger' relationships with passengers, the benefits of carriage by air cannot be derived. Second, injurers (or polluters) are assumed to have better information (information asymmetry) and can thus better assess, avoid or reduce risk. Third, the goal of the law of carriage by air governing passenger, surface and environmental damage risks is taken to be the minimisation of the sum of accident and avoidance costs.

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1. Polinsky, 108-09. Each passenger is in contractual/market relationship with the carrier or manufacturer, but in 'stranger' relationship with the airport operator, the ATCA or the licensing/certifying body.
2. See ch 1: 2.3.4 above.
CHAPTER 2

LIABILITY OF THE CARRIER FOR PASSENGER DAMAGE
UNDER THE WARSAW CONVENTION SYSTEM

According to the law, each death costs the com-
pany about $5,000, which is paid to the widow or
heirs, and each cripple costs $10,000, paid to the
casualty himself. These compensations are due so
long as the company does not introduce certain
precautionary measures. But they have calculated
that four hundred casualties a year cost less than
would the necessary precautions. The company
therefore does not introduce them.

--- Max Weber

Introduction

In Chapter 1 of this study, we examined how economic analysis and its analytical tools and
techniques centred round the goal of minimising accident and its avoidance costs can help
us to evaluate the efficiency of existing liability rules governing disputes over the valuation
of the life and limb. We considered how under parties' risk aversion, liability insurance
affects the achievement of the cost minimisation goal, why and under what circumstances
regulation is justified, and how different regulatory regimes can supplement the role of tort
liability in creating optimal deterrence for accident avoidance and environmental
protection. One of the cardinal conclusions there was that under positive transaction costs
for bargaining, the efficiency of a particular liability rule governing passenger damage
caused in contractual/market relationships can be assessed by reference to efficient
risk/loss allocation, adequate incentive creation and least administrative costs.

Relying on these three principal criteria of efficiency, we will in this chapter assess
existing liability rules of the Warsaw Convention system governing the carrier's passenger
liability. In this passenger damage risk created between parties in contractual/market
relationships, although the Convention provides for an initiative by the passenger in the
form of special contract, it is infeasible to envisage the possibility of bargaining over the

4. Letter to his mother (1904), in Marianne Weber, Max Weber: Ein Lebensbild (Tübingen 1926) 300,
5. Ch 1: 4.2.3 & 5.1 above.
6. Ch 1: 5.3 above.
7. This, however, on no account means that there is no kinship whatsoever between the Warsaw
Convention system and the law of torts at large. See the Carriage by Air Act 1961, s 3: Fatal Accidents
Act 1976, 31 Halsbury's Statutes 251. The law of carriage by air is a hybrid field where the law of contract
intersects the law of torts.
8. Art 22(1) of the Convention provides: "Toutefois par une convention spéciale avec le transporteur, le
passager pourra fixer une limite de responsabilité plus élevée".
valuation of life and limb. This is because the passenger's freedom to negotiate is at best limited and at worst illusory.\textsuperscript{9} This is because of unequal bargaining power between the carrier and the passenger especially on some routes of imperfect competition\textsuperscript{10} and time constraints on bargaining in case of scheduled services (consider e.g. a successive carriage). Even if bargaining is possible, high transaction costs would be incurred, given the number of passengers in each flight, their different income backgrounds, their different places of residence and so on.

The application of the three criteria to evaluating the efficiency of the Warsaw Convention's rules and cases will be done in three steps: first, identifying the factors affecting the expected accident losses; second, building a simple model applicable to different situations; and third, applying this model to evaluating the efficiency of the key liability regime in respect of single-carrier accidents. Our reasoning developed in single-carrier accident cases will later be extended to joint- and multiple-injurer cases involving more than two carriers as in a collision. In-between, we examine the optimal deterrence ability of the regulation of aircraft operation in view of the fact that the air carrier is subject to safety and security regulation in parallel with civil liability. Prior to proceeding on to assess the efficiency of liability rules under the Warsaw Convention system, an outline of its key characteristics will be given below. For, as will be shown, this multiple treaty-based, universal legal regime has a rather complicated structure in functioning and a certain acquaintance with its key features is a necessary precondition to any discussion of substantive issues that will follow.

1. The Warsaw Convention System in Outline

The Warsaw Convention of 1929\textsuperscript{11} was the product of two international conferences, one held in Paris in 1925 and the other in Warsaw in 1929.\textsuperscript{12} As its title indicates, the Warsaw Convention 1929 was intended to address and achieve two main objectives:\textsuperscript{13} a degree of uniformity as to jurisdiction and choice of law questions\textsuperscript{14} and to documentation of carriage _ tickets, waybills, etc. _ and liability limits in favour of the carrier in case of an

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\textsuperscript{10} The inequality in bargaining power between carrier and passenger need not necessarily be a disparity in economic power but an inequality in expertise and knowledge of the nature of a transaction. Drion, 232.


\textsuperscript{12} Symposium on the Warsaw Convention, 33 JALC (1967) 518.


\textsuperscript{14} Grein v. Imperial Airways, Ltd., [1 Avi 622, at 634] [1937] 1 KB 50 (CA), per Greene LJ at 75-76; Benjamins v. British European Airways, sec 5.1.2 below.
accident. By providing for applicable rules and the fori where an action for damages can be brought, the Convention has succeeded in eliminating most of the problems of choice of law. As a quid pro quo of establishing a rebuttable presumption of the carrier's liability, the Convention has limited to a specified maximum the carrier's liability for passenger injury or death.

1.1 Structure

The Warsaw Convention system consists of the original Convention and seven international agreements which are all intended to amend or supplement it. Of this ensemble of international instruments, only the original Convention and the Hague Protocol 1955 are currently in force. Although these succeeding instruments have injected a new lease of life to the system, the adoption of these successive instruments has thus been criticised for their failure to address the key issues such as efficient and equitable risk bearing and the rationale of liability limitation. The criticism may not wholly be justified except for the fact that this complexity has given rise to the problem of applicability of different agreements as between states parties thereto (treaty relationship), if more of these Protocols entered into force to offer an array of combinations.

Of the seven succeeding instruments, six have been adopted in the form of Protocol including four Montreal Protocols of 1975 and one in Convention (Guadalajara

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15. For the meaning of 'accident', sec 3 below.
17. Art 22(1); sec 1.3 below.
18. For a chart illustrating these different instruments and their relationships, see B Cheng (1986), at 213.
19. The Warsaw Convention was drawn up only in French, while the Hague Protocol was drafted in three languages, i.e. English, French and Spanish. See Fothergill v. Monarch Airlines, Ltd., (1977) 3 All ER 616 (QB 1977); A Kean, Fothergill Revisited, [1981] J Bus L 69, 72. Where necessary, these two instruments will hereinafter be referred to as one single instrument, the 'amended Convention' in accordance with Art XIX of the Hague Protocol, while the original Convention as the 'unamended Convention'.
20. The longevity of the Warsaw Convention system has thus been attributed to its rather complicated but flexible structure capable of coping with whatever situations it has been entrusted to tackle. See C Bédard, Le système de Varsovie: complexités? _ flexibilité, 2 AASL (1977) 14.
21. It has been described as 'a galaxy of unified laws', 'patch-up' or 'the Warsaw shambles'. R Mankiewicz, 1 Air L (1975-76) 157; L S Kreindler, Guatemala Patch-up, 1 Air L (1975-76) 25; Shawcross, VII(56).
The carrier's liability

Convention 1961) which governs the relationship between actual and contracting carriers. Added to this body of international instruments is the Montreal Interim Agreement 1966 adopted as a private inter-carrier accord and not as a 'special contract' between the carrier and the passenger within the meaning of the Convention. The Agreement therefore is not a treaty in the proper sense of the term and does not enjoy any legal status as such in international law, nor does it make up part of the Warsaw Convention system. That is why the agreement has been subjected to a barrage of criticism. Nevertheless, it functions as if it were a de facto limited amendment to the Convention in respect of its scope of applicability and its liability regime, as will be explained below.

1.2 Scope of Application

The Warsaw Convention 1929 and its succeeding Protocols apply as between contracting States to any contract of international carriage of passengers (and baggage and goods) by air performed by aircraft for hire. An 'international' ('Conventional') carriage means any carriage in which, according to the contract of carriage, the point of departure and the point of destination are situated in two different contracting states, or within one contracting state with an agreed stopping place in the territory of another.

24. Convention Supplementary to the Warsaw Convention, for the Unification of Certain Rules relating to International Carriage by Air Performed by a Person Other than the Contracting Carrier, Signed at Guadalajara, 18 September 1961, ICAO Doc 8181 (In force on 1 May 1964); Cmnd 1568; Carriage by Air (Supplementary Provisions) Act 1962.
25. Arts I & II. Some commentators, however, doubt the very raison d'être of this instrument, especially under French law. See Mankiewicz, para 8; id, Charter and Interchange of Aircraft and the Warsaw Convention, 10 ICLQ (1961) 707; Juglart, I(2442); Miller, 261ff.
27. The special contract envisaged under art 22(1) of the Convention must be entered into between a carrier and a passenger and not between a carrier and a regulatory body such as the CAB.
29. Shawcross, VII(17); Juglart, I(2478).
31. For the definition of aircraft (aéronef), see the Chicago Convention 1944, Annex 7, s I & Table I; ICAO Definitions; Civil Aviation Act 1982, s 97(6); Air Navigation Order 1989, SI 1989/2004, sch 1: Code, art L.110-1: 49 USC Appd s 1301(5) (1988); Shawcross, V(3); Juglart, I(473)ff & (2517). Aircraft include helicopters, gliders, airships, seaplanes and even balloons.
32. Unamended Convention, art 1(1). Thus, for the purpose of determining the applicability of the Convention, it does not matter whether a particular carriage was performed as part of scheduled or non-scheduled (charter) service; Block v. Compagnie Nationale Air France, n.13 above, at 325 n.1.
contracting state, whether or not a contracting state.\textsuperscript{33} For the purpose of determining whether a particular carriage performed was 'international' or not, attention should be paid not to the nationality of the aircraft, but to the \textit{contract} of carriage regardless of whether or not the envisaged carriage was actually performed.\textsuperscript{34} The passage 'carriage performed by aircraft for hire' does not necessarily require an element of pecuniary remuneration or profit, for the Convention equally applies to gratuitous carriage (\textit{transport aérien gratuit})\textsuperscript{35} and to a carriage performed by the State or public entities.\textsuperscript{36}

In the case of carriage of passengers, delivery of the passenger ticket constitutes prima facie evidence of the conclusion and conditions of such a carriage\textsuperscript{37} and the parties to a contract are those who made an agreement relating to the carriage.\textsuperscript{38} If the carriage envisages the touching of the US territory whether as a point of departure, destination or mere agreed stopping place, it will be subject to the \textit{Montreal Agreement 1966}. Where a carriage envisaged was to be performed by several successive carriers, such carriage is deemed one undivided carriage insofar as the parties agreed it to be a single operation, whether in the form of a single contract or a series of contracts.\textsuperscript{39} In a successive carriage by air, any distinction between contracting and actual, performing carriers is not necessary because victims of an accident would sue the carrier who actually caused the damage.\textsuperscript{40}

### 1.3 Liability Regime

The risks inherent in carriage by air were well perceived in the discussions preceding the Warsaw Conference of 1929.\textsuperscript{41} But in view of the lack of perfection of carriage by air at

\textsuperscript{33} Art 1(2); Juglart, I(2519). A carriage is not deprived of its "international" character merely because one contract or a series of contracts is to be performed entirely within the territory of the same contracting state. \textit{Collins v. British Airways Board}, [1982] QB 734, [1982] 1 All ER 302 (CA).

\textsuperscript{34} \textit{Grein v. Imperial Airways, Ltd}, n.14 above, at 74-75 (per Greene LJ); \textit{Carriage by Air Act 1961}, s 1(1) & sch 1, art 1(2). For some typical examples of 'international' carriage, see Shawcross, VII(99); Cheng (1963); Juglart, II(3210) & I(2519).


\textsuperscript{36} Art 2(1).

\textsuperscript{37} Art III(2), amended Convention.

\textsuperscript{38} The Convention does not require direct contracting between parties and indeed anticipates participation of a third party, as where the individual passenger ticket was issued under a charter flight arrangement negotiated by the agent acting on behalf of a group of travellers. \textit{See Block v. Compagnie Nationale Air France}, n.13 above, at 17,523; Drion, 52; Juglart, II(3208); \textit{Ross v. Pan American Airways}, [4 Avi 17,682] 299 NY 88, 85 NE 2d 880, 884 (1949), cert den 349 US 947 (1955).

\textsuperscript{39} Art 30; \textit{Riediger v. T.I.T.I.}, 6 Avi 17,315 (NY S Ct 1959); Shawcross, VII(105)-(107) and the cases cited therein; Juglart, I(2528).

\textsuperscript{40} Mankiewicz, n.25 above; \textit{Egan v. Kollsman Instrument Corp.}, [10 Avi 17,651] 234 NE 2d 199 (NY 1967), cert den 88 S Ct 1636 (1968) (the substituted carrier held as the successive carrier).

\textsuperscript{41} Il Conférence internationale de droit privé aérien, 4-12 Oct. 1929, Warsaw (ICAO Doc 7838) 15. 30-37 & 136-37.
the time, the risk theory was not adopted as the Convention's liability principles. Instead, the Convention established a rebuttable presumption of fault on the part of the carrier in return for liability limitation (quid pro quo), except arguably for damage caused by his 'wilful misconduct'. The limit of damages recoverable for passenger injury or death had initially been set at 125,000 gold francs (approximately $10,000) per passenger and was doubled by the Hague Protocol, but was still regarded as insufficient by the United States. In the face of the US threat to withdraw from the unamended Convention and with the intervention of the CAB, major international airlines agreed to higher passenger liability limits of $58,000 exclusive of, or $75,000 inclusive of, legal fees and costs and to waive their defence available under the 20(1) of the Convention that they had take all necessary measures to avoid the damage or that it was impossible to take such measures.

The Guatemala Protocol has introduced an important change to the amended Convention's liability regime of presumed fault by providing for no-fault liability with no defence available to the carrier except for that of contributory negligence. Under this Protocol, which is not yet in force, the passenger liability limit has been substantially increased to the 'unbreakable' sum of 1,500,000 gold francs (approximately $120,000). What is characteristic of this Protocol is that a contracting state party will be allowed to operate within its own territory a national supplementary compensation scheme to complement damages payable to claimants. The four Montreal Protocols, none of them yet in effect, have been adopted to replace as the unit of account the gold franc with the Special Drawing Rights (SDR), to facilitate the entry into force of the Guatemala Protocol 1971 and to introduce some other necessary changes.

42. Arts 17 & 20, unamended Convention.
43. Arts 17 & 20(1). The normal burden of proof was thus reversed from the consumer to the provider of the service.
44. Hjalsted, Passenger Liability, at 93; Miller, 63; sec 3.3 below. For 'wilful misconduct', see 4.2.1 below.
45. Art 22(1) & 22(4), unamended Convention. For the conversion of the gold franc, see 5.2 below.
48. New arts 24(2) & art 20. By the latter provision, the defences of "all necessary measures" or "impossibility" to do so have been deleted. See sec 3.2 below.
49. Arts VIII(1)(a) & IX, Guatemala Protocol. Again, by the insertion of art X replacing art 25 of the amended Convention, the Protocol has made the carrier's new liability limit unbreakable even if the damage was caused by his or his servants' wilful misconduct; sec 4.2 below.
50. Art XIV inserted as new art 35A. The Protocol has also eliminated controversy relating to cause of action and added another forum to which an action can be brought. New arts 24(2) & 28(2).
51. E.g. Protocol No. 3, art II(4) inserted as new art 22(4). See Fitzgerald (1976). For the value of one SDR, see sec 5.2 below.
53. E.g. Art II(1)(a) allowing the court to award damages in periodic payments in addition to the traditional lump sum payouts, and arts II(3) and XI(1)(a) concerning the award of legal costs.
2. Simple Models for Single-Carrier Accidents

As we have outlined the basic features of the Warsaw Convention system, we will now build simple models applicable to evaluating the efficiency of liability rules governing passenger damage. It is important to recall that the carrier is in market relationship with his passengers which means that he offers on the market various carriage by air products for which passengers are paying on their own choice (producer-consumer).\(^{54}\) We will first identify the factors that may affect expected accident losses and then examine their effect on the parties' behaviour and on the choice of an optimal legal rule.

2.1 Factors Bearing on Expected Accident Losses

2.1.1 The carrier's and passenger's care: Assuming first that passengers cannot affect expected accident losses, only the carrier's care will determine expected losses.\(^{55}\) Now, assuming that passengers can also affect expected losses by taking care or purchasing a proper amount of travel insurance, their level of care will depend on their information about expected losses.\(^{56}\) This is because passengers' information will affect their willingness to pay for carriage by air products. In other words, passengers will purchase a carriage product only if they reckon that the utility of the product to them exceeds or at least equals its full price, i.e. air fares carriers actually charge on the market plus expected accident losses passengers perceive.\(^ {57}\)

2.1.2 The carrier's and passenger's activity level: In the carriage by air market as in those of other products, there will be no carriage unless the carrier and the passenger both agree. This means that a carrier's output (as measured by e.g. total miles flown by his fleet) depends on the passenger's willingness to pay for his products. From the long-term perspective, either the carrier's output or the passenger's consumption level alone will have little effect on expected losses, whether passengers are perfectly or imperfectly informed about risks. For the carrier's activity level itself does not, from the long-term perspective, very much affect his accident probability or the average magnitude of losses, provided that his care level is kept constant. Whether he operates 100 or 100,000 flights, his accident frequency or average magnitude of losses will not change very much from the stochastic standpoint. We will thus not include the carrier's activity level as an independent factor affecting expected losses.

\(^{54}\) A gratuitous carriage can be seen as a product offered free of charge. Sec 1.2 above.
\(^{55}\) See Shavell, 51 & 77ff.
\(^{56}\) Sec 2.3.3 below.
\(^{57}\) Shavell, 52.
2.2 Passengers' Perfect Information

If the passenger has perfect information about expected losses, every rule will lead to the efficient outcome with respect to both the carrier's care and his activity level for the following reasons. Under strict liability, since the carrier will be liable to the passenger for his losses whenever losses occur, air fares will exactly reflect full accident costs. Consequently, the passenger will be forced to buy the efficient number of flights. Under negligence, since the carrier will not be liable as long as he takes due care, air fares generally will not exactly reflect true costs of carriage by air. Nevertheless, since the passenger has perfect information about expected accident losses, he will correctly take into account the true costs of air travel and will purchase the efficient amount of carriage by air products. Again, if the passenger can also affect expected losses by taking care, he will be motivated to take optimal care because he knows that otherwise he would be made to bear his own losses. Thus, the negligence rule is also efficient with regard to the care exercised by the parties. Therefore, where the carrier and the passenger are risk neutral and the passenger has perfect information about risk, the choice of a liability rule is irrelevant to efficiency. In fact, the assumption of passengers' perfect information is equivalent to that of zero transaction costs in the Coase Theorem.\(^58\)

2.3 Passengers' Imperfect Information

The assumption of the passenger's perfect information may be unrealistic, since infrequent passengers may not keep up with updated information on the safety record of individual airlines (consider e.g. terrorists' threat to passenger safety which the airline was reluctant to make public in advance and which subsequently materialised).\(^59\) Imperfect competition on some routes also affects passengers' access to information and their choice of an airline when they buy carriage by air products. Now, if the types of service (e.g. fares, connecting service and flight duration) are similar, the passenger's information about risk will depend on different classes of customers.\(^60\) Frequently-flying business travellers will act in a more calculated way and may well value in their scale of preferences safety record as highly as the convenience of flight schedules, aircraft type and seating comfort, load factors, in-flight service quality or efficient reservation system.\(^61\) Leaving aside safety-conscious commercial customers, certain infrequent passengers such as tourists or casual trippers

\(^58\) In fact, this result is a tautology of the main premise of the economic analysis of law because every rational individual with perfect information will act in no other way but in a wealth-maximising way which will always lead to the efficient outcome. Ch 1: 3.1 above.
\(^59\) J E Assimotos, To Warn or Not to Warn _ the Airline's Duty to Disclose Terrorist Threats to Passengers, 56 JALC (1991) 1095.
\(^60\) Shavell, 54-55.
\(^61\) Doganis, Flying Off Course, 262, Table 10.1.
may for budget-saving purposes prefer charter flights with a lower safety record to scheduled services. Now, we will examine the effect of the passenger's imperfect information on the choice of an optimal liability rule.

Example 2.1 Suppose an airline has registered a certain accident rate in the course of his activity over a period of time and that he faces three choices in relation to its safety record: to take high level of care (e.g. by installing all the safety devices available and by maintaining aircraft and training its flight crews more frequently than required by the law), take medium care, or to take low care and simply risk an accident. As Table 2.1 shows, both the negligence rule and strict liability create adequate incentives for the injurer-carrier to take medium care so that he can maximise total benefits net of total costs or minimise the sum of accidents plus their avoidance costs. Here, the term 'strict' liability will be used interchangeably with that of 'absolute' liability, since under either regime, fault is not required in order to hold the wrongdoer liable.62

Table 2.1
Aviation Accident Example: Carrier's Care Affects Expected Losses

<table>
<thead>
<tr>
<th>Behaviour of the Carrier (Level of Care)</th>
<th>Cost of Production per 100,000 kms (including cost of care)</th>
<th>Accident Probability (Fatal Accidents per 100,000 kms flown)</th>
<th>Losses to Each Victim Accident if Accident</th>
<th>Expected Accident Losses</th>
<th>Full Cost of Production per 100,000 kms (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>low</td>
<td>500</td>
<td>0.0020</td>
<td>100,000</td>
<td>200</td>
<td>700</td>
</tr>
<tr>
<td>medium</td>
<td>600</td>
<td>0.0008</td>
<td>100,000</td>
<td>80</td>
<td>680</td>
</tr>
<tr>
<td>high</td>
<td>700</td>
<td>0.0005</td>
<td>100,000</td>
<td>50</td>
<td>750</td>
</tr>
</tbody>
</table>

62. Cheng. A Reply to Charges, at 9-11. The difference is that although strict liability requires causal link between the person strictly liable and the damage caused, there is no such requirement under absolute liability. In French law, while the term 'objective' liability (responsabilité objective) generally denotes no-fault liability, it is also used to mean not only strict but absolute liability. 'Objective' liability in French law does not necessarily excludedefences available under strict or absolute liability.
2.3.1 Risk neutrality: Assuming that under the negligence rule the carrier will be induced to take medium care and will not be liable for accident losses, the carrier in Table 2.1 will be willing to sell his 100,000-km carriage product for £600. However, since passengers have imperfect information, they will misperceive and generally underestimate risk and will not add £80 to the air fare to account for expected losses. Consequently, they may be motivated to buy too much of the carriage products. In this situation, the important question is whether the rational passenger, if fully informed of the possibility of uncompensated losses when optimal care is taken, would still be prepared to buy the same amount of travel. If he were not prepared to do so, as is believed, the negligence rule can produce the efficient result.

The efficiency of strict liability is not affected by passengers' information, however. Under strict liability the carrier will be liable for whatever passenger losses that may be caused in the course of his activity. Given the full costs of production per 100,000 kms in Table 2.1, the carrier will obviously take medium care and be willing to sell his 100,000-km carriage product for £680 per passenger. Passengers will then be forced to buy the efficient quantity of carriage products, because the price correctly reflects the full cost of the product. Thus, assuming the passenger's imperfect information and underestimation of risk under parties' risk neutrality, strict liability will have advantage over the negligence rule in achieving the efficient outcome with regard to both the carrier's care and passengers' purchase decisions.

2.3.2 Risk aversion: Although the choice of a liability rule under parties' risk aversion will also affect their incentive to take care, discussion here will focus on risk allocation issues. This is because it will generally increase aggregate utilities to shift risk from the more to the less risk-averse and from the risk-averse to risk-neutral party. Assuming that both incomplete liability and first-party insurance are available because of the moral hazard problem, the carrier will bear some risk under strict liability, whereas passengers will bear some risk under the negligence rule. Given both imperfect liability and first-party insurance, the optimal choice between strict liability and the negligence rule depends on the relative risk aversion of the parties. Thus, under passengers' imperfect information and parties' risk aversion, strict liability would be preferred to the negligence rule to the extent that passengers are more risk averse than carriers or that passengers are risk averse and carriers are risk neutral. The negligence rule would be desirable if the reverse is true.

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63 Polinsky, 98; Shavell, 53-54. On the other hand, if the consumer overestimates the risk, he will buy too less of carriage products, since he will add more than 50 pounds to the price of air fare.

64 The carrier will choose to take medium care, because compared to other levels of care, it would make his fare competitive and give him comparative advantage over his competitors' fares.

65 A risk-averse party prefers a certain to uncertain wealth and is willing to pay more than the expected value of losses. Ch 1: 6.1 above.
2.3.3 Passengers' care: In most of accident situations in carriage by air, passengers cannot affect expected losses. Nevertheless, in certain cases they can do reduce and minimise the risk of his own injury at minimal costs. This is the case with a situation where passengers have only to comply with the pilot's instructions during the flight, e.g. wearing seat belts in accordance with the "Fasten Seat Belt" sign. In this apparent case of what constitutes efficient behaviour, not much costs will be incurred for passengers to wear their seat belts. Nor will much information be needed or much costs be incurred for the court to assess the correct level of due care applicable to each passenger. The carrier's defence of contributory negligence can also be justified in view of a tendency of passengers to misperceive and underestimate risk and not to take adequate precautions. This is so under the negligence rule, but is especially the case under strict liability, since under the latter passengers are effectively insured and compensated under strict liability by the carrier and they may not have an adequate incentives to take care.

It may be arguable that if a man's basic instinct for self-preservation or self-interest does not deter him from indulging in a dangerous or risk-increasing conduct, it is unlikely that tort law incentives will and can do. Although this may generally be the case, the problem is that not all people always act rationally to minimise the probability and magnitude of his own injury. Some may risk the future occurrence of a low-probability accident in favour of the enjoyment of the present pleasure. This accords with a press report that business travellers are ignoring in-flight safety demonstrations and instructions which are vital to their safety in the event of an accident. Here, some legal compulsion will be needed to correct an inefficient outcome. A strict liability without the defence of contributory negligence is less efficient than the negligence rule with a contributory negligence standard. As such, some version of the defence of contributory negligence is always

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66. See Shavell, 57-58.
67. Contributory negligence is defined in § 463 of the Restatement (Second) of Torts as "...conduct on the part of the plaintiff which falls below the standard to which he should conform for his own protection, and which is a legally contributing cause co-operating with the negligence of the defendant in bringing about the plaintiff's harm". In fact, one of the original rationales of the rule was that the negligent victim is in effect a joint tortfeasor with the injurers. See W Shofield, Davis v. Mann: Theory of Contributory Negligence, 3 Harv LR (1890) 263, 267 & 269.
68. If the passenger overestimates expected losses, he will buy too little of carriage products (when he is risk-neutral) or too much first-party insurance (when he is risk-averse).
70. See James, Accident Liability Reconsidered, p.21.
needed, whether under the negligence rule or strict liability, to deter the victim and produce the efficient result.

2.3.4 Passengers' care under the *Warsaw Convention* text and case: The unamended Convention adopting a negligence rule provides for total or partial exoneration of the carrier's liability upon proof of the passenger's contributory negligence, which is the efficient result as already explained above. The *Guatemala Protocol 1971* adopting a strict liability regime with the unbreakable limits has amended this provision so that the victim's contributory negligence will exempt or reduce the carrier's liability to the extent that such negligence caused or contributed to the damage. This is the efficient outcome, as already explained above. In *Goldman v. Thai Airways International Ltd.*, the court held that it was not contributorily negligent for a passenger not to wear his seat belt during the flight in the absence of the 'Fasten Seat Belt' sign. This is a correct decision, because the carrier, or the pilot to be exact in this context, has superior information about wake turbulence in a particular airspace and can minimise injury of passengers by lighting the sign. It is another, totally different matter to hold a passenger contributorily negligent when he failed to comply with the pilot's instructions.

2.4 Passengers' Imperfect Information and the Requirement of Adequate Notice

On the basis of the above analysis, we can now assess the efficiency of liability rules under the *Warsaw Convention*. The unamended (amended) Convention requires the carrier to deliver passenger tickets containing, among others, a 'statement' ('notice') to the effect that in the event of an accident, the carrier's liability for a passenger's wounding, death and other bodily injury will be subject to a certain specified maximum established by the Convention. This provision has turned out a prime source of controversy, together with the liability limitation provision. We will now examine the efficiency of the requirement under the passenger's imperfect information and also proper sanction against any failure. It is assumed here that not only the carrier's but the passenger's care affect expected losses, that passengers have imperfect information about risk and that administrative costs of informing passenger of the risk by printing it on the passenger ticket are negligible.

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73. Art 21.
74. Art VII. To the similar effect, see the *Carriage by Air Act 1961*, s 6 & sch 1, art 21; *Civil Liability (Contribution) Act 1978* (c 47), ss 1, 2 & 6; *Law Reform (Contributory Negligence) Act 1945*, s 1(1); Clerk & Lindsell, on Torts, paras 1-39ff; Miller, 70-71.
76. Arts 3 & 17.
77. Juglart. Il(3278); sec 4.1 below for discussion of liability limitation.
2.4.1 Negligence rule and strict liability compared: Under negligence, if the passenger can affect expected losses but is not fully informed of the true risk inherent in carriage products, he will underestimate the value of meeting the standard of care. Consequently, he will not take adequate care (if he is risk neutral) or will not purchase adequate first-party insurance (if he is risk-averse). Therefore, in order for the negligence rule to be efficient, the carrier must give passengers adequate 'notice' about risk so that they can take appropriate self-protective actions. Under strict liability, although passengers may not take adequate care or take out adequate first-party insurance, it would be wasteful for both to take care. It is efficient for the carrier alone as the cheapest cost avoider to take care or purchase liability insurance.

2.4.2 Proper timing, print size and notion of a 'notice' under negligence: Even if under negligence a 'notice' is required in order to induce passengers to take self-protecting measures, questions still remain as to when, how and to whom such a 'notice' should be given and what constitutes a 'notice'? Obviously, in order to induce the passenger to take proper self-protective steps, such a 'notice' should be delivered before his boarding, whereby the passenger is deemed to have agreed to liability limitation. However, the airline need not necessarily deliver tickets to individual passengers, since he can hand them over to their agent after he has concluded a contract with the agent acting on behalf of a group of passengers as in a charter flight.

Indeed, in this kind of contract, delivery of group tickets to the agent is deemed delivery to all members of the group and the carrier need not care about when (e.g. at the foot of the ramp) and whether or not the ticket will be delivered to individual passengers. If the agent did not actually deliver the ticket to his clients at all or failed to deliver it well ahead of their boarding, if such omission led to their failure to buy adequate first-party travel insurance and if passenger losses resulted, the agent should be liable for his failure to draw to the terms of contract the attention of his clients for whom he is acting. For, aside from regular business travellers, casual tourists would have no real chance to scrutinise the contract of carriage, and the agent is indeed responsible for explaining to his clients its full implications. For this reason, it is not economically sound to sanction the carrier with deprivation of limited liability when he merely allowed the passenger to embark without the ticket having already been delivered.

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78. Drion, 67. If, on the other hand, the passenger has imperfect information and 'overestimates' the risk, he will be induced to take too much care.
79. Sec 2.3.3 above.
80. Art 3(2), amended Convention; Drion, 235.
82. Drion, 232.
As to what can be regarded as a 'notice', two types of situation can be identified, barring a complete failure to deliver the ticket which obviously does not constitute a valid notice in any sense: failure to contain all the prescribed particulars in the notice and failure to print a notice in a legible size. In the former case, mere irregularity of particulars does not automatically amount to complete failure to deliver the ticket. Only such losses as may result from the carrier's failure to print a statement of liability limitation in the ticket can be regarded as tantamount to no notice. In the latter, it appears sufficient to print a 'notice' in a size not inconsistent with that of other information contained in the ticket so that the ordinary passenger concerned with the terms of the contract can catch sight of it without much difficulty. This accords with art 3(2) of the unamended Convention that the absence, irregularity, or loss of the ticket will not affect the validity of the contract of carriage or the Convention's applicability.83

2.4.3 Efficient sanctions against non-compliance: It will be clear by now that any sanction of the carrier under negligence is justified only when he did not deliver the ticket at all to either the passenger or his agent,84 when he failed to print a 'statement' of liability limitation, or when he omitted to contain such particulars as the name and address of the carrier(s).85 In these cases of non-compliance with the requirement of notice, proper sanctions would certainly be deprivation of liability limitation.86 The carrier need not be deprived of liability limitation where he had delivered the tickets to the agent acting on behalf of a group of passengers but the agent failed to hand over the ticket to his client-passengers.87 Thus, the carrier's permission to allow a passenger to embark without a valid ticket having been delivered to his agent, should not be equated with losses resulting from the carrier's fault. Indeed, there is no reason not to expect in the future a simple ticket without any conditions of carriage printed on it like one used in carriage by rail or by sea.88

2.4.4 Warsaw Convention cases: It was held by some American courts that the prescribed 'statement' ('notice') provision was necessary to "give the passenger fair warning of the existence of limitations on the carrier's liability",89 thereby affording a "reasonable

83. Unamended and amend Convention, art 3(2); Drion, 224.
84. Juglart, II(3278); Drion, 251 [mainly on the basis of the drafting history of art 3(2)].
85. Art 3(1)(d).
86. Drion, 223.
87. Drion, 252.
88. Id, 252.
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opportunity to take self-protective measures\(^{90}\) against liability limitation. As we have shown, these decisions can be justified from the economic approach only under the negligence rule and to the extent that presumed fault liability is deemed a form of the negligence rule. Again, in the case of a contract entered into between the carrier and an agent acting on behalf of a group of passengers, the agent should be held liable for belated delivery or non-delivery of the ticket to the individual passenger for whom he is acting. For these reasons, the decision in *Mertens v. Flying Tiger Line, Inc.*\(^{91}\) is flawed.

Although the Convention, whether unamended or amended, nowhere requires a specified print design or size for the 'statement' or 'notice', American courts began to read into the provision such a requirement towards the adoption of the Montreal Agreement 1966.\(^{92}\) In *Lisi v. Alitalia*,\(^{93}\) the court equated the "diminutively sized" and "camouflaged in Lilliputian print" with non-delivery of the ticket. In so ruling, the court grounded its judgment on the construction that the 'statement' or 'notice' should be reasonably legible so as to alert the passenger against limited liability. The validity of these decisions was questioned even by the dissenting judge in the *Lisi* court who termed the judgment as "judicial treaty-making".\(^{94}\) This criticism is justified from economic approach, since the Agreement adopted strict liability\(^{95}\) under which no such 'notice' is necessary if the damages equal the actual damage caused. Although the *Lisi* decision was followed in some other American cases,\(^{96}\) these American decisions were not followed by other countries\(^{97}\)

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91. [9 Avi 17,187 (SDNY 1963)], aff'd & rem't'd, [9 Avi 17,475] 341 F 2d 851, 856-57 (2d Cir 1965), cert den 382 US 816 (1965) (individual servicemen not given their tickets until after their boarding of the chartered aircraft which subsequently crashed on its flight to Vietnam); *Warren v. Flying Tiger Line, Inc.*, 9 Avi 17,621 (SD Cal 1964), rev'd on other grounds, [9 Avi 17,848] 352 F 2d 494 (9th Cir 1965) (ticket delivered at the foot of the boarding ramp, i.e. before embarkation, but passengers given no time to read it and take out first-party insurance and consequently the carrier not eligible for liability limitation). Juglart, II(3278).

92. Agreement CAB 18900, Clause 2 on 'Advice to International Passengers on Limitation of Liability', which stipulates no particular sanction for the breach. See also art 22(1), unamended Convention; Crans, n.9 above.

93. N.90 above, at 243 & 514.

94. *Ibid*, at 18,378 & 515, per Judge Moore (dissenting): "The majority do not approve of the terms of the treaty and, therefore, by judicial fiat they rewrite it".

95. Sec 1.3 above. For the nature of the Agreement's liability regime, see Cheng, A Reply to Charges.


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and criticised in legal writings. Indeed, no common law country outside the United States has found that there was no ticket delivery merely because of an inadequate 'notice'.

The argument that failure to give an adequate 'notice' gives rise to the carrier's unlimited liability was quashed in *In re: Korean Air Lines Disaster of September 1, 1983* and finally repudiated by the US Supreme Court in *Chan v. Korean Air Lines*. Both cases were governed the *Montreal Agreement 1966* applicable to any contract of carriage which envisaged the touching of the US territory whether as a place of departure or destination or as a stopping place. In the latter, an unamended Convention case, the issue was whether the carrier was obligated to print the 'statement' of liability limitation in 10-point type size as required by the *Montreal Agreement*. The Court held that the carrier's failure to print the notice in 8-point size should not be read into stripping the carrier of the liability limits. In so ruling, the Court pointed out that nothing in the Agreement or in art 3(2) of the unamended Convention provides for deprivation of liability limits for delivery of a 'defective' ticket.

The Supreme Court correctly ruled that the carrier will not be entitled to liability limitation only when the defect consists of failure to deliver a ticket or to give passengers proper notice of various particulars (e.g. omission of the carrier's address).

In this vein, it should be noted that the *Guatemala Protocol 1971* adopting strict liability with higher liability limits has abolished the requirement of 'notice' to be contained in the passenger ticket.

### 2.5 Regulation of Airline Safety and Security and Optimal Deterrence

In addition to civil liability for passenger losses, air carriers are also subject to regulatory control designed to ensure the safety and security of aircraft operation. We thus examine briefly the nature of such safety and security regulations and standards applicable to the air carrier, their efficiency, and the relationship between these regulations or standards and civil liability in producing optimal deterrence for the carrier.

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99. Miller, 85.


101. *Ibid* (the contract envisaging a carriage between one point in Korea, a party only to the amended Convention, and another in the United States, a party only to the unamended Convention). Treaty relationship was assumed in this case between the two states in respect of the unamended Convention. For criticism, see Gardiner, n.28 above: Miller, 38-44.


103. *Ibid*, at 124 (per Scalia, J) and see the unamended Convention, art 3(1)(d).

104. Art II (2) & II(3) inserted as new arts 3(2) & 3(3), respectively. The Guatemala Protocol 1971 virtually removed the sanctions for failure to provide a notice relating to liability limitation, effectively blockading the possibility of getting around the passenger damage limits. See arts II(3) & III(3).
2.5.1 Regulation of aviation safety in general: In the United Kingdom, Her Majesty is empowered to regulate air navigation by an Air Navigation Order for the safety of aircraft and of persons and property carried therein. The Secretary of State is charged with the general duty of promoting safety and efficiency in the use of aircraft. Specific regulatory functions are conferred on the CAA with respect to the licensing of air transport, the safety of air navigation and aircraft. The Air Navigation (No. 2) Order 1995 provides in part V entitled "Operation of Aircraft" that a person must not recklessly or negligently act in a manner likely to endanger an aircraft, or any person therein and not recklessly or negligently cause or permit an aircraft to endanger any person or property. This shows that British aviation safety regulation, formulated as target standards, requires any person engaged in the operation of aircraft to exercise due care in discharging his obligations.

In America the FAA Administrator is charged to prescribe minimum safety standards for an air carrier to whom is granted an air carrier operating certificate. When prescribing a safety regulation or standard, the Administrator should consider the duty of an air carrier to provide service with the highest possible degree of safety in the public interest. He should also perform these and other regulatory functions "in a way that best tends to reduce or eliminate the possibility or recurrence of accidents in air transportation". Given the American approach based on a performance standard, it is not clear, however, whether the Administrator's own knowledge of what best tends to do so will necessarily accord with the economic goal of optimal safety. Nor is it clear how well he is qualified to translate into, and relate to, the goal of optimal safety such a performance standard on the basis of his own consideration of the duty of the carrier to provide the service with the highest degree of safety.

2.5.2 Safety regulations and standards for maintenance and inspection: It is the duty of each carrier, both under English and American law, to inspect, maintain, overhaul and

106. Civil Aviation Act 1982, s 60(1)-(2), 60(3)(b) & (h).
107. Ibid, s 1(c).
108. Ibid, s 3(b)-(c).
110. Arts 55-56.
111. 49 USC s 44701(b)(1) (1996).
112. Ibid, s 44701(d)(1).
113. Ibid, s 44701(c).
114. See Ogus, 207 & 252.
115. Ogus, 166-67: ch 1: 7.3.2 above.
repair equipment used in air transportation. In English law, regulation of the safety of air navigation and aircraft (including that of maintenance) is mainly conducted by the Secretary and the CAA through the certification and air transport licensing functions, as will be seen in the next section. In the case of the United States, the FAA Administrator is under obligation to promote safe flight of civil aircraft by prescribing regulations and minimum standards for inspecting, servicing, and overhauling aircraft, aircraft engines, propellers, and appliances, for equipment and facilities for, and the timing and manner of, the inspecting, servicing, and overhauling. Nevertheless, the Administrator's duty of prescribing safety regulations and standards applicable to air carriers is discharged, as in English law, primarily through certification and licensing, as will be seen below.

2.5.3 Delegation of regulatory functions to the private sector: To discharge his obligations relating to inspection, maintenance and overhauling, the FAA Administrator should employ inspectors who must inspect aircraft, aircraft engines, propellers, and appliances designed for use or actually used in air transportation, and during manufacture, enabling the Administrator to decide whether the aircraft, etc. are in safe condition and maintained properly. However, given inspectors' heavy workload on inspection work and given constraints on their competence in every aspect of highly technical matters, it is questionable whether they can conduct inspection in such a manner as to produce optimal deterrence for airlines. For these reasons, the FAA delegates much of the inspection functions to the private sector. The Administrator should simply prescribe regulations and minimum standards for a qualified private person, instead of an officer or employee of the FAA, to examine and report on the inspecting, servicing, and overhauling. The Administrator may, subject to regulations, supervision, and review he may prescribe, delegate to a qualified private person, or to an employee under the supervision of that person, a matter related to i) the examination, testing, and inspection necessary for issuing a certificate and ii) the issue of a certificate. Thus, maintenance quality is in practice

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117. Civil Aviation Act 1982, ss 1(1)(c), 3(c), 64 & 68(1).

118. 49 USC s 44701(a)(2)(A) & (B) (1996).

119. Ibid, s 44713(b)(1)-(2); 49 USC s 1425(b) (1988).

120. In 1979 US airlines providing scheduled services were employing 44,467 mechanics engaged in maintenance work, whereas the FAA had only 266 inspectors at its disposal to supervise the work carried out on the entire US territory. Juglart, I(565). The disproportion between the FAA's size and its scope of task becomes more evident on the provincial level. In 1979, at the maintenance centre of Delta Air Lines at Atlanta, the FAA had five inspectors for Delta's 2,200 mechanics, while at the maintenance centre of Eastern Airlines at Miami, the FAA had four inspectors for Eastern's 3,800 employees. Juglart, ibid.

121. Ch I: 8.2.3 above.


123. Ibid, s 44702(d).
assured under the responsibility of the carrier who obviously has an adequate incentive to take due care in maintenance to avoid any liability.

Likewise, in English law certificate of maintenance review may be issued only by the holder of an aircraft maintenance engineer's license granted under the Order, by a person whom the CAA has authorised to issue such a certificate in a particular case, or by a person approved by the CAA as being competent to issue such a certificate. The person approved as such may issue a certificate of maintenance review only after first verifying that maintenance has been carried out on the aircraft in accordance with the maintenance schedule, that inspections and modifications required by the CAA have been completed as certified in the relevant certificate of release to service and that defects entered in the technical log of the aircraft have been rectified.

2.5.4 Suspension or revocation of certificates and licences: As already explained, any prospective carrier intending to engage in carriage by air must obtain an air operator's certificate, certificate of maintenance review, and maintenance engineers' licence. Thus, an aircraft may not fly unless the aircraft and its engines, together with its equipment and radio station, is maintained in accordance with a maintenance schedule approved by the CAA in relation to that aircraft. Nor is an aircraft allowed to fly unless there is in force a certificate of release to service if the aircraft or any part of it or its equipment has been overhauled, repaired, replaced, modified, or has been inspected. Failure to comply with these obligations may lead to revocation or suspension of air operators' certificates (air carrier operating certificates), licences and other documents.

In The Queen v. Civil Aviation Authority, Ex Parte Northern Air Taxis Ltd., the applicant company applied, among others, for an order of prohibition to prohibit the suspension or revocation of their certificate, contending that the CAA exceeded its powers in suspending provisionally their air operator's certificate without a period of formal prior notice. The CAA's power to suspend a certificate or licence pending due inquiry into the

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126. *Civil Aviation Act 1982*, ss 64-65; *Air Navigation (No. 2) Order 1995*, ibid, art 6; 49 USC s 44705 (1996) (air carrier operating certificate); ch 1: 8.2 above. Air operator's certificate is not a requirement imposed by the *Convention on International Civil Aviation 1944*.
127. Ch 1: 8.1.5 above.
130. 49 USC ss 44709(b)(1) & 44907(e) (1996).
131. *Air Navigation (No. 2) Order 1995*, art 71; *Civil Aviation Act 1982*, s 66; Shawcross, IV(53) & (58).
132. Divisional Court (QB), 22 April 1975. See A Kean, case note, 1 Air L (1975-76) 30.
case was authorised under the *Air Navigation Order 1974*. Before suspending the applicant company's air operator's certificate, the CAA had conducted a 10-day inspection of the company and took note of a series of infractions by the company of the safety requirements of the Order. In the opinion of the CAA, the violations individually were relatively minor, they extended over almost two years and continued operations would constitute a danger to life.

In consequence of suspension of the certificate, the applicant company found itself in what the Lord Chief Justice described as a 'situation of total disaster because of their operations being stopped'. Following the judgment of the court, the CAA decided, in compliance with the applicable procedural regulations, to revoke the certificate on the ground that the company is not competent to operate its aircraft safely. The suspension could hardly amount to what the Lord Chief Justice described as a 'bolt from the blue', because the inspector had expressed criticisms over a period of almost two years and also expressed dissatisfaction during the 10-day inspection. As this case clearly indicates, the important point is that the possibility or threat of an air operator's certificate being revoked or suspended and of being subsequently put out of business will create an adequate incentive for the carrier to take due care in complying with safety regulations.

2.5.5 Mandatory and optional security regulations: English security regulations rely largely on target standards rendering certain activities unlawful. Thus, an aircraft registered in the United Kingdom wherever it may be and no aircraft within the UK, is *prohibited* from carrying any munition of war in any compartment or apparatus to which passengers have access. It is also *unlawful* for a person to carry or have in his possession or take or cause to be taken on board an aircraft any weapon or munition of war unless it is either part of the baggage of a passenger on the aircraft or consigned as cargo to be carried thereby, unless it is carried in a part of the aircraft, or in any apparatus attached to the aircraft inaccessible to passengers and unless it is unloaded in the case of a firearm, and unless particulars of the weapon or munition of war have been furnished by

133  SI 1974/1114, art 60(1).
134  Kean, *ibid*, 31-32.
136  Kean, *ibid*, 32.
137  Kean, *ibid*, 31.
138  Ch 1: 8.1.4 above.
139  For international agreements adopted to prevent and punish various offences on board aircraft, unlawful seizure of or interference with civil aircraft, see generally Matte, pt V; Julart, II(3746)ff. For domestic legislation giving effect to them, see the *Aviation Security Act 1982* and *Aviation and Maritime Security Act 1990* (UK) and *Antihijacking Act 1974* and *Air Transportation Security Act 1974* (US); 49 USC ss 44910 (1996); Juglart, II(3802)ff & II(3852)ff.
that passenger or by the consignor to the operator before the flight commences.\textsuperscript{141} English security regulations therefore do not require air carriers to conduct search or screening to detect any weapon or munition. It is up to airlines to decide how to comply with such security target standards.

On the other hand, the American approach is mainly based on performance standards. \textit{Mandatory} security regulations require an air carrier to refuse to transport (i) a passenger who does not consent to a search involving screening establishing whether the passenger is carrying unlawfully a dangerous weapon, explosive, or other destructive substance or (ii) property of a passenger who does not consent to a search of the property establishing whether the property unlawfully contains a dangerous weapon, explosive, or other destructive substance.\textsuperscript{142} Apart from the mandatory regulations, an air carrier himself, subject to regulations of the Administrator, may refuse to transport a passenger or property the carrier decides is, or might be, inimical to safety (\textit{permissive} or \textit{voluntary} security regulations).\textsuperscript{143} Under the American approach, these security performance standards are further subject to regulation of screening.

2.5.6 Screening of passengers and baggage: When prescribing a security regulation, the FAA Administrator should consider whether a proposed regulation is consistent with protecting passengers and the public interest and require, to the maximum extent practicable, "a uniform procedure for searching and detaining passengers and property to ensure their safety and their courteous and efficient treatment by an air carrier" (his agent or employee).\textsuperscript{144} The Administrator is charged to prescribe regulations requiring screening of all passengers and property that will be carried in a cabin of an aircraft in air transportation.\textsuperscript{145} The screening must take place prior to boarding and be carried out by a weapon-detecting facility or procedure used or operated by an employee or agent of an air carrier or foreign air carrier.\textsuperscript{146} Each carrier must thus conduct screening "to prevent or deter the carriage aboard airlines of any explosive, incendiary device, or a deadly or dangerous weapon on or about each individual's person or accessible property, and the carriage of any explosive or incendiary device in checked baggage."\textsuperscript{147} Thus, an airline has a duty to conduct searches of the carry-on baggage of boarding passengers with the highest possible degree of care, and to prevent the carrying aboard of unauthorised weapons

\textsuperscript{141} Ibid, art 46(3)(a)-(b).
\textsuperscript{142} 49 USC s 44902(a)(1)-(2) (1996).
\textsuperscript{143} Ibid, s 44902(b).
\textsuperscript{144} Ibid, s 44903(b)(2)-(3).
\textsuperscript{145} \textit{Air Transportation Security Act}, 49 USC Appd s 1356(a) (1988); 49 USC s 44901(a) (1996).
\textsuperscript{146} Ibid.
\textsuperscript{147} 14 CFR s 108.9(a) (1986).
where such prevention can reasonably be achieved.\(^{148}\) This clearly indicates that the goal and actual effect of screening will induce the carrier to exercise due or high care.

In *In re Air Disaster at Lockerbie, Scotland, on Dec. 21, 1988*,\(^{149}\) one of the issues before the court was whether Pan Am’s x-ray screening of unaccompanied interline bags violated FAA directives concerning inspection of baggage, including unaccompanied one, which might contain explosive devices. Although the exact cause of the terrorist bombing was not known, plaintiffs contended that the bomb hidden in a suitcase had travelled from Malta to Frankfurt to be transferred there to the first leg of Flight 103 bound for New York via London.\(^{150}\) The FAA had established in 1986 specific ACSSP (Air Carrier Standard Security Program) regulation XV C.1.(a) concerning the detection of unaccompanied bags, under which an airline operating out of an extraordinary security airport like Heathrow or Frankfurt was required to "[c]onduct a positive passenger/checked baggage match resulting in physical inspection or noncarriage of all unaccompanied bags".\(^{151}\) The FAA further promulgated "physical inspection guidelines" in the ACSSP which specified that physical inspection involved opening up bags and inspecting all compartments of baggage, but which did not permit x-ray inspections as a substitute for physical inspection.\(^{152}\)

Pan Am, however, found the process for identifying unaccompanied interline bags too "cumbersome and expensive", stopped and eliminated physical searches of such bags to simply x-ray them and to put on board, and alleged that their x-ray inspection of interline bags complied with FAA requirements and that no bomb was discovered.\(^{153}\) The defendant airline also sought to present documentary evidence in the form of British Department of Transport documents and circulars to argue that Pan Am’s reliance on X-raying interline bags would have complied with British security regulations.\(^{154}\) The court held that the overwhelming evidence at trial established that Pan Am ignored repeated warnings and signals that its existing security measures were insufficient".\(^{155}\) That evidence supported the jury’s conclusion that but for Pan Am’s wholly inadequate terrorist prevention techniques and its deliberate indifference and overt acts of willfulness, the bombing and the
senseless loss of life would not have occurred". The court noted that the exclusion of the evidence was proper, because the documents and circulars neither had the force of law nor were in effect at the time of the accident.

2.5.7 Relationship between regulation and civil liability: The Lockerbie decision makes it clear that the FAA's ACSSP security regulation requiring physical inspection of opening up and inspecting all compartments of baggage will induce the carrier to take at least due care, and often excessive care, given the high costs involved in compliance with such procedures. Failure to detect a pistol in a carryon bag may thus leave the airline negligent. As to a safety regulation, some US courts took the view that the violation of a safety regulation, or failure to perform a duty imposed by regulation for the public safety, constituted actionable negligence or negligence per se. When this view is adopted, compliance with a safety regulation may represent the exercise of due care. Other US courts, however, admitted the violation of a regulation merely as some evidence of negligence. Compliance with regulations, and the receipt of appropriate certificates or licenses to that effect may thus be admissible evidence of due care, but may hardly provide a conclusive evidence of due care. Here may lie the difference in American law between regulation and civil liability in terms of their ability to produce optimal deterrence. In English law, however, there does not appear to exist much difference between the two in producing optimal deterrence, since safety regulation, just as tort liability, prohibits "negligent" or "reckless" action as already explained.

3. Accident, Causation and Burden of Proof under the Warsaw Convention System

In the previous chapter, while discussing the notion of causal link, we saw that the legal requirement consists of two components: necessary (but-for) and proximate cause. In what may be viewed as a parallel causal requirement, the Convention links liability for passenger injury or death to a rebuttable presumption of the carrier's fault (thus shift in the

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156. Ibid, at 820.
159. E.g. Eastern Airlines Inc., v. Union Trust Co., 221 F 2d 62 (DC Cir 1955), cert, granted and judgment rev'd on other grounds. 350 US 907 (1955); L S Kreindler, Aviation Accident Law, para 10.02[5][a]. It may be noted that even if negligence is admitted, it is quite another matter for a plaintiff to discharge his burden of proof for recovery, i.e. the negligence constituted the proximate cause of the injury.
160. Citrola v. Eastern Airlines, Inc., 264 F 2d 815 (2d Cir 1959); Hough v. Rapid Air, Inc., 298 SW 2d (Mo 1957); Kreindler, ibid, para 10.02[5][b].
162. Sec 2.5.1 above.
163. Ch 1: 5.2 above; Cane, ch 3 & p.94 & 103.
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usual burden of proof)\textsuperscript{164} and relates the foreseeability test to such defences as 'all necessary measures' or 'impossibility' exonerating him from liability.\textsuperscript{165} This delicate but precarious balance, the so-called \textit{quid pro quo}, has drawn much criticism. Furthermore, since the Convention simply refers to an "accident which caused the damage" without offering a definition of 'accident', controversy has arisen over whether an 'accident' is a necessary condition of resulting damage to hold the carrier liable and to entitle the injured passenger to damages. In order to analyse the causal requirement under the \textit{Warsaw Convention}, it is assumed that parties are risk neutral; that presumed fault liability as adopted by the Convention is a form of the negligence rule, since such presumption is always rebuttable; and that unforeseeability of a consequence may be equated with a situation where an injury occurs despite all necessary measures taken by the carrier.

3.1 Causation, Burden of Proof and the Doctrine of \textit{Res Ipsa Loquitur}

Example 2.2 Suppose a commercial aircraft of an airline on an international carriage as defined under the \textit{Warsaw Convention}\textsuperscript{166} was hijacked, diverted from its intended destination and landed at an airport in a third country on the orders of several hijackers who were armed with guns and firearms they smuggled into the aircraft when boarding. Suppose also that while the hijackers were negotiating with the authorities of the country on their demands, heavily armed security forces of the country blasted the doors open and killed or captured the hijackers and that several passengers were injured by the hijackers during their shooting against the security forces. It is assumed that the airline had taken all reasonable measures to prevent hijacking and to avoid liability that may arise therefrom\textsuperscript{167} and that the injured passengers committed no contributory negligence during the shooting. In this Example, a chain of causation relevant to the injury started with hijacking and the airline conducted all normal, reasonable procedures and its failure to screen out suspected hijackers or to ferret weapons could not be regarded as the most immediate and direct (proximate) cause of the injury. This is because it is conceivable that the hijackers surrendered without shooting or that someone may carry weapons intending to use after landing at the destination.

\textsuperscript{164} Art 17 provides: "The carrier shall be liable for damage sustained in the event of the death or wounding of a passenger or any other bodily injury suffered by a passenger, if the accident which caused the damage so sustained took place on board the aircraft or in the course of any of the operations of embarking or disembarking".

\textsuperscript{165} Art 20(1). This provision originated from the concept of 'due diligence' which most closely matches that of 'absence of fault' in French law. See Miller, 66-67; see 1.3 above.

\textsuperscript{166} Sec 1.2 above.

\textsuperscript{167} The assumption would be reasonable, since hijacking has occurred despite reasonable measures taken by airlines to prevent it.
In order to determine the proximate cause of the injury of some passengers, it is necessary to inquire whether the military operation conducted to end hijacking was a cause sufficiently independent to break the causal chain triggered by hijacking.\textsuperscript{168} In other words, was the military operation an inevitable result of hijacking (i.e. hijacking was the cause of the operation)\textsuperscript{169} or did the hijacking merely facilitate the occurrence of the military operation?\textsuperscript{170} In the case of the former, the causal sequence was not broken and the injury was proximately caused by hijacking, while in the latter, hijacking was a mere necessary cause and the proximate cause of the injury must be attributed to the military operation. In any case, the efficient outcome would require imposition of liability on the carrier regardless of whether the injury sustained by some passengers occurred as the result of an accident or whether such injury had been foreseeable or not. This is because it is reasonable to assume that the hijackers have assets insufficient to meet their potential liability and that the carrier is better placed to minimise such losses by undertaking appropriate security steps or by buying adequate liability insurance.\textsuperscript{171}

3.1.1 Constraints on causation: As already explained in Example 2.2 above, the carrier's failure to screen out the passengers suspected of hijacking attempts was a mere necessary cause of the passengers' injury and one may not attribute the injury \textit{directly} or \textit{proximately} to the carrier's failure to prevent the hijackers from boarding or to ferret weapons during normal baggage screening. And if the causal requirement were strictly observed, liability should probably fall on the hijackers because we can reasonably ascribe the injury of some passengers to hijacking or to the military operation as its proximate cause (\textit{causa causans}). Nevertheless, imposing liability on the hijackers, let alone on the security forces, would have little effect on future avoidance of similar losses. Only when liability is imposed on the carrier, he will be adequately induced as the cheapest cost avoider to take optimal precautions to reduce risk (e.g. by conducting thorough screening of carryon bags and baggage, by searching cargo compartments before flight, by screening out weapons before boarding and by stationing highly-trained, anti-terror security stewards on board). It would clearly be infeasible for the entire travelling public to take precautions against such risk, given their imperfect information about its frequency and magnitude.

3.1.2 Rebuttable presumption of fault under the negligence rule: In aviation accidents, whereas disputes about the cause of injury are rare, the cause of accident is frequently not

\begin{footnotesize}
\textsuperscript{168} Margo, 286.


\textsuperscript{170} See Margo, 285-86. In this latter case, the operation would constitute either an intervening, concurrent or contributing cause of the injury that resulted. See \textit{Fooks v. Smith} [1924] 2 KB 508.

\textsuperscript{171} See the decision in \textit{Husserl v. Swiss Air Transport Co., Ltd.} in sec 3.1.5 in fine below.
\end{footnotesize}
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certain.\textsuperscript{172} Still, since some accidents occur even without anybody's fault, this has often presented substantial difficulties for the victim or his relatives to prove the carrier's fault. By contrast, the carrier is at least in a superior position to present an acceptable \textit{factual explanation} of an accident having already happened without his fault; and at most the carrier is in almost exclusive control of the evidence that the accident was not caused by his negligence.\textsuperscript{173} In these circumstances, it is doubted that a mere presumption of fault and transfer of the usual burden of proof to the defendant would create an appropriate incentive for the carrier to take optimal care. This is because whenever the carrier considers unfavourable to himself relevant facts and evidence on the probable cause of the accident which are under his exclusive control, he will have an incentive to cover them up. The carrier's reluctance to make known relevant facts would incur otherwise unnecessary administrative costs for the courts to determine negligence and causation.

3.1.3 The doctrine of \textit{res ipsa loquitur}: The rule of presumed fault also has less of practical value and import than it appears to have, because courts sometimes resort to \textit{res ipsa loquitur} ("The thing speaks for itself").\textsuperscript{174} Although it is not clear whether \textit{res ipsa loquitur} represents a doctrine of causation, a principle of circumstantial evidence or a method of proof,\textsuperscript{175} \textit{res ipsa loquitur} is generally regarded as creating \textit{a permissible or probable inference under certain circumstances}.\textsuperscript{176} It is true that leaving aside certain theoretical differences between the rebuttable presumption of fault and \textit{res ipsa loquitur}, under either rule the passenger wins when the carrier's negligence is established; and the passenger loses when the carrier is found free from any fault.\textsuperscript{177} In other words, both the presumption and inference of fault are pegged to the establishment of negligence. Just as the presumption of fault may be rebutted, so the inference may not be allowed \textit{under certain other circumstances}.

Nevertheless, the uncertainty\textsuperscript{178} over the application of the \textit{res ipsa loquitur} test should not be confused with its practical effect if it is in fact applied. Even though it is admittedly difficult to distinguish between \textit{res ipsa loquitur} cases and those to which it does not

\textsuperscript{172} See e.g. TT, 22 Dec. 1994, p.3. Cause of US Crashes Puzzles Investigators.
\textsuperscript{173} Drion, 33.
\textsuperscript{174} Drion, 33 & 35; Miller, 68 & 52; Shawcross, I(113); Speiser & Krause, Aviation Tort Law, paras 13:4 & 1:9-1:16.
\textsuperscript{175} See Hart & Honoré, 419 & 425.
\textsuperscript{176} "Where the instrumentality involved in an accident is within the exclusive control and management of the defendant and where the accident would ordinarily have not happened in the absence of the neglect of some duty owed to the plaintiff, then evidence of circumstances, if not sufficient, would justify an inference of negligence and shifting of the burden of explanation to the defendant", \textit{Citroia v. Eastern Airlines}, 264 F 2d 815 (2d Cir 1959); \textit{Sweeney v. Erving}, 228 US 233, 240, 33 S Ct 416 (1913); Lowenfeld & Mendelsohn, 521; Hart & Honoré. 419; Juglart, ll(3354); Cane, 265.
\textsuperscript{177} Lowenfeld & Mendelsohn. 522.
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apply,179 once the test is in fact applied, plaintiff will be relieved of the burden of proof. This provides substantial benefits to the plaintiff and adequate incentives to the carrier for accident avoidance, given the carrier's incentive to control information on the accident under the ordinary negligence rule. Indeed, under *res ipsa loquitur* the accident itself affords "reasonable evidence, in the absence of an explanation by the parties charged, that it arose from want of proper care, and that the plaintiffs by proving the crash of the aeroplane into the building made out a prima facie case of negligence on the part of the defendant".180 And in the 1960s, the *res ipsa* test justified its inference of the carrier's fault not just in explicable and inexplicable aeroplane crashes but in the complete disappearance of a plane.181 This is why it has been argued that the practical effect of *res ipsa loquitur* is to depart from fault liability and move towards strict liability.182

3.1.4 Restatement of 'accident' and causation: Obviously, hijacking and resulting injury in Example 2.2 above constitute an 'accident', whether as the cause or consequence, within the meaning of art 17 of the Convention. This is because hijacking, which will not happen in the normal course of events,183 took place on board and caused injury to passengers. For the purpose of art 17, the only important points are whether there occurred in point of fact any harm to the integrity of passengers' life and limb and how the law can attribute the losses to minimise such accident and its avoidance costs. It would thus be pointless to inquire whether the injury was *caused* by an 'accident' or 'intentionally'.184 The term 'accident' is indeed often used to denote both cause and consequence without distinction185 and therefore need not necessarily be the cause of the death or injury complained of. Although the French Cour de cassation in *Haddad v. Cie Air France*186 held that the airline had no power to exclude particular passengers merely for their suspicious appearance, this should not be read into justifying the exemption of its liability for damage caused as the result of hijacking by the suspects. In another French case involving armed hijackers on board, the airline was correctly held liable by the same court rejecting the argument that the airport authorities were responsible for security checks.187

A point of caution is that an accident, nevertheless, does not include such injury or death as resulting "solely from the state of health of the passenger"188 or from his own internal or

179. Hart & Honoré, 419.
181. Lowenfeld & Mendelsohn, 521.
182. Hart & Honoré, liv.
183. Cheng, A Reply to Charges, at 12.
186. Sec 4 AASL (1979) 686 (CA Paris, 19 June 1979); Juglart, 1(2778) & (2781); n.193 below.
188. Guatemala Protocol, new art 17(1).
natural reaction to normal, usual and expected operation of the aircraft. This can be explained on efficiency grounds, since in this case the passenger concerned is the best judge and the cheapest cost avoider of such risk, and he therefore should take necessary precautions to avoid such losses before boarding. Indeed, if he is not induced to take care against the threat of his own health and safety, it is doubted whether other incentives will work. Discerning injury from internal or natural causes will not be difficult nor costly. Nor will there be any danger of 'floodgate claims' for compensation for injury suffered from one's own health problems during a normal international carriage, as demonstrated in the meagre volume of case law on this issue and by the clarity of court decisions.

3.1.5 Warsaw Convention cases on accident: In *Air France v. Saks*, the US Supreme Court held that an accident must be an "unexpected or unusual event or happening that is external to the passenger". In other cases, an accident has been defined as an "unlooked-for mishap or untoward event" which caused physical injury or death to the passenger, or as a sudden event independent of the will of the carrier. As such, no question is raised either by the Convention or by courts' decisions as to how an 'accident' was caused. The important point is whether there happened any compensable damage as a consequence of, or in the course of, the carrier's activity. This is compatible with the literal reading of art 17 which leads to the conclusion that it does not matter who or what caused injury or how it was caused, viz. by fault, by 'accident', whatever the term exactly means, or otherwise.

Although the Convention's text speaks of the "accident which caused the damage", the phrase is not conceived of as requiring that the injury or death ensue as the result of an 'accident'. This is apparent in cases of wilful misconduct which may not be regarded as 'accidental' but nevertheless, the carrier will still be liable when found guilty of wilful misconduct.

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190. See 2.3.3 above, in fine.


192. For various types of 'accident' under art 17, see n.275 below.


194. See TT, 6 April 1994, p.1 for the crash of an Aeroflot Airbus A310 caused by the pilot's teenage son who, left alone at the controls, tampered with the auto-pilot.

195. Art 25; sec 4.2.1 below; Margo, 150-51.
of and subsequent detour by defendant's aircraft during its scheduled flight from Zurich to New York, the defendant argued that hijacking constituted an intentional act and not an 'accident' within the meaning of art 17. Rejecting this, the court held that proceedings leading to the Montreal Agreement 1966 indicated plainly that sabotage was expressly discussed to render the carrier liable to the innocent victims of such intentional acts and that a hijacking is within the ambit of 'accident' and sufficient to raise the presumption of liability. It further ruled that the Convention functions to redistribute the costs involved in carriage by air and that the carrier is best qualified to avoid such incidents and to assess and insure against the risks associated with his activity.

3.2 Accident, Foreseeability and the Defence of All Necessary Measures

Foreseeability is a legal device to limit liability for the consequences of negligent action and is, from the economic approach, not so useful to determining the existence and extent of liability as it is assumed to be. In what can be regarded as a provision comparable to foreseeability, the Warsaw Convention provides the carrier with the defence of all necessary measures. In order to examine foreseeability in the Warsaw Convention context, let us consider a situation where the pilot of an aircraft on international carriage came across a clear air turbulence but did not light the 'Fasten Your Seat Belt' sign because a moderate turbulence which was unlikely to cause injury to unsecured passengers had been forecast and as the result some passengers were severely injured. Here, foreseeability of injury from air turbulence is construed as meaning that the pilot (or the carrier) would have known that if seat belt had not been worn in the presence of air turbulence, injury would probably have resulted. And unforeseeable losses may be defined as losses that occur anyway regardless of the injurer's level of care, i.e. those that he could not avoid by taking all necessary measures.

3.2.1 Foreseeability and the defence of all necessary measures under the negligence rule and strict liability: If the liability rule is the negligence rule and if the injury from air turbulence had been foreseeable to the pilot but he had failed to warn the passengers of the danger and to require passengers to wear seat belt, the pilot was clearly negligent in exercising due care to avoid such injury and the carrier will duly be held liable for the

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197. Ibid, at 17,640-41; Juglart, II (3238); See H Gam (1988); Burnett v. TWA, [12 Avi 18,405] 368 F Supp 1152 (D NM 1973) (detour).
198. Ibid, at 17,640.
199. Ibid, at 17,650.
200. Ch 1: 5.2.3 & 5.2.4 above.
201. See ch 3: 3.2 below for the rule of vicarious liability.
202. See Shavell. 107-08.
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injury caused. So the defence of all necessary measures will not be necessary under negligence if the injury had been foreseeable. On the other hand, if under the negligence rule the injury had been 'unforeseeable' to the pilot (e.g. where the turbulence occurred so suddenly and unexpectedly that the pilot had no time to warn the danger), he could not have avoided it even with due care and could not be held negligent in failing to warn of the danger. Hence, the carrier will not be liable for such unforeseeable losses and the defence will not be necessary again.

Under strict liability, the carrier will be held liable for all the losses they may cause, whether they were foreseeable or not, and the defence of all necessary measures will not be necessary. If liability is imposed on the carrier for unforeseeable losses, he will be forced to take all justified precautions to avoid losses or to take out adequate insurance that will maximise the utility of a risk-averse carrier. The carrier as the cheapest cost avoider should therefore be liable for all the consequences resulting from his activity, whether foreseeable or not. This will produce the efficient outcome because of the price deterrence mechanism of the market, even if the passenger has imperfect information about expected harm and is thus unable to take optimal care or to buy adequate first-party insurance.

3.2.2 Irrelevance and redundancy of the foreseeability test: Without prejudice to certain utility of the foreseeability test, it will often not be easy to distinguish between foreseeable and unforeseeable losses. Thus, in a situation described above, was the severe injury of some passengers from a moderate clear air turbulence foreseeable? It may be said that the pilot did not take all necessary measures in the sense that he at least should have made, as a precaution against passenger injury, an announcement of an expected moderate turbulence to make passengers refrain from moving around for the moment. This is nevertheless not necessarily because such injury was foreseeable. Foreseeability that is applied in negligence actions is thus regarded as a test more favourable to the defendant than the test of all necessary measures or that of proximate cause. Since foreseeability is to be determined in each case and it is almost impossible to set out objective standards applicable uniformly to like situations, foreseeability tends to produce neither a predictable

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203. In this case, the injured passengers will have to bear the losses himself. This is the efficient result, insofar as they have been fully informed about such risk and given the chance in advance to take appropriate precautions or to buy adequate first-party insurance. Otherwise, the result would be inefficient.
204. Morris, Enterprise Liability.
205. Ch 1: 5.1.4 above. As the prices of the carrier's products exactly reflect the full costs of his activity including liability payments, he will engage in the efficient level of activity, while passengers will also be induced to buy the efficient quantity of products even if he is not fully informed of risk.
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nor uniform result. It is thus arguable that the carrier should be held liable even under the negligence rule for all consequences of his negligence without setting such artificial and even arbitrary restrictions on the injurer's liability as 'unforeseeable' losses.\textsuperscript{207}

This argument accords with the reading of the Convention's text which does not warrant any valid distinction between foreseeable and unforeseeable accidents in aircraft crashes, hijackings, bomb threats or even in-flight food poisoning.\textsuperscript{208} Indeed, almost every aviation accident is in a sense fortuitous, unexpected and thus unforeseeable and it would be inappropriate to inquire into foreseeability of harm in each case. This is because under the Convention's presumed fault liability, the carrier as a rational profit-maximising entrepreneur has more accurate information about such risk, can better weigh up all the risks arising from his activity, and can choose between accident and its avoidance. The nondistinction between foreseeable and unforeseeable losses would also be cheaper administratively because there will not arise the question of determining what constitutes the 'foreseeable' in each case. As such, from the economic approach the foreseeability test as represented in the defence of 'all necessary measures' is an inadequate criterion for determining liability in an aviation accident.

3.2.3 Warsaw Convention cases: The principle of "all reasonably necessary measures" was established in the pioneering case, \textit{Grein v. Imperial Airways, Ltd}.\textsuperscript{209} and was followed in many cases including \textit{Swiss Bank Corp. v. Brink's-MAT Ltd}.\textsuperscript{210} In \textit{Goldman v. Thai Airways International Ltd.},\textsuperscript{211} the trial court held that all necessary measures meant all those measures necessary "in the eyes of the reasonable man", i.e. "all reasonably necessary measures".\textsuperscript{212} The court then ruled that the defendant carrier had not made out their case, because, despite a clear air turbulence that had been forecast for the particular section of the international carriage, the pilot failed to light the 'Fasten Your Seat Belt' sign in advance to warn passengers of the risk of injuries in the presence of clear air turbulence. These are all obvious cases of failure by the carrier to take all reasonable measures, and the court duly held the carrier liable for the damage caused.

Nevertheless, if, as assumed, presumed fault liability as adopted by the Warsaw Convention is a form of fault liability, one may still doubt whether the phrase "all necessary measures" has actually added to any clarification of the negligence standard and has thus

\textsuperscript{207} See Landes & Posner, Causation in Tort Law, 117; ch 3: 3.3.2 below.

\textsuperscript{208} Shawcross, VIII(153).

\textsuperscript{209} N.14 above; Juglart, II(3259).

\textsuperscript{210} Unreported on this point. See [1986] QB 853, [1986] 2 All ER 188; \textit{Preyval v. Cie Air France} (Trib Comm Nice. 7 May 1973), 27 RFDA (1973) 345; Miller, 161-66; Shawcross, VII(116) n.11.


\textsuperscript{212} Juglart, II(3258), citing \textit{Manufacturers Hanover Trust Co. v. Alitalia}, 14 Avi 17,710 (SDNY 1977).
given the carrier any guide as to the proper level of care in various different circumstances.\textsuperscript{213} Further ambiguity exists under the Convention because of the presence of the carrier's defence of the impossibility to take such measures, however scant its probability is. Hence, the defence of all necessary measures was rejected in \textit{In Re Air Disaster at Lockerbie, Scotland on December 21, 1988},\textsuperscript{214} which arose from a bomb explosion on board a Pan Am jumbo airliner. Similarly, it is also economically sound that the Guatemala and Montreal Protocols have abolished the defence of all necessary measures and adopted strict liability with an unbreakable limit.\textsuperscript{215} This is justified on efficiency grounds not only because the liability limit keeps the insurer's administrative costs down and manageable and but because strict liability reduces all the costs of procrastinated litigation, costs of expert opinions, witness statements and so forth.\textsuperscript{216}

\subsection*{3.3 Trend in Causation Rules under the Warsaw Convention System}

It is obvious from the reading of the unamended and amended Convention that the carrier will be exempt from liability if he successfully proves that he took "all necessary measures" to prevent such losses.\textsuperscript{217} This is clearly not the efficient nor desirable outcome as already explained.\textsuperscript{218} This reasoning is largely consistent with and well reflected in succeeding international agreements and the \textit{Montreal Agreement 1966} under which the defence of "all necessary measures" is no longer available to the carrier.\textsuperscript{219} As the carriers under the Agreement waived all the otherwise available defences except that of contributory negligence, they will be liable even for the damage caused by armed conflict and civil disturbance.\textsuperscript{220}

The \textit{Guatemala Protocol 1971} also substituted the wording "event (événement) which caused the death or injury" for the original one "accident (accident) which caused the damage".\textsuperscript{221} The movement towards no-fault liability has been combined with the adoption of the unbreakable limit in that Protocol.\textsuperscript{222} For these reasons, the liability regime of the

\textsuperscript{213} See Juglart, I(2769) & (2780).
\textsuperscript{215} Art VI inserted as new art 20 & art VIII inserted as new art 22.
\textsuperscript{216} R P Boyle, The Warsaw Convention - Past, Present and Future, in A Kean, Essays, 1, 12.
\textsuperscript{217} Art 20(1).
\textsuperscript{218} See 3.1.3 above.
\textsuperscript{219} Sec 1.3 above. The last paragraph of Clause 1 of the Agreement even abolished the term 'accident'. See J N Onek, The Montreal Agreement and Enterprise Liability. 33 JALC (1967) 603.
\textsuperscript{220} Cheng, A Reply to Charges, at 12.
\textsuperscript{221} Art IV inserted as new art 17(1). Art IV(1) of the said Protocol also attempted to avoid the rather ambiguous wording in the unamended Convention by substituting 'personal injury' (préjudice) for 'wounding or any other bodily injury'.
\textsuperscript{222} The limit of 1,500,000 gold francs is unbreakable even if the carrier has acted with wilful misconduct under art X of the Protocol intended to replace art 25 of the unamended Convention.
Warsaw Convention system has effectively been shifted from the original *de jure* presumed fault into a *de facto* strict liability. This argument is grounded upon the wider application of *res ipsa loquitur* and upon the difficulties the carrier faces in exonerating himself from liability through the defence of "all necessary measures".

4. Compensable Damages under the Warsaw Convention System

We have so far demonstrated through the application of economic analysis that the legal device of causal requirement consisting of necessary and proximate cause is neither quite relevant nor useful to determining the liability of the carrier under the Warsaw Convention. Now, once causal link has been established, the level of damages must be determined. The amended as well as unamended Convention provides for the carrier's limited liability for the death, wounding, or other bodily injury of a passenger, except for those losses caused by his wilful misconduct. For some time, opposition to limited liability was so strong in some states parties to the Convention that they invoked their own constitutional provisions such as the 'inviolable rights of man' or 'due process of law' and 'equal protection' to strike down the validity of the duly ratified treaty and its liability limitation provisions. Two questions are embedded here. First, does limited liability make any economic sense? Second, does the efficient outcome require compensation of pecuniary losses (*dommage matériel*) only or that of non-pecuniary losses (*pretium doloris; dommage moral; préjudice esthétique*) as well? Pecuniary losses mean any type of financial and economic losses incurred by the injury or death, including loss of wages and expected benefits (foregone profits or earnings), medical and funeral expenses, whereas non-pecuniary losses refer to all other forms of damage including mental pain or suffering.

4.1 Liability Equal to Actual Losses

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223 Sasseville, Air Traffic Control Agencies, at 246; art 20(1), unamended Convention; P Stern, Domestic Commercial Tort Litigation: A Proposal for Absolute Liability of the Carriers, 23 Stan LR (1971) 569, 578. Peter Martin has on different grounds proposed to impose strict liability upon carriers. See his 50 Years of the Warsaw Convention: A Practical Man's Guide, 4 AASL (1979) 233, 234.

224 Arts 17 & 22(1), unamended Convention & art XI, amended Convention.


226 Sec 4.1.6 below.

227 For the notion of economic losses, see Shavell, 135.

228 Miller, 112-13. 125-26; Juglart, II(3248); Drion. 112.
A general rule of remedies in tort is that it is essential that damages recoverable be set to equal actual losses to a good, which are taken to mean pecuniary losses sustained by the victim. If an injurer were made to pay the actual losses he causes, his expected liability will equal expected losses to produce the right amount of deterrence on him. However, if damage is to human life or limb, it would usually accompany, to the victim or his relatives, some forms of disfigurement, loss of mobility and pain and suffering, which may collectively be called *nonpecuniary* losses.

4.1.1 Compensability of non-pecuniary losses: If nonpecuniary losses do not involve a direct loss in the market earning capacity of the injured, they would have no pecuniary dimension. Nevertheless, this is not because nonpecuniary losses are not true *economic costs* but because there is no markets for injuries and mutilation. Such losses will invariably be related to a loss to the physical integrity or emotional well-being of a person injured and will often impair his market earning capacity (consider a person whose leg had to be amputated or whose eye was seriously injured in an accident). Nonpecuniary losses will thus affect the level of individuals' utilities and the measure of social welfare. If these losses were not compensated or undercompensated, however difficult it is to assess them, the aggregate social welfare would be diminished. The position would, however, be different if the victim suffered only mental suffering unaccompanied by physical injury.

4.1.2 Liability equal to the sum of pecuniary and nonpecuniary losses: In these circumstances, if the magnitude of liability equals the sum of pecuniary and nonpecuniary losses, parties will have an adequate incentive to take care. If liability fails to fully reflect nonpecuniary losses, parties' incentive, especially that of the injurer, to reduce risk may be diluted. Especially, under the negligence rule, since not all negligent offenders are detected because of huge monitoring costs, the injurer's incentive to take care is stronger the higher the level of liability imposed on the wrongdoer. Even if nonpecuniary losses were awarded on top of pecuniary losses in negligence cases, the carrier will not be led to take excessive care to the extent that errors of quantum do not matter in the injurer's incentive to take care or that the victim has substantial non-financial utility in his own safety.

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229. Shavell, 127. If the injurer were forced to pay more than actual losses, some economical accidents might also be deterred; If he were permitted to pay less, some uneconomical accidents would not be deterred. Posner, 143.

230. Shavell, 126, 133-34.

231. It is important to remember that the right amount of deterrence is produced where the injurer's cost of taking an additional unit of care exceeds the reduction in harm that results.

232. Posner, 149.

233. Posner, 149.

234. See *Eastern Airlines Inc. v. Floyd* in s 4.1.6.

235. Shavell, 133-34.

Compensability of nonpecuniary losses is therefore not so much related to parties' incentives to take care as it is to the administrative costs of measuring them and their insurability.\(^{237}\)

4.1.3 Effect of limited and unlimited liability on incentives: Under the negligence rule, as already stated, the higher the level of liability imposed on the wrongdoer, the stronger his incentive to take care. Thus, even if unlimited liability is imposed on the carrier under the negligence rule, he will not be led to take excessive care. This is similar to a situation where imposition of liability on the manufacturer for 'unforeseeable' losses would not lead him to take excessive care.\(^{238}\) Under strict liability, the injurer has already an adequate incentive to take all justified precautions in order to reduce risk and to avoid liability and the price of his service already fully reflects his liability payments. If unlimited liability is imposed on the injurer under strict liability, he would probably be over-deterred and his activity would be below the optimal level. In fact, limiting the injurer's liability to certain maxima under strict liability is equivalent to limiting it to his assets and to deciding against imposing vicarious liability on his shareholders.\(^{239}\)

4.1.4 Administrative costs: Unlimited liability is likely to create an additional incentive for the victim and his relatives to bring an action than is the unbreakable limit, thus increasing the courts' administrative costs. The victim or his relatives would also have an additional incentive to do so when they are awarded damages for mental pain or suffering than when they are given compensation only for physical injury. Under unlimited liability, huge administrative costs will probably be incurred for courts to assess the exact level of damages for death or injury accompanied by pain and suffering in a collision case involving hundreds of passengers.\(^{240}\) One way of avoiding these huge administrative costs is to award average damages based on courts' judgements or insurance payments.\(^{241}\) By contrast, strict liability with liability limits has at least three advantages:\(^{242}\) ensuring certainty and speedy recovery for the victim, reducing litigation issues merely to questions of quantum, and protecting the carriage by air activity from catastrophic losses and reducing administrative costs of possible actions against shareholders.\(^{243}\)

\(^{237}\) Sec 4.1.4 & 4.1.5 below.

\(^{238}\) Ch 3: 3.3.1 below.

\(^{239}\) Shavell, 175; ch 3: 3.2 below (vicarious liability).

\(^{240}\) See in this context the settlement process during trials in two mass disaster cases - Turkish Airlines Paris Crash and the Tenerife collision. Lowenfeld. Aviation Law: Cases & Materials, 7-187ff.

\(^{241}\) Landes & Posner, Causation in Tort Law, at 132. For the reason why expected cost can be replaced with average cost, see ch 1: 2.3 above.


\(^{243}\) Shavell, 176 n.17.
4.1.5 Insurance coverage and premium-setting: Insurers rarely provide a cover for pain and suffering, since these risks are not insurable. Nor do insurers provide an unlimited cover. It is fair to say that there is little public demand for insurance against mental pain and suffering, because pecuniary compensation will not be much of consolation for mental injury. The passenger legal liability policy usually limits indemnity per accident or occurrence, although excess cover may be arranged. Unlimited compensation by liability rules should be viewed as a last-resort substitute for liability insurance. Unlimited cover is also liable to engender the moral hazard problem to the insured carrier.

By contrast, limited liability will provide a predictable basis for calculating the risk and setting premiums with less measurement costs than unlimited liability. Premium rates are usually rated on revenue passenger miles flown by the insured carrier and may be adjusted periodically with the final premiums calculated at the close of the coverage period by reference to the insured's declarations of passenger miles flown. This, however, is not efficient, because, although an insured carrier's activity level represents its exposure to the risk of passenger damage, it does not reflect expected losses or actual losses claimed. Only when the insurer bases premium-setting on the insured accident or claims record, a risk-averse carrier will be induced to engage in the efficient amount of activity after assessing his liability insurance premiums for a given volume of activity for a given length of time.

4.1.6 Warsaw Convention cases and domestic legislation: It is generally agreed that the drafters of the Warsaw Convention and the contracting states parties thereto wanted to establish a uniform limit on the carrier's liability, which is economically sound. And the adoption of a limited liability regime was the result of balancing the interests of carriers and consumers of their services. Obviously, the most persistent objection to the Convention's liability limitation provision was attempted by US courts. Thus, in Burdell v. Canadian Pacific Airlines, Ltd., the court found that the unamended Convention's

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244. Cooter & Ulen, 467.
246. Shawcross, VIII(77) n.10.
248. One possible advantage of unlimited liability over limited one would be in relation to the possibility of strengthening the plaintiff's bargaining position. Drion, 47a.
249. See Margo, 107 n.4; Shawcross, VIII(71).
250. Re Air Disaster in Lockerbie, Scotland, on December 21, 1988, 22 Avi 17,735 (EDNY 1990), reh den 22 Avi 17,858 (EDNY 1990).
251. Drion, 44.
252. As a general rule, American courts refrain from passing judgment on the constitutionality of a statute whenever they can resolve the case without addressing it. See D M Haskell, The Warsaw System and the US Constitution Revisited. 39 JALC (1973) 483. 496; In re Pago Pago Air Crash, 14 Avi 17,598 (CD Cal 1976).
253. 18 Avi 18,151 (Ill Cook Cir 1968).
liability limit violated the 'due process and equal protection' clauses of the US Constitution and therefore was unconstitutional and unenforceable. However, since the same court had already found that there had been no 'international' carriage in that case, it later had to forego its earlier ruling on constitutionality. In In re Air Crash in Bali, Indonesia, on 22 April 1974, the court recognised the arbitrary and unreasonable nature of such a limit, but ruled that if the limit acted merely as a taking of property without just compensation, the constitutional provision might not be invoked and an alternative cause of action might lie against the US government in respect of such losses.

As to the compensability of nonpecuniary losses, a literal reading of the French text of art 17 appears to negate such an interpretation, since the provision speaks of lésion corporelle (bodily injury) as distinguished from lésion mentale (mental suffering). But the district court in Husserl v. Swiss Air Transport Co., Ltd. had attempted a broader concept of 'bodily injury' to include mental anguish unaccompanied by physical injury, which was allegedly suffered by plaintiff during hijacking. The interpretation given by the Husserl court, however, was quashed by the US Supreme Court in Eastern Airlines Inc. v. Floyd. As such, although we argued that compensability of nonpecuniary losses is much more a question of administrative costs of measuring them and their insurability, there exists uncertainty in the assessment of damages for accident losses governed by the uniform international instrument. In the absence of an unambiguous guidance on this point in international law, it may be useful to have a brief look at domestic laws, even though this chapter is admittedly concerned with the analysis of the liability regime of the Warsaw Convention system.

French law itself, unlike the Warsaw Convention, does not draw a sharp distinction between pecuniary and nonpecuniary losses and allows both dommage matériel and dommage moral (préjudice moral) to be recoverable, provided that the damage is certain and direct. English law provides for two types of actions for fatal accidents. One type of action arises under the Fatal Accidents Act 1976 which is primarily designed to allow the dependants to recover the lost income (pecuniary losses) of a person killed, plus

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254 At 18,160-61; Fifth Amendment to the US Constitution, discussed in Juglart, II(3270).
255 11 Avi 17,351. at 17,354 (III Ct 1969).
256 17 Avi 17,416] 684 F 2d 1301 (9th Cir 1982).
257 See B Monts, Due Process, Equal Protection and the Right to Travel: Can Article 22 of the Warsaw Convention Stand up to These Constitutional Foes?, 49 JALC (1984) 907, 917-45; Shawcross, VII(157).
260 Sec 4.1.2 above.
261 See Juglart, II (3248) & (3251-52); Miller, 112-13 & 115; id, Compensable Damages under Article 17 of the Warsaw Convention, 1 Air L (1975-76) 210, 213.
262 31 Halsbury's Statutes 251, as made applicable by the Carriage by Air Act 1961.
The carrier's liability

funeral expenses. The other type of action for damages ('survival action') may be brought under the Law Reform (Miscellaneous Provisions) Act 1934, which allows the estate of a person killed to recover damages for both pecuniary and nonpecuniary losses suffered by the deceased between the accident and death, plus funeral expenses. The two actions may be brought concurrently in most cases. In the United States, a majority of state jurisdictions which have accepted a no-fault system in tort law in general abolished damages for pain and suffering only. But mental pain and suffering resulting from physical injury are recoverable in American law, since US courts are generally liberal in awarding nonpecuniary losses for damage to physical integrity as already seen above in the interpretation of Warsaw Convention cases.

4.1.7 Award of interest on damages: Two points merit consideration with regard to the award of interest on damages. First, given the usually lengthy trial process of aviation litigation and mounting hardships to the bereaved families, the award of a reasonable rate of interest on damages calculated up to the date of judgment (pre-judgment interest) can induce the injurer to cooperate for a speedy resolution of the dispute. For otherwise it is to the defendant's benefit to delay. The court must therefore order payment of interest on damages "unless there are special reasons to the contrary". Where interest is awarded, it is a question to be decided by lex fori and is regarded as part of damages in many countries. In Swiss Bank Corp. v. Brink's MAT Ltd., it was held that the total sum payable, including interest, is subject to the liability limits of art 22 and that interest cannot be awarded over and above those limits. Second, the sum of damages and interest awarded should not exceed actual losses. As to the method of payout, one lump sum payment would be cheaper to administer than payment in instalments.

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264. c.41, in Statutes in Force, Tort and Delit: 3 (London HMSO).
265. S 3(1D), as inserted by the Administration of Justice Act 1969 (c.58), s 22; Cane (1993) 113. See also Chaplin v. Boys, [1971] AC 356 (HL) (damages for pain and suffering recoverable in English law); Cane, ibid, 211.
268. Juglart, II(3248).
269. For the economic meaning of interest and its elements, see Posner, 147.
272. Shawcross, VII(125)-(129); Law Reform (Miscellaneous Provisions) Act 1934, s 3.
4.2 Wilful Misconduct and Liability in Excess of Actual Losses (Punitive Damages)

The unamended Convention provides that the carrier will be deprived of the benefits of limited liability if the damage was caused by wilful misconduct on the part of himself or his servants or agents acting within the scope of his employment.\(^{274}\) And passenger legal liability insurance policies often require that injury or death be caused by an accident, i.e. some kind of 'unlooked-for mishap or untoward event' causing bodily injury or death.\(^{275}\) Losses caused by the insured's wilful misconduct may not be termed as 'accidental' losses, and as a corollary the insurer may not be obligated to pay the insured for such losses.\(^{276}\)

Assuming that wilful misconduct is a form of intentional or reckless tort,\(^{277}\) discussion here is focused on whether a distinction between intentional and unintentional misconduct is justified in aviation accidents. This will provide an appropriate basis for the discussion later of compensability and insurability of punitive damages (dommages-intérêts punitifs).\(^{278}\) It is assumed that in parallel with civil liability, penal and administrative sanctions are in force against any violation of relevant safety procedures.\(^{279}\)

4.2.1 Notion of wilful misconduct: The common law concept of wilful misconduct is broad and does not easily lend itself to an unambiguous definition. In wilful misconduct, an intention to cause harm is not usually required as a constitutive element of the act or omission. In this sense, a wilful misconduct is closer in its legal meaning to a reckless misconduct or gross negligence (faute lourde) than to an intentional or deliberate misconduct and as such, it is not an equivalent of the French law term of dol.\(^{280}\)

274. Art 25(1) & 25(2). The amended Convention gave a clearer, although still not without ambiguity, meaning to the expression 'wilful misconduct' and thus provides, "...damage resulted from an act or omission...done with the intent to cause damage or recklessly and with knowledge that damage would probably result" (italics added).


278. Ch 3: 4.2 below.


280. B Cheng, Wilful Misconduct, at 66, 72-76; id. Centrifugal Tendencies in Air Law, 10 Cur Leg Probs (1957) 200, 217-18; Miller, 73-74, 80-81, 195; Drion, 170-73; Shawcross. VII(210), n.8.
care of or with indifference to its probable consequences, while 'intentional' misconduct in law refers to a deliberate act or omission whereby the person performs the misconduct with knowledge of what its probable consequences will be, but in wanton disregard of its likely wrongful injury. But the difficulty is how to distinguish between the two on borderline cases.

4.2.2 Irrelevance of the distinction between intentional and unintentional misconduct: If, as in intentional misconduct cases, the carrier acted 'deliberately' with knowledge of its probable consequences but in wanton disregard of its wrongful injury, this means by definition that the probability of injury if the act were done is very high, whilst his avoidance costs will be minimal. Here, social benefits derived from deterring an intentional tort will be greater than in unintentional injury cases. Although an intentional tort generally will have a higher probability of losses than a reckless misconduct, both types of misconduct will substantially increase the probability of injury. Thus, the problem is that it would be practically difficult or costly for the court to attempt a distinction between a reckless or intentional and unintentional misconduct that caused injury.

More importantly, since the carrier has direct financial and other interest (dislike of adverse publicity, etc.) in accident avoidance, he already has adequate incentives not to commit an unintentional, let alone 'intentional', wrongdoing. And most accident losses are predictable and thus 'intentional' in that the carrier would recognise from his past experience the plain fact that he could have reduced the probability of the accident had he taken additional precautions. Furthermore, penal and regulatory sanctions (e.g. fines, revocation or suspension of the carrier's operating licence or the threat of imprisonment of the pilot) will play the primary deterrence role against a reckless or 'intentional' misconduct. Thus, in the absence of any considerable incentive gains derived from the distinction, the two cases would better be treated without distinction, since such a distinction in civil liability is confusing.

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284. Compare Case 5 with 7 in Table 2 in Landes & Posner, An Economic Analysis of Intentional Torts, at 134.
285. Since it is never all too clear where a deliberate intent to cause damage starts and ends, attempting a distinction may degenerate into a matter of anybody's guess.
286. Drion, 45; ch 1: 5.1.1 above.
4.2.3 *Warsaw Convention* cases: The conclusions above are consonant with the interpretation that art 17 relating to passenger injury or death contemplates only the award of compensatory damages actually sustained by plaintiff and excludes non-compensatory claims.\(^{289}\) A point of controversy during the drafting stages of the Guatemala Protocol concerned the possibility of getting rid of the liability limits for wilful misconduct.\(^{290}\) But the possibility was abrogated because breaking the limit was considered commercially unsound and could unduly encourage costly and unwarranted litigation.\(^{291}\) Indeed, punitive damages are rarely, if any, awarded in respect of airlines even in American courts.\(^{292}\) This will promote predictability of aviation risks, ensure uniformity and stability in international transactions and bring down administrative costs associated with determination of the proper level of punitive damages. Alternatively, plaintiff may be induced not to claim punitive damages by awarding him legal costs when he waives claims to them.\(^{293}\)

In *Goldman v. Thai Airways International Ltd.*,\(^{294}\) an amended Convention case involving the interpretation of the pilot's 'recklessness' for his failure to illuminate warning lights for the use of seat-belts under a clear air turbulence, the Court of Appeal took a very restrictive view on the meaning of 'recklessness'. The court noted unanimously that while recklessness was related to the existence of a risk, even of a mere possibility, art 25 speaks of probability that something is likely to happen. It was in this vein that Circuit Judge Van Graafeiland said in his dissenting opinion *In re Air Disaster at Lockerbie, Scotland, on Dec. 21, 1988*\(^{295}\) that "[t]he issue was not whether Pan Am violated the regulation; it was whether Pan Am used x-ray screening with knowledge that its use would probably result in injury or in reckless disregard of the probable consequences". Likewise, the French Cour de Cassation held in an armed hijacking case that the airline was not guilty of an intentional or reckless misconduct.\(^{296}\) Although in *Cie Korean Air Lines v. Entiope*\(^{297}\) the airline was...

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289. Shawcross, VII(115.1).
290. International Conference on Air Law (Guatemala City 1971), ICAO Doc 9040-LC/167.1, Minutes, 135 ff; Miller, 81. The French delegation argued that it was contrary to *ordre public* that anyone guilty of *dol* should be allowed to limit his liability, however high the limit was.
291. See ICAO Working Draft No. 745-15, Doc 8878-LC/162, at 51 ff, 364; Miller, 78-81. The new art 25 under the *Guatemala Protocol 1971* deleted any mention of *dol* and is thus seen as having instituted "unbreakable limits".
293. See the *Guatemala Protocol*, art VIII(3)(b) inserted as new art 22(3)(b) for settlement inducement.
294. "The doing of the act or omission is not only qualified by the adverb 'recklessly', but also by the adverbial phrase "with knowledge that the damage would probably result", per Eveleigh, LJ (CA).
295. N. 146 above, at 846.
297. Shawcross, VII(134).
found guilty of an intentional or reckless conduct, no punitive damages were sought by the plaintiff nor awarded by the French Supreme Court.

5. Administrative Costs Reduction and Private International Law Issues

We have so far discussed the efficiency of liability rules in terms mainly of resource allocation and incentive creation. Issues to be discussed here have no direct bearing on these issues but have economic relevance chiefly in relation to administrative costs reduction. There are two aspects in this respect as already mentioned: reduction of the number of cases to be litigated and reduction of judgment costs. 298

5.1 Cause of Action and Choice of Law

One of the main thrusts behind the adoption of the Warsaw Convention 1929 was to avoid as much as possible the "chaos of conflicting laws", a "jungle-like chaos" or a "veritable jungle". 299 To avoid this and achieve uniformity, the Convention established its own choice of law rule by referring a number of questions to lex fori 300 and indeed achieved a lot in removing uncertainty about otherwise difficult questions of the law. Nevertheless, not all issues have been resolved and recourse may often have to be had to national laws. Thus, even if the injurer has been found liable, that does not necessarily and automatically entitle victims to damages. To recover damages, victims must find a cause of action on which to base their claims. Art 24(2) of the Convention simply refers to "any action for damages" for which compensation is sought, and provides no choice of law rule on two issues: questions who are the persons that have the right to sue and what are their respective rights. 301 Here, choice of law questions will arise, 302 and from the economic approach we will focus our discussion on the second issue. Two issues merit consideration in this context. One is whether the Convention creates an independent cause of action. If it does

298. Ch 1: 5.3 above.
299. Reed v. Wiser, [14 Avi 17,841, 17,849] 555 F 2d 1079, 1092 (2d Cir 1977); In re Paris Air Crash of March 3, 1974, 399 F Supp 732, 739 (CD Cal 1975), per Judge Hall; Lovenfeld & Mendelsohn, 510. This kind of chaos in choice of law rules would be more acute in American law than in other countries because of its state legal systems; sec 1 above.
300. I.e. effect of contributory negligence (art 21); form of damages [art 22(1)]; questions of procedure [art 28(2)]; and calculation of the limitation period [art 29(2)].
301. Article 24(2) of the unamended Convention provides: "In the cases covered by Article 17 [i.e. wounding or death of a passenger or other bodily injury], the provisions of the preceding paragraph shall also apply [i.e. any action for damages, however founded, can only be brought subject to the conditions and limits set out in the Convention], without prejudice to the questions as to who are the persons who have the right to bring suit and what are their respective rights" (Italics added).
302. P P C Haanappel, The Right to Sue in Death Cases under the Warsaw Convention, 6 Air L (1981) 66; Mankiewicz, para 20; Shawcross, VII(71) & 1(94).
not, the claimant must rely on other possible causes of action in domestic law to recover damages. The other is about the heads of damages.

5.1.1 Does the Convention create an independent cause of action?: From the economic approach, the question whether the Warsaw Convention creates its own cause of action or not has little to do with the number of suits to be brought by the victims. It is more relevant to the consideration of administrative (judgment) costs reduction. From this perspective, it will be less costly to infer that the Convention establishes its own cause of action rather than the other way round. Indeed, if art 17 of the Warsaw Convention did not create cause of action, then it is doubtful what it really did in view of its two main objectives to achieve.  

5.1.2 Cause of action under domestic laws: In England treaties (or commercial treaties in France) generally need separate domestic legislation in order to render treaty provisions enforceable in that country. The cause of action for passenger damage created by the Convention is thus provided for in the Carriage by Air Act 1961 and in the Code de l'aviation civil 1967 respectively, although in French law the issue is not considered as important as it is at common law. English cases have consistently confirmed that the Convention has the force of law in the United Kingdom.

Nevertheless, US courts showed no consistency on this point until very recently when it was also confirmed that the Convention creates an independent cause of action.

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303. Salamon v. KLM, 107 NYS 2d 768, 773 (S Ct NY 1951), aff'd mem, 120 NYS 2d 917 (1953); Lowenfeld & Mendelsohn, 518 n.78; Matte, p.420; Shawcross, VII(71); sec I above.
Thus, in Komlos v. Compagnie Nationale Air France, the court ruled that the Convention merely created a presumption of liability from the happening of an accident and that the right of action for wrongful death is created by lex fori. This line of reasoning was later followed in Husserl v. Swiss Air Transport Co., Ltd but reversed in Benjamins v. British European Airways. The whole question was fully examined in In re Air Disaster at Lockerbie, Scotland on December 21, 1988 by the Court of Appeals for the Second Circuit which held that the Convention preempts any state cause of action despite its some references to lex fori and that the need for uniformity was seen as a powerful argument for pre-emption. Allowing divergent state causes of action would have subjected the Convention's own cause of action to usual choice of law rules, which would also have increased judgment costs.

5.1.3 Determination of the law applicable to heads of damages recoverable: When leaving aside the question whether the action is based on breach of contract or tort and whether the issue is about a substantive or procedural matter, there are two main approaches to determining the law applicable to heads of damages recoverable: *lex loci delicti commissi* (the law of the place of the wrong committed) and *lex fori* (the law of the forum). Although some American courts and commentators have recently developed "the most significant relationship (contact) to the occurrence and the parties" approach and the "governmental interest" approach, we will focus here on the two traditional approaches, since these two American approaches are variations on *lex loci*.

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313. [14 Avi 18,369, 18,374] 572 F 2d 913 (2d Cir 1978), cert den 439 US 833 (1979) ("[t]he desirability of uniformity in international air law can best be recognised by holding that the Convention, otherwise universally applicable, is also the universal source of a right of action"); Juglart, II(3308); 3 AASL (1978) 613.

314. N.214 above.

315. This issue is indeed immaterial since the Convention provides for "however founded" in art 24. See Shawcross, VII(72), *in fine*.

316. American courts usually apply *lex loci delicti* to all substantive rights of the parties including limitations on damages and *lex fori* to procedural issues. See Haanappel, n.302 above, at 76; W L M Reese, Choice of Law in Torts and Contracts and Directions for the Future, 16 Colum J Trans L (1977) 1. 2; Lowenfeld & Mendelsohn, 527; K S Cagle. The Role of Choice of Law in Determining Damages for International Aviation Accidents, 51 JALC (1986) 953, 973 & 975.


As to the lex loci approach, the place of the wrong or injury would be often fortuitous to the passenger. It is neither easy nor realistic nor costless to ascertain the place of the wrong in the context of aviation accidents. Thus, it may well be asked, does the place of the wrong committed mean the place where the accident actually occurred or the place where the conduct that caused the injury occurred? Even if the place of the wrong is held to be the place where the last conduct or event in the chain of causal linkage took place, the precise moment and place of such an act or omission would often prove elusive, since the situs of an accident is fleeting and fortuitous. Lex loci therefore tends to yield "harsh, unnecessary and unjust" results. Thus, in the Tenerife collision case, which stopped short of compensation by judgment, if the proceedings had been continued in the US District Court for the Southern District of New York, the court would probably not have applied lex loci delicti, Spanish law. Again, lex loci cannot be applied to accidents occurring over the high seas.

These difficulties and inefficiency can be mitigated by applying lex fori, even though it may equally be fortuitous. Lex fori will guarantee high predictability of the outcome, cause little margin of error and reduce unnecessary litigation. The rule of lex fori is certainly superior to that of lex loci in terms of the court's administrative costs reduction, for under lex loci the judges seized of a case will be compelled to adjudicate on the basis of the law extraneous to them. And the problem of 'forum shopping' will not count in terms of the courts' judgment costs, insofar as the court seized of the case set the quantum of damages to equal actual losses or average pecuniary damages. Again, if lex fori should induce the victim to go 'forum shopping' in search of more favourable forums, this will in turn induce the carrier to take proper care in order not to be sued at a forum unfavourable to him in terms of the award of damages.

5.1.4 Domestic laws governing the heads of damages: Although the position in English law in respect of choice of law rules is not clear, it is regarded as using the double test of lex fori and lex loci, the former assuming the preponderant position. Some writers even argue that English law has preserved lex fori as the sole source for liability in tort and that lex loci has no claim to application in tort liability cases. Thus, although the precise effect of Cha[8]p[8]lin v. Boys remains to be seen in view of the diverse opinions expressed, it is generally agreed that the decision gave more room for application of lex fori as to the question of damages. In French law the restoration of lex fori has also been supported. In America lex loci had prevailed until 1961 when the New York Court of Appeals in Kilberg v. Northeast Airlines, Inc. refused to apply the rule in respect of limitation of damages in force in the state of Massachusetts, the crash site. Following in the Kilberg court's footsteps, the Supreme Court of Pennsylvania rejected lex loci and applied instead the 'state interest' test in relation to the amount of recovery. Although couched in different language and alleged to have applied a different test, nevertheless, the decision did the same thing and reached the same consequence as applying lex fori.

5.2 Unit of Account and Conversion of the Gold Franc into National Currencies

The amended Convention provides for conversion of recoverable sums expressed in gold francs into national currencies in round figures at the date of judgment, thus envisaging national legislation on the matter. Yet in the absence of uniform national legislation, the gold franc clause has caused considerable uncertainty about the exact level of losses and has thus resulted in much higher or lower than the optimal level of compensation.

331. [1971] AC 356, 391 per Lord Wilberforce (in a car accident context), [1969] 2 All ER 1085 (HL); Shawcross, 1(93).
332. A F Lowenfeld, Conflict of Laws English Style: Review Essay, 37 AJCL (1989) 353, 374; Haanappel, n. 302 above, at 73. Canadian courts have consistently applied lex fori to determining the applicable law governing recoverable damages in Warsaw Convention cases. See Juglart, II(3249)
334. N. 321 above; Lowenfeld & Mendelsohn, 529ff; Juglart, II(3270) n. 146. The court applied lex fori on two grounds: the measure of damages was a procedural issue and the Massachusetts low limit was contrary to the public order of the state of New York.
336. Art 22(5); art 22(4), unamended Convention. The French gold franc (commonly known as Poincaré franc) is defined to consist of 65.5 milligrammes of gold with a millesimal fineness of 900 (0.05895 grammes of fine gold). For the conversion of the unamended Convention's 125,000 francs into the dollar on the basis of the last official gold price of $43.22 per ounce, see Shawcross, VII(120.4) n.1.
337. See the Carriage by Air Acts (Application of Provisions) Order 1967 and Carriage by Air (Sterling Equivalents) Order 1986, SI 1986/1778. Shawcross, VII(118). In the United States, the liability limits had been determined in terms of US dollars by the CAB on the basis of the par value of the US dollar. In France, however, no official valuation of the gold franc has been made. Miller, 180; Drion, 159.
5.2.1 Effect of conversion uncertainty on the parties' loss control: Uncertainty over the exact level of compensation figures in efficiency consideration. If the parties are risk neutral and there is conversion ambiguity, the carrier would be unable to calculate accurately the risk involved and would thus not be properly induced to take optimal care under the negligence rule. Under strict liability, if the carrier are uncertain of the exact level of losses because of conversion ambiguity, he may not be able to include correctly expected losses in the price of his products, leading to too much or too little purchase by passengers. If the parties are risk averse and there exists uncertainty about the exact amount of losses, the insurance company may find it difficult or costly to measure the risk involved and set premium rates accordingly. If as a result the premium is set too high, too little insurance will be purchased by the parties. In particular, assuming that the carrier is the cheapest cost avoider, he will not take out adequate liability insurance. Nor will the passenger with imperfect information be induced to buy adequate first-party insurance.

5.2.2 Uncertainty and disunity in the gold price-linked conversion: Conversion uncertainty and low level of compensation need not be entirely attributable to the conversion clause of the Convention. When the official gold price was stable and nearly matched the market price, the amount of damages converted into national currencies could retain the real value and provide predictability. And had some national governments not set the artificially low conversion rates and instead linked the conversion to free market prices of gold, the Convention's damages limits would be very realistic even today. But ever since the suspension of the dollar-gold convertibility in 1971, the difference between the official and free market rates became uncompromisingly pronounced. Although in *Trans World Airlines, Inc., v. Franklin Mint Corp.* the US Supreme Court upheld the last official gold price solution, this price is far removed from the more realistic free market rates. The free market gold price, on the other hand, does not guarantee any stability and desirability as a predictable guide to international transactions. This is apart from the question whether the free market gold price was really intended by the Convention's drafters as the benchmark for conversion.

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338 B Cheng, Report on an Integrated System of Aviation Liability (1980) paras 6 & 8 and cases cited therein. Thus, if the conversion is calculated by reference to the market price of gold, e.g. $500 per ounce rather than the last official price of $43.22, the limits under the unamended and amended Convention would amount to $118,453 and $236,906, respectively.

5.2.3 The SDR-based conversion: The SDR\textsuperscript{341} solution, although its value is subject to inflation and liable to go down along with a basket of currencies being used to determine its value, will give more predictability and uniformity in the computation of the damages recoverable in national currencies than will the free market gold price solution. The SDR solution would also make less costly risk management by the parties and their insurers.\textsuperscript{342} The Montreal Protocols 1975, which are not yet in force, have also adopted the SDR solution. In order to hedge against the inflationary effect on the value of the SDR over the years, an international body may be charged with the task of assigning an inflation index to the SDR.

6. Joint- and Multiple-Carrier Accidents

We have so far evaluated the efficiency of the Warsaw Convention's liability rules in the context of single-carrier accidents. Not infrequently, however, there occur accident losses caused by two or more aircraft like a collision.\textsuperscript{343} This is the question of joint and multiple injurers\textsuperscript{344} which would justify a separate discussion, since this raises the question of whether and how joint injurers can be motivated to exercise optimal care under different liability rules. Again, since the Convention does not properly address the issue of collision damage,\textsuperscript{345} there also arises the problem of efficient liability attribution as between joint injurers. There is indeed no international treaty which governs passenger legal liability arising from a mid-air collision, e.g. damage caused by one aircraft to the passengers on board a second aircraft.

6.1 Collision, Costs and Care: Simple Model

Example 2.3 Suppose two carriers A and B jointly caused a collision which resulted in mass death and injury of passengers. It is assumed that both the states of registry of carriers A and B are parties to either the unamended or the amended Convention\textsuperscript{346} and that both the carriage were 'international' as defined by the Warsaw Convention. It is also

\textsuperscript{341} The value of the SDR was originally linked to gold and defined to consist of 0.888671 grammes of gold which equals 15 gold (Poincaré) francs as result of $0.888671/0.05895=15.0074995$. Although the SDR still retains this conversion factor which was taken into account when drafting the Montreal Protocols 1975, there has since 1978 been no link between it and gold. Shawcross, VII(120.4)

\textsuperscript{342} P Martin, The Price of Gold and the Warsaw Convention (III), 6 Air L (1981) 246, 249; Shawcross, VII(120.4); See also S A Silard, Carriage of the SDR by Sea: the Unit of Account of the Hamburg Rules, 10 JMLC (1984) 13, 37.

\textsuperscript{343} For the notion of collision, see ch 4: 6.1.1 below.

\textsuperscript{344} See further ch 3: 6 below.


\textsuperscript{346} This assumes treaty relationship and thus applicability of the Convention between the states of registry of carriers A & B in respect of the unamended Convention. See n.101 above.
assumed for simplicity that only the carrier's care affects expected losses; that each carrier is capable of paying out their liability in full; and that no wilful misconduct was committed by either carrier. Discussion here will be focused on incentive promotion towards safety. The probabilities of accident as a function of the injurers' levels of care are illustrated in Table 2.2, together with total accident costs. In this situation, as the prevention of a collision calls for joint care by all the injurers, the notion of the cheapest cost avoider will not apply. Therefore, unlike in single-carrier accidents, there is no ground for attributing the entire losses to one of the injurers. As the Table shows, total accidents costs are minimised when carriers A and B both take care, the efficient solution.

<table>
<thead>
<tr>
<th>Levels of Care Taken by Injurers</th>
<th>Cost of Care Incurred by Injurers</th>
<th>Expected Losses per Passenger if Accident Occurs (£)</th>
<th>Probability of Accident per 100,000 kms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>none</td>
<td>none</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>none</td>
<td>care</td>
<td>0</td>
<td>3,000</td>
</tr>
<tr>
<td>care</td>
<td>none</td>
<td>4,000</td>
<td>0</td>
</tr>
<tr>
<td>care</td>
<td>care</td>
<td>4,000</td>
<td>3,000</td>
</tr>
</tbody>
</table>

6.1.1 The negligence rule: Under the negligence rule, if one carrier failed to take due care, he would be liable for the victim's entire losses. And if both carriers jointly fail to take due care, they will share the losses between them usually through an action for contribution by one of them. Thus, each carrier acting independently as well as acting in concert will be led to take optimal care (on the assumption that due care is optimal), since each knows that otherwise he would be held to bear the entire losses. In Table 2.2, an equilibrium will be reached when both A and B take due care, for each will reckon that if he fails to take due care, his expected liability would be £15,000, respectively. Further, an equilibrium will not be arrived at if neither carrier takes due care, for if that should happen,
The carrier's liability 145

either carrier A or B must bear expected liability amounting to at least £10,000 and at worst the entire expected loss of £20,000. Thus, the rule of negligence creates incentives for both carriers to take optimal care.

6.1.2 Strict liability: Assuming that under strict liability each carrier is liable for a fraction of losses and that the fraction does not depend on his level of care, the expected liability of each carrier will fall by only a fraction of the reduction in expected losses which his exercise of care will bring about. Therefore, if the carriers act independently, they may not be induced to take optimal care.\(^{350}\) In Table 2.2, if A and B each bear half the accident losses, neither will take care, because the reduction in expected liability from taking care will be £2,500 for each, whereas the cost of taking care is £3,000 or £4,000, both of which are greater than £2,500. Again, if the fraction of A's liability is increased big enough to make him take care, B will certainly not take care because to do so would cost him more than the reduction in his expected liability. Thus, under strict liability injurers acting independently may not be properly induced to take optimal care. However, if both carriers act in concert to minimise their joint expenses, they will all choose to exercise optimal care regardless of how liability is assigned between them.\(^{351}\) Indeed, airline pilots are always required to act in concert through the agency of air traffic controllers. This situation is equivalent to one in which a single carrier acts to minimise his losses under strict liability, and in that situation his behaviour has already been found optimal.\(^{352}\)

6.2 Indemnity, Contribution and Probability-based Liability Apportionment

Although both the negligence rule and strict liability induce multiple injurers to take optimal care in a situation calling for their joint care, the problem is that different and disparate liability regimes\(^{353}\) will apply to a similar category of losses caused by joint injurers.\(^{354}\) In Example 2.3 above, carrier A's liability vis-à-vis his own passengers will be governed by presumed fault liability under the Warsaw Convention but his liability in respect of damage to the passengers on board carrier B's aircraft will be determined by reference to a haphazard system of national law determined by the choice of law rule. Such a system is any body's guess;\(^{355}\) it may require proof of fault rather than its presumption or may impose strict liability. The similar may be said of carrier B's liability. Difficulty, let alone unpredictable and disparate liability regime and probable inefficiency, will also arise

\(^{350}\) Shavell, 11-12.
\(^{351}\) Injurers are generally presumed to act independently when they are strangers, whereas injurers are deemed to act in concert when they have some type of relationship. See Shavell, 165-66.
\(^{352}\) See 2.3.1 above.
\(^{353}\) D D Oldham & W L Maynard, Indemnity and Contribution between Strictly Liable and Negligent Defendants in Major Aircraft Litigation, 43 JALC (1977) 245.
with the determination of the respective injurer's degree of fault and with loss allocation between joint tortfeasors.

6.2.1 Indemnity and contribution under negligence and strict liability: Once found liable, one or more of the joint injurers must pay whatever proportion of the losses the victim chooses to recover from that injurer(s). In this case, a complete recoupment by one injurer from the other or the others is called indemnity, whereas partial recoupment is called contribution. But should one of the joint injurers who has been forced to pay in full, be entitled to receive reimbursement through recourse actions from the other joint injurers primarily responsible? Under strict liability, the problem of inadequate incentives arising from liability division may be significant where the number of joint injurers is large. The more injurers who share the losses, the greater incentive dilution for each injurer, which is certainly not the case in our example above. An equal division of losses between joint injurers, however, will not bring about an incentive gain.

Under negligence, the fact that joint injurers will each take due care means in strict logic that it is irrelevant whether and how liability will be shared between them. The sharing of liability among several negligent injurers will only be relevant where the court's errors bring about disincentives as to the optimal level of care applicable to each injurer. And this possibility of incentive dilution of liability apportionment does not weigh heavily, given the slim probability of multiple injurers being found simultaneously negligent. If no indemnity/contribution is allowed between joint tortfeasors under negligence, it can reduce the number of actions to be brought and curtail administrative costs associated with judicial division of liability. This, however, should be balanced against the allocative gain from apportionment among joint tortfeasors. Joint and several liability with no contribution among negligent tortfeasors is not necessarily superior to the loss allocation effected by contribution.

6.2.2 Actual liability apportionment under negligence: Liability apportionment under negligence can be effected mainly by two ways. One is that if the victim sues only one of the joint injurers and recovers damages in full or in part, that injurer may sue the other

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356. Shavell, 166-67. As regards indemnity, we are not here concerned with indemnification by an actual wrongdoer of the injurer held vicariously liable as in the pilot-carrier relationship under the doctrine of respondeat superior. Drion. 196; ch 3: 3.2 below. We are just taking issue with whether the law should grant a right of indemnity to one of the joint injurers against another or the others on efficiency grounds. See Keeton, Contribution and Indemnity Among Tortfeasors, 27 Insurance Counsel J (1960) 630, 631-32. See Note: The Allocation of Loss Among Joint Tortfeasors, 41 S Calif LR (1968) 728, 737-47. 357. Ibid. 358. Shavell, 166. 359. Ibid. 360. Rizzo & Arnold, Causal Apportionment, at 1428 n.140. 361. Landes & Posner, Joint and Multiple Tortfeasors. at 531, 518-19 & 519 n.4; ch 3: 6.1 below.
injurer or injurers in a separate action for indemnity or contribution. A similar consequence will ensue when the court renders a judgment against all joint injurers, but the victim enforces it against only one of them. Under this approach, if one of the joint injurers is allowed to bring a separate action for indemnity or contribution against the other(s), such an action would have distributive consequences but little impact on incentives for efficient accident avoidance and only incur administrative costs. A legal system concerned with efficiency therefore should discourage such actions.  

The other is that the victim sues all joint injurers in one action and the court gives an apportioned judgment. Under this approach, the difficulty is whether the court can determine the standard of due care applicable to each injurer and determine correctly the relative degree of fault of the joint injurers without error. In order to identify each tortfeasor's exact degree of fault, the court must have correct information on the standard of care applicable to the respective joint tortfeasor. If the court lacks such information and makes errors, losses will not be allocated pursuant to their relative degree of fault as in loss apportionment in equal proportion regardless of their relative contribution to damage. An even more unpredictable and inefficient result will follow where a collision involves not just carriers but manufacturers and the ATC agency and their relative degree of fault cannot be ascertained as in the Tenerife collision.

In *Kohr v. Allegheny Airlines, Inc.* which arose from mid-air collision between the airline's DC-9 jet and a small Piper Cherokee aircraft over Indiana, one of the issues was whether defendants Allegheny and the US government should be allowed to maintain their cross-claims and third-party complaints for indemnity/contribution against the Piper owner-operator. The Seventh Circuit applied the federal rule of contribution and indemnity and held the Piper owner-operator liable on a comparative negligence basis. The court noted that the trier of fact would determine on a percentage basis the degree of negligent involvement of each party in the collision and that the loss would then be distributed in proportion to the allocable concurring fault. The problem, however, is whether the relative degree of fault is always ascertainable without error.

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363. The original form of the comparative negligence rule applies to an accident situation involving the injurer and the victim, and this reasoning can be extended *mutatis mutandis* to joint and multiple injurer cases. Shavell, 15. 18, 85 & n.12.
365. Ch 6: 6.3.2 below, *in fine*.
6.2.3 Probabilistic liability apportionment under strict liability: The difficulty with efficient liability allocation under negligence can be overcome by apportioning the losses among joint injurers in proportion to their relative accident probability. For example, consider a case where total losses caused by a collision amount to £100,000 and the accident probability of carrier A is 0.1 while that of carrier B is 0.05. In this case, the losses can be divided between the two injurers by reference to their relative accident probability, i.e. 0.1 versus 0.05 or 2:1. Thus, carrier A's portion of liability would be £100,000 multiplied by two thirds (carrier A's relative probability of causing the accident) or £66,667. Likewise, carrier B's portion of liability would be £100,000 multiplied by one third or £33,333.

In the probabilistic liability apportionment, each injurer will bear a positive fraction of losses not independent of his accident record or his average level of care exercised in the past. No pilot of a high risk-creating carrier would attempt to collide with another aircraft of a low risk-creating airline to see his employer-carrier bear more than the damage he in fact caused in a particular situation. Again, no pilot of a low risk-creating airline would intend to collide with a high risk-creating aircraft to raise his airline's accident probability and to deal a blow to its public image as safe carrier, let alone the liability falling on his airline however small it would be relative to the other airline. Even if the low risk-creating carrier is not properly induced to take precautions against the higher risk-creating one, these ostensible disincentives can be offset by the incentives strict liability creates for the injurers to engage in the proper level of activity. Accident probability-based liability apportionment between joint tortfeasors will also significantly reduce administrative costs for the courts, since it will make redundant any separate actions for indemnity and contribution between multiple injurers. Again, if the joint injurers are risk averse, their respective insurers can easily come up with their share of payments to the victims. In short, probabilistic liability apportionment would apply continual pressure on airlines to reduce accident risks and accident probabilities.

6.2.4 Collision-related conventions and apportioned judgements under domestic laws: The ILA's Draft Convention on Aerial Collision Liability provides that the aircraft operators involved in a collision bear the liability: 1) in proportion to the degree of fault respectively committed; 2) if such degrees cannot be ascertained, in equal parts; and 3) if

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369. Rizzo & Arnold, Causal Apportionment, at 1428: ch 1: 5.2.6 above.
370. This probability refers to passenger fatalities per e.g. 100,000 kilometres flown by each carrier.
371. Ch 1: 5.1.3 above.
372. Sec 2.3.1 & ch 1: 5.1.4 above.
373. Landes & Posner, Joint and Multiple Tortfeasors, at 539.
none of the operators proved to have been at fault, in proportion to the weight of their respective aircraft.\textsuperscript{374} Similarly, the \textit{Draft Convention on Aerial Collisions}\textsuperscript{375} prepared by the ICAO Legal Committee provides that if the respective degree of fault cannot be ascertained, the losses should be divided equally. These two approaches may not adequately induce joint injurers to take optimal care and are practically infeasible or costly because of the difficulty associated with the determination of their respective fault.

At common law, apportioned judgements had generally been prohibited and the courts were not to sever damages among joint tortfeasors. Where wrongful acts of multiple tortfeasors concurred to produce an indivisible damage, they were jointly and severally liable, whether the victim sued one or all of them.\textsuperscript{376} Thus, a right to indemnity was often recognised at common law but a right to contribution was not, since it was considered no duty of the courts to come to the aid of a wrongdoer as represented in the maxim "No one should be allowed to benefit from his own wrong".\textsuperscript{377} Nevertheless, an apportioned outcome was possible to the extent that one of the tortfeasors who paid out to the victim in full won a contribution action against the other joint wrongdoers. Now, most American state jurisdictions as well as English law allow contribution through the adoption of statutes.\textsuperscript{378} The result is that any of the joint- and multiple-tortfeasors will be held liable for such portion of the damage as may be proportionate to his share in the losses.

In French law the \textit{Code de l'aviation civile 1967} governs passenger damage caused by a 'collision' (\textit{abordage aérien}) which involves "two aircraft both in movement (\textit{en évolution})" where one of them clashes, interferes with or disturbs the other.\textsuperscript{379} Thus, art L.141-1 provides: "En cas de dommage causé par un aéronef en évolution à un autre aéronef en évolution la responsabilité du pilote et de l'exploitant de l'appareil est réglée conformément aux dispositions du code civil". For the purpose of this provision, it is immaterial whether such a collision occurred in flight or on the ground.\textsuperscript{380} In this type of damage, whatever the cause of action,\textsuperscript{381} the two aircraft operators are jointly liable for the

\textsuperscript{374} Guldimann, n.266 above, at 124.
\textsuperscript{375} Signed on 18 Sept. 1964, ICAO/LC Doc 8582-LC/153-1 & LC/153-2, art 7(1)-(2).
\textsuperscript{376} See G Williams, Joint Torts and Contributory Negligence (London 1951) 63-64; Rizzo & Arnold, Causal Apportionment, at 1400.
\textsuperscript{377} Cooter & Ulen, 409; R A Leflar, Contribution and Indemnity Between Tortfeasors, 81 U Pa LR (1932) 130.
\textsuperscript{378} See J G Fleming (1987) ch 10; Landes & Posner, Joint and Multiple Tortfeasors, at 550-51 & Table A-1; \textit{Law Reform (Contributory Negligence) Act 1945}, ss 1(1) & 4; \textit{Civil Liability (Contribution) Act 1978}, ss 1, 2 & 6(1); Shawcross, V(89) & I(149).
\textsuperscript{379} Juglart, I(2177). An aircraft is in movement from the moment when it is moving without the intervention of external force. \textit{Ibid, in fine}. For a distinction between \textit{abordage aérien} and \textit{collision aérienne} in French law, see ch 4: 6.1.3 below.
\textsuperscript{380} Juglart, I(2181) & cases cited therein.
\textsuperscript{381} I.e. whether governed by art 1382 or 1384 of the \textit{Code civil}. Juglart, I(2182).
whole damage caused, if both were at fault or if liability were based on the duty of care towards third parties (e.g. passengers of the other aircraft).\textsuperscript{382} Thus, French law also bases passenger legal liability arising from a collision on fault and envisages apportioned liability as between joint injurers. The efficiency of fault liability under English, American and French law depends on whether the respective courts can determine without error the correct level of care applicable to each injurer.\textsuperscript{383}

6.3 Collision Caused by Wilful Misconduct of One of the Joint Tortfeasors

Example 2.4 Imagine a situation where airline A's pilot (or an aircraft owner-operator) is facing an imminent crash and decided to collide 'intentionally' with another plane of airline B (or even a small private aircraft operator) on the runway in order to share and lessen his airline's liability. It is assumed that the pilot acted with knowledge that carrier B's accident probability is much higher than his airline's and that if he wilfully collides with carrier B's aircraft, his airline's liability will be reduced by the operation of the relative probabilistic allocation of liability. It is assumed that carriers A and B are both risk averse and that imperfect insurance is provided because of the moral hazard problem. The efficient outcome will still be to allocate the losses in proportion to their past accident record. This result should not be any different even if the collision involved a small private aircraft operator, since the difference, if any, that may exist in the financial position between a big international carrier and a small private operator may be regarded as not so essential as to justify another basis of liability allocation.\textsuperscript{384}

In this Example, if there exists a clearly defined category and criterion to distinguish between a wilful misconduct and an unintentional misconduct and thus if it would incur negligible costs for the court to identify a wilful misconduct, only carrier A (or through his insurer) should be held liable for the entire losses. For in this case it is obvious that imposition of liability in full on carrier A would bring about only the incentive gain without much administrative cost. Thus, if the collision happened between a moving aircraft and a stationery one, the moving aircraft should be held liable for the losses, since it should, and is better positioned to, avoid the collision.\textsuperscript{385} Carrier A's insurer will provide cover for such 'wilful' losses, indemnify the victims and may impose a 'penal' premium on his insured carrier for his wilful misconduct, which will deter the latter from committing wilful misconduct afterwards.

\textsuperscript{382} Juglart, J(2183).
\textsuperscript{383} Sec 6.2.2 above.
\textsuperscript{384} Guldimann, n.266 above, at 128-29. See J J Kennelly, A Novel Rule of Liability, at 348, sec F.
\textsuperscript{385} See Cane, 105; id (1993) 103.
On the other hand, if the court cannot correctly sort out 'wilful' losses without considerable costs, it will be efficient for the court to allocate the losses between them in proportion to their relative accident probability. For the administrative costs of identifying a wilful misconduct in a particular collision may outweigh the benefits of deterring carrier A from committing such misconduct again. Accordingly, insurers of carriers A and B will again provide cover for such losses, indemnify the victims and adjust carrier A's premium accordingly.

Conclusion

In this Chapter, we applied the economic analysis to evaluating the efficiency of liability rules under the Warsaw Convention system governing the carrier's liability for passenger damage in the context of both single- and multiple-carrier accidents. In so doing, we have built simple economic models and included in them only the carrier's and the victim's care as the relevant factor affecting expected losses, while giving underlying reasons for the exclusion of the carrier's and passenger's activity level. Drawing on the analysis above, we have found that liability rules under the Warsaw Convention as interpreted by the courts reflect on the whole the efficient outcome, except for e.g. the exclusion of nonpecuniary losses from the scope of award of damages, and unlimited liability for wilful misconduct. Especially, the inclusion of the carrier's defence of contributory negligence is necessary, whether under the negligence rule or strict liability. This is because some people may not always act rationally or because even a rational passenger may not always be induced to take optimal care to avoid injury in the absence of appropriate information.

In the first application of the economic models, we demonstrated that if only the carrier can affect expected losses, he must give a notice under negligence to induce the passenger with imperfect information to purchase adequate first-party insurance or to take other self-protective measures. But the carrier need not be required to do so under strict liability. Accordingly, deprivation of liability limits in the event of the carrier's failure to give a notice is necessary under negligence, but not under strict liability. In the second application of the models, we have seen that if the parties are risk neutral, the carrier's defence of all necessary measures is not necessary under the negligence rule, let alone under strict liability. For under either rule, the carrier is already adequately induced to take all reasonably necessary steps to avoid liability. The function of the causal requirement has been found not so important from the economic approach and is useful only to the extent

386. We will not repeat here the possibility of imposing punitive damages. See sec 4.2, above.
387. Sec 6.2.4 & ch 1: 5.2.6 above.
388. Even in this case, granting the insurer a right to reimbursement may increase the number of recourse actions and incur administrative costs associated with judicial investigation of wilful misconduct.
389. Sec 2.3.3 above.
that the proximate cause test can be used as the yardstick for allocating the losses to multiple injurers in proportion to their relative accident probability.

As to the efficient level of liability, the right amount of deterrence is created when the carrier's liability is set to correspond to actual losses including both pecuniary and nonpecuniary losses (mental pain and suffering) related to physical injury. The problem is the insurability of nonpecuniary losses and the court's administrative costs for measuring them in individual cases. Unlimited liability will not lead the carrier to take excessive care under the negligence rule but is not necessary under strict liability. Insofar as liability is linked to actual losses calculated on the basis of average court judgements or average insurance payments, the carrier will be adequately induced to take optimal care and spend the efficient amount of resources on accident avoidance. Strict liability with the limit pegged to average losses would ensure certain and speedy recovery, reduction of litigation issues to questions of quantum and protection of carriage by air from a catastrophic loss. An unbreakable limit also provides a predictable basis for insurers to calculate risks correctly and setting premium rates with less measurement costs than unlimited liability. Unlimited liability may also engender moral hazard to the insured carrier. When heads of damages are taken into account, damages recoverable should include both pecuniary and nonpecuniary losses but should exclude nonpecuniary losses not directly related to physical injury.

Again, in view of the carrier's financial interest in accident avoidance and of the threat of penal sanctions, no further incentives such as punitive damages are needed under strict liability to deter losses caused by wilful misconduct. For the imposition of punitive damages may unduly discourage the socially useful activity of carriage by air under strict liability. The award of punitive damages is also likely to incur additional judgment costs for determining a wilful misconduct and assessing the proper level of punitive damages. If parties are risk averse, the court would rather leave the issue to the insurer who, faced with similar difficulties and costs, may well choose to provide cover, indemnify the victims and impose 'penal' premiums against his insured if the loss caused were a clear case of wilful misconduct. If, on the other hand, the insurer decided not to provide cover for his insured carrier's wilful losses and if his insured carrier had assets inadequate to meet his liability in full, victims would face no compensation at all. This is clearly the inefficient outcome if passengers misperceived risk and consequently failed to buy adequate first-party insurance. In short, the incentive gain from not providing cover for 'wilful' losses need be balanced against the court's ability and administrative costs of identifying correctly such losses and against victims' entitlement to compensation.
Issues arising from private international law mostly bear on administrative costs incurred to the courts: number of actions to be brought and the court's informational and administrative costs for determining a liability rule. As to cause of action, it has been concluded that the Warsaw Convention creates its own cause of action independently of national law. The administrative costs reduction rationale and the need for uniformity justifies this conclusion. For similar reasons, *lex fori* rather than *lex loci delicti* should govern the issue of recoverable heads of damages, since *lex fori* is the law of the forum which the plaintiffs have voluntarily chosen. As for the unit of account for conversion of the damages expressed in the gold franc into national currencies, although this is also a question to be decided by the *lex fori*, we argued in favour of the SDR solution for reasons of uniformity, predictability and thus efficient risk management. In this case, an international body may have to be charged with the task of assigning an index to the SDR in order to hedge against the inflationary effect on the value of the SDR and thus maintain the real value of compensation.

Finally, in our model relating to multiple-carrier accidents like a collision, the efficient outcome consists in liability allocation in proportion to the relative accident probability. This will create proper incentives for carriers to allocate an efficient amount of resources on accident avoidance, since the high risk-creating carrier will be forced to minimise risk to survive the competitive market environment. This will in turn apply pressure on the low risk-creating carrier for further risk reduction. Under this system of liability assignment, the higher the accident record a carrier has registered, the more it will be deterred from engaging in the risky activity, thus contributing to bringing down accident probability of airlines as a whole. Furthermore, this solution will get rid of administrative costs of indemnity and contribution suits as between joint tortfeasors or between their insurers.
CHAPTER 3

LIABILITY OF THE AIRCRAFT MANUFACTURER
FOR PASSENGER DAMAGE

Nature [including the man himself] is placed under the sign of active man, of the man who inscribes technique in nature.

-------- Gaston Bachelard

There are only two qualities in the world: efficiency and inefficiency; and only two sorts of people: the efficient and the inefficient.

-------- George Bernard Shaw

Introduction

In the previous chapter, while evaluating the efficiency of the carrier's passenger legal liability rules, we argued for strict liability with the defence of contributory negligence for minimisation of accident and its avoidance costs. In this chapter we will consider the efficiency of the alternative liability rules governing the manufacturer's liability for passenger injury or death caused by defective aircraft. The law of product liability is one of the most dynamic fields of law and is taking on growing importance in the law of carriage by air. For passenger-victims, this body of rules provides an additional basis for recovery when dissatisfied with insufficient damages from the carrier. For manufacturers, since the law of product liability is in a state of flux, they may not be sure of the proper level of safety precautions. For insurers, it is quite risky to underwrite 'hard-to-predict' risk in the absence of reasonable certainty over their insureds' legal liability and in the presence of the threats of punitive damages. As a result, there is growing dissatisfaction among manufacturers with decreased availability of market insurance or increased insurance costs, since they have to bear much of risk.

2. John Bull's Other Island (1904), Act IV.
3. Shawcross, V(32); Cooter & Ulen, 421.
5. See J E Saba, Aircraft Crashworthiness and the Manufacturer's Tort Liability in the United States. 7 AASL (1982) 171, 204; Danzon. Tort Reform, at 539; Stapleton, 31.
In product risk, there exists no direct contractual relationship between the aircraft manufacturer and its user-passengers who happen to get on board a particular aircraft without prior knowledge about its specific characteristics or dangers. In this *market relationship*, the possibility of bargaining or contracting is at best remote because of growing technological complexities of aircraft and resulting information asymmetry. And unlike airlines purchasing aircraft from manufacturers where there exists parity of bargaining power as buyer and seller, it would virtually be infeasible for individual passengers to contract on an equal footing with the manufacturer over the terms of potential liability.

Again, given the extended life expectancy for aircraft, it is almost impossible to write every conceivable contingency into the contract setting out all the detailed terms of liability. Even if bargaining is possible, huge transaction costs may well exceed its benefits. Furthermore, the doctrine of privity may bar user-victims of a defective aircraft from recovering damages against the manufacturer on breach of implied warranty of marketability that goods sold must be of merchantable quality and reasonably fit for its intended use. In any case, a passenger's choice of a 'safer' aircraft on a particular route is at best very limited.

As in the previous chapter, our aim in this chapter is to evaluate existing rules and cases to present the efficiency-based legal regime governing the aircraft manufacturer's liability for passenger damage caused by defective aircraft. In the absence of a uniform international legal regime applicable to the manufacturer's liability in tort, our starting point for assessment will be the *EC Council Directive 1985* and the *Consumer Protection Act 1987* enacted to give effect to it in English law. We will also analyse relevant provisions of the *Restatement (Second) of Torts* and the *Model Uniform*
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Product Liability Act 1979,\(^\text{12}\) published by the US Department of Commerce to promote uniformity and predictability in state laws, though without success.

Since there is much confusion and inconsistency in the notions and application of the negligence rule and strict liability, we will first define the alternative liability rules to argue in favour of the latter. In recognition of the fact that manufacturers are subject to regulatory obligations in addition to tort liability, we will examine the effect of different regulatory devices on optimal deterrence and the relationship between safety regulation and civil liability which is mutually complementary. We will then evaluate the efficiency of the manufacturer's duty to warn of dangers and the efficiency of causal requirement in the context of the manufacturer's vicarious liability for his subcontractor's defective component parts and of the state-of-the-art defence. After discussing the efficient level of compensable damages and choice of law issues, we will finally deal with liability apportionment among multiple joint tortfeasors, i.e. damage caused successively by the manufacturer and the carrier or simultaneously by two or more manufacturers.

1. Economic Approach to Aircraft Product Risk and Liability

1.1 The Province of Product Liability in Tort Defined

1.1.1 Products liability in tort:\(^\text{13}\) The idea of product liability\(^\text{14}\) in tort is that a person who produces, alters or adds to goods and puts them into circulation may be subject to liability for personal injury caused by his product to third parties using it for its intended use. Historically, the negligence rule, first recognised in the aviation context in Maynard v. Stinson Airplane Corp.,\(^\text{15}\) prevailed as the rule establishing liability for damage caused by defective products.\(^\text{16}\) In a negligence action, the focus of inquiry is placed on the manufacturer's standard of conduct, i.e. whether he exercised reasonable

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\(^\text{13}\) Nuclear-related damage is excluded from the scope of this chapter. See the EC Directive 1985, art 14; Consumer Protection Act 1987, s 6(8) & Nuclear Installations Act 1965.

\(^\text{14}\) The term 'products liability' is an American invention. England has no product liability law as such, but only laws relating to liability for defective products. Pearson Report, I(1216); Lord Griffiths et al. n.4 above at 355.

\(^\text{15}\) 1 Avi 698, 699-700 (County Ct Ct Mich 1937) (defendant manufacturer found negligent for an in-flight fire caused by two design defects _ short exhaust stacks emitting high temperature gases and flames and the carburettor draining opening so close to the exhaust stacks presenting a fire hazard).

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care in design or manufacture of aircraft. In strict liability, by contrast, attention must be directed to the condition of the aircraft itself. Strict liability thus asserts liability of the manufacturer for damage caused by his product, whether he exercised due care or not. In short, whereas the negligence rule is conduct-oriented asking whether defendant's act was reasonable, strict liability is product-oriented asking whether the product was safe for its intended uses.

1.1.2 Notions of manufacturer, component part maker and product: Under the EC Directive, the term 'producer' (producteur) includes not only the manufacturer of a finished product but the component part maker and the assembler. But in line with more common usage in the aviation context, we will use the term manufacturer (fabricant; constructeur) to mean the producer of an aircraft product. An aircraft product is, for products liability insurance purposes, defined as complete aircraft and any article forming part thereof or supplied for installation in aircraft or for use in connection with aircraft or for spare parts for aircraft. The term product (produit) does not necessarily mean a finished product but includes any goods or movable which is comprised in another product, whether as a component part or otherwise. Similarly, under the Consumer Protection Act 1987, 'goods' defined thereunder include substances and things comprised in or attached to any ship, aircraft or vehicle.

1.1.3 Notions of design and manufacturing defect: The term defect (défaut; vice) is neither self-defining nor susceptible to a single definition applicable to all contexts. Barring the cases of products marketed with warnings or instructions inadequate to alert users to the danger (marketing defects), a product may be defective largely in

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21. Art 3(1); Consumer Protection Act 1987, s 1(2).
22. An assembler means one who has assembled the aircraft product and sells it as his own, even though he has not manufactured any part of it or has manufactured many component parts but not manufactured the part which later proves defective. Shawcross, V(33); King v. Douglas Aircraft Co., [9 Avi 17,178] 159 So 2d 108 (Fla App 1963) (second-hand engines installed); Boeing Airplane Co. v. Brown, [7 Avi 17,446] 291 F 2d 310 (9th Cir 1961).
23. See Margo, 185 n.15.
25. Art 45(1).
two ways: 27) it may have been manufactured improperly in that at the time of
delivery it was not in such a condition as its manufacturer intended it to be (defective
manufacture); or 2) it may have been improperly designed (defective design).
Manufacturing or construction flaws usually arise from insufficient quality control28
and are generally the result of inadvertent errors. They are more readily identifiable
because a product with such flaws differs from the manufacturer's intended production
standards or from other ostensibly identical units coming off the same production line29
(deviation from the norm).30 For example, a nut is lacking, or a metal with considerable
porosity or with an irregular grain is substituted for another which must have been
used in the place in question (i.e. materials of inadequate strength and durability used
in construction).

By contrast, design defects are usually the result of the manufacturer's conscious
choice and as such affects the whole line of products and overall safety.31 If all the
products contain a common flaw, the defect may well relate to that of design, whereas
if only sporadic flaws are spotted, the defect may be attributed to the manufacturing
process.32 Design defects include defective safety devices and features inappropriate to
test and inspect the product during manufacture.33 Another distinguishing element is
that in design defects, feasibility of making a safer product is in issue under the
negligence rule, whereas feasibility is not usually an issue in manufacturing flaws.34
Although a history of safe use per se will not establish nondefectiveness nor will
defectiveness be proved by the fact of an accident alone, repeated accidents caused by
a particular type of aircraft may well be associated with its design defect.35

1.2 Fault Liability

27. Hodges, Product Liability, 98ff; Keeton, n.9 above, 33-34; Speiser & Krause, 2 Aviation Tort Law,
489-500; Frumer & Friedman, Products Liability, chs 11 & 12; Abramson, n.17 above, at 172; sec 2.5
below.
344-45.
29. P Keeton, Manufacturer's Liability: The Meaning of 'Defect' in the Manufacture and Design of
30. V Walkowiak, Product Liability Litigation and the Concept of Defective Goods: "Reasonableness"
Revisited?, 44 JALC (1979) 705, 719 & 722; Saba, n.5 above, at 190-91.
(1977) 101, 104.
32. Abramson, n.17 above, at 173.
33. See Vrooman v. Beech Aircraft Corp., 183 F 2d 479 (10th Cir 1950) (obligation to test and
inspect).
34. Phillips, n.31 above, at 104-05.
35. Ibid, at 110.
Example 3.1 Suppose an aircraft manufacturer designed the right and left elevator trim tab actuators, which control the airflow and allow the plane to climb up, in such a manner as to be identical-looking, although they are opposite-functioning parts. Let us suppose that maintenance engineers were led to take one for the other and inadvertently switched during routine maintenance procedures and that as a result, the aircraft crashed in a flight conducted shortly after the maintenance work. Assuming that the manufacturer also failed to publish in the maintenance manual any warnings against the danger of reverse installation of the visually symmetrical but functionally asymmetrical component parts, the manufacturer was negligent in the design of actuators to make them unreasonably dangerous for its intended use. For the manufacturer could have imprinted the two actuators physically with a "R" and a "L", respectively, without much additional cost.

1.2.1 Notion of negligent design and manufacture (conception fautive et fabrication fautive): In a negligence action, the manufacturer is liable to its users if he failed to exercise reasonable care (une prudence suffisante) and precautions in the adoption of a design at the time of construction, and consequently if the product involves an unreasonable risk (un risque excessif) and causes physical harm to expected users during its intended uses. The test for deciding dangerousness of a product in a negligence action is thus whether the manufacturer's conduct matches the reasonably prudent manufacturer's. The essential elements of an actionable negligence, are the existence of a duty of care owed by the manufacturer to take reasonable care; a breach of that duty; and injury or loss by the breach to the person to whom the duty is owed.

1.2.2 Determination of negligence: Under the negligence rule, the manufacturer will trade off complex competing factors in aircraft design to balance safety against cost, or utility against risk: more metal in aircraft fuselage to enhance safety and survive a crash means not only higher fuel consumption but also higher risk in the event of engine failure, longer landing strip, etc. Under negligence, a defect or flaw, however, may not necessarily lead to liability and it must be attributable to negligence on the part of the manufacturer. In order to discharge the onerous burden of proof of negligence,

37. See sec 2.5 below for the manufacturer's duty to warn.
38. Restatement (Second) of Torts, s 398 & 395.
39. Montgomery & Owen, n.20 above, at 828-29; Keeton, n.9 above, at 568; Saba, n.5 above, 194.
40. Donovan (M. Alister) v. Stevenson, [1932] AC 562 (per Lord Atkins); Bell Helicopter Co. v. Bradshaw, n.18 above, at 17,225 & 531 (in-flight fatigue fracture failure of the helicopter blade); Y Quintin & J Wyser-Pratte, n.16 above, at 327.
41. O'Keefe v. The Boeing Co., 335 F Supp 1104, 1132 (SDNY 1971) (a flaw in the fillet weld of the military bomber B-52's bulkhead not necessarily giving rise to the inference of negligence).
plaintiff must prove to the court's satisfaction that defendant's conduct was unreasonable in adopting the design and that a safer, alternative design was not only technologically feasible but economically practicable. A manufacturer may thus be excused for forgoing thorough inspection procedures at his own risk, for, in light of high costs involved, he may have to market his aircraft despite the likelihood of harm. Thus, under negligence, despite the danger involved, a product may not be defective nor may its manufacturer be negligent, insofar as it is sufficiently useful.

1.2.3 The risk-utility balancing test: Although the risk-utility analysis has been used by many courts under the rubric of strict liability in tort, the balancing test — the weighing of the benefits of reducing accident risk against its costs — is essentially a negligence concept. Indeed, determination of unreasonable dangerousness under the negligence rule is always a process of establishing, in light of relevant factors, that on balance the benefits of the challenged design were outweighed by the risk inherent in such a design. The relevant factors include the gravity of the danger created by the challenged design, the likelihood that such danger would occur, the technological and mechanical feasibility of an improved design, the economic costs of a safer, alternative design, and the probable adverse consequences that would result from such an alternative design (e.g. adverse effect on the utility of the product).

1.2.3 Case law: In *Krause v. Sud-Aviation*, which arose from wrongful death of the pilot and passengers in the crash of one of the helicopters manufactured by the defendant, the court correctly held the defendant liable on negligent manufacture of the aircraft. The court's decision was based on expert opinions that one T-shaped weld joining the horizontal stabiliser bracket to the failed longeron was defectively fused to each other as well as to the weld metal ('root') and that this inadequate fusion introduced abnormal stress in the weld and caused a break in that area leading to the

42. *Nesselrode v. Executive Beechcraft*, n.19 above, at 17,231; Phillips, n.31 above, at 103; *id, n.28 above*, at 347.

43. E.g. *Bell Helicopter Co. v. Bradshaw*, n.18 above, at 17,224 & 530; J W Wade, *Strict Tort Liability of Manufacturers*. 19 SW LJ (1965) 5, 15; *id, On the Nature of Strict Tort Liability for Products*, 44 Miss LJ (1973) 825, 836-38; Keeton, n.9 above, at 38; Abramson, n.17 above, at 177, 180.

44. *Model Uniform Product Liability Act 1979*, s 104[A], [B] & [D] (rejecting the 'consumer expectation test' and returning to the negligence rule for design defects, except for construction defect cases); G Galerstein, A Review of Crashworthiness, 45 JALC (1979) 187, 202 & n.57; Saba, n.5 above, at 204-05; Griffiths et al, n.4 above, at 381-82.

45. *Bell Helicopter Co. v. Bradshaw*, n.18 above, at 17,224 & 530 (an actual alternative design for the helicopter rotor system being already available and established as demonstrably superior).


47. 301 F Supp 513 (SDNY 1968), aff'd 413 F 2d 428. 431 (2d Cir 1969).
In Wilson v. Piper Aircraft Corp., the crash of a Piper Cherokee aeroplane, plaintiff alleged that the crash was caused by engine failure resulting from carburettor icing and that a fuel injection engine would have prevented such a crash. The court held that in design cases the utility of the product may be so great, and the change of design necessary to alleviate the danger in question may so impair such utility that it is reasonable to market the product as it is, even though the possibility of injury exists and was realised at the time of sale. For the cost of the necessary change may be so great that the article would be priced out of the market or no one would buy it despite its high utility.

Although the Wilson court said that it based its decision on strict liability, its reasoning is in fact based on the negligence standard, i.e. risk-utility test. This is evident in its ruling that when a design feature of a manufactured product creates a risk and actually causes injury, the test is whether "a reasonably prudent manufacturer would have so designed and sold the article in question had he known of the risk involved which injured plaintiff". The court held that plaintiff's burden in a design defect case includes a showing that an alternative safer design was not only available but feasible under the given circumstances in terms of cost, practicality and technological possibility. In determining a design defect, the court must weigh in the balance the utility of the product against its risk, and one of the factors to be weighed in making this determination is the manufacturer's ability to eliminate the unsafe character of the product without impairing its usefulness or making it too expensive to maintain its utility. The court concluded that there was little evidence about what effect the substitution of a fuel injection engine in the design of the aeroplane in question would have had upon the aeroplane's cost, economy of operation, maintenance requirements, overall performance, or safety in respects other than icing.

1.3 Strict Liability

Central to the determination of strict liability is the presence of a defect in the product which caused physical injury, since strict liability focuses on the condition of the product and the manufacturer will be liable for damage caused wholly or partly by a
defect in his product. In this respect, the *Restatement (Second) of Torts* has been regarded, though not always with justification, as indicating the extent of strict liability in tort. As if to take a leaf out of the Restatement's approach, the European Communities adopted a *Council Directive* in 1985, some nine years after such a move was initially proposed. The Directive has been adopted on the belief that imposition on the producer of liability without fault is "the sole means of solving the problem, peculiar to our age of increasing technicality, of a fair apportionment of the risks inherent in modern technological production".

1.3.1 The notion of defect under the *Restatement* and the *EC Directive*: The *Restatement* provides a celebrated formulation of strict products liability in tort: "One who sells any product in a defective condition *unreasonably dangerous to the user or consumer* or to his property is subject to liability for physical harm thereby caused to the ultimate user or consumer, or to his property...". The term 'unreasonably dangerous' is further described as dangerous, at the time when the product in question left the hands of the manufacturer, to an extent beyond that contemplated by the ordinary consumer with the ordinary knowledge common to the community as to its characteristics. The *Restatement* therefore links the term "unreasonably dangerous" to defectiveness of a product, whether as a definition of a defect, as a measure of design defect, or as a means of confining the applicability of strict products liability.

Likewise, although the *EC Directive* refers to "damage caused by a defect" in the manufacturer's product, it also employs the notion of consumer expectation as its test

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57. Shawcross, V(39).
58. N.10 above.
60. Directive, preamble. See also the Pearson Report, I(1255) for its recommendation in favour of strict liability for defective products; Shawcross, V(35.1).
61. S 402A(1) & comment g & i (1965) *Italics added*; Juglart, I(2162). For the meaning of "defect" in American law, see sec 1.1.3 above and accompanying notes.
62. *Restatement*, ibid, s 402A, comments i, f & g; Rigby v. *Beech Aircraft Corp.*, 548 F 2d 288, 291 (10th Cir 1977) (defective design of auxiliary fuel tanks); Radisaile v. Hawk Aviation, Inc., [15 Avi 17,473] 592 P 2d 175 (S Ct NM 1979) (aircraft leased without engine oil held defective); *Bell Helicopter Co. v. Bradshaw*, n.18 above, at 17,224; Wade, n.43 above, at 829-33.
63. Galerstein, n.44 above, at 198-99; Keeton, n.9 above, at 32.
by providing: "...when it does not provide the safety which a person is entitled to expect, taking all circumstances into account, including: (a) the presentation of the product; (b) the use to which it could reasonably be expected that the product would be put; (c) the time when the product was put into circulation". Similarly, for purposes of Part I of United Kingdom's *Consumer Protection Act 1987*, there is a *defect* in a product if its safety is not such as persons generally are entitled to expect. Safety includes safety with respect to products comprised in that product (e.g. in relation to an aircraft engine and other part or equipment as well as the entire aircraft) and safety in the context of risks of personal injury or death.

1.3.2 Constraints on the consumer expectation test: The consumer expectation test, however, is a vague, imprecise and unpredictable one. For average passengers cannot possibly have sufficient knowledge of how safely an aircraft could be made, given the complicated safety features of technologically advanced aircraft. Average passengers' expectations may be too low or too high, depending on their knowledge and information, and as such their expectations cannot be uniform. The newer and the less familiar the aircraft and its equipment are, the greater the expectations tend to be. If the manufacturer's liability is limited to "unreasonable" risks as determined by consumer expectations, his liability will depend on the capricious expectations of average passengers and would be diminished where the average passenger holds low expectations. Again, unpredictability of consumer expectations as to product safety will not induce the manufacturer to take optimal care. Although the state-of-the-art at the time of manufacture may help to determine average expectations of ordinary passengers, it is not relevant under strict liability.


67. *Ibid*, s 3(1).


70. Bruce v. Martin-Marietta Corp., 418 F Supp 829 (WD Okla 1975), 418 F Supp 837 (WD Okla 1975), aff'd, 514. or 544 F 2d 442, 447 (10th Cir 1976) (plaintiffs failing to show that the ordinary consumer would expect a plane made in 1952 to have the safety features of one made in 1970).


72. See sec 3.3 below.
Further, determination of being unreasonably dangerous always involves a process of risk-utility balancing, an essentially negligence test, which would place a significantly increased burden on plaintiff with "proof of an element which rings of negligence." For, whereas the manufacturer is in a position to assess and reduce or insure against the dangers inherent in his products, consumers do not have the skills or the means to investigate the safety and soundness of a product. Thus, imposing such a burden on passengers contradicts and defeats the purpose of strict liability which is to relieve them of the difficulty of proof inherent in negligence actions. Indeed, the Restatement formulation of strict liability rarely leads to a conclusion different from that of the negligence rule. This is why the element of "unreasonable danger" has been rejected as a valid part of testing defectiveness under strict liability. As such, both the Restatement and the EC Directive have failed to enunciate a clear and consistent test of strict liability.

1.3.3 Restatement of strict liability in tort: A strict liability proper or full strict liability would therefore require that liability be triggered whenever an aircraft the manufacturer places on the market proves defective and causes injury to its users, whether he exercised reasonable care or whether it was unreasonably dangerous or not. For the manufacturer should not market such a defective aircraft product which is likely to cause injury but could not be made safer at the time of design and manufacture. Or if he nevertheless should choose to do so, the risk of aircraft products should be borne by manufacturers and not by the injured persons who are 'powerless to protect themselves'. However intermittently and haphazardly such injuries may occur, the risk of their occurrences is a constant, general risk and that the manufacturer with superior knowledge is far better positioned to provide protection by taking appropriate

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73. Sec 1.2.2 above.
74. Cronin v. J.B.E. Olson Corp., 8 Cal 3d 121, 132, 501 P 2d 1153, 1162, 104 Cal Rptr 433, 442 (S Ct Cal 1972); Barker, n.71 above, at 456.
77. Montgomery & Owen, n.20 above, at 842; Keeton, n.9 above, at 32; Jobe, n.46 above, at 402.
78. Stapleton, 130 & 161.
79. See Berkebile v. Brantly Helicopter Corp., 337 A 2d 893, 899 (S Ct Pa 1975); Restatement (Second) of Torts, s 402A(2)(a).
risk-reducing steps or by insuring the risk and distributing the losses in the price of his product as a cost of engaging in the business.\textsuperscript{82} Indeed, a large verdict of liability or a threat of one has induced manufacturers to produce safer products.\textsuperscript{83}

2. Simple Models for Single-Manufacturer Accidents

2.0.1 Assumptions: It is assumed that penal-administrative regulation of safety (e.g. duty to report to the authority of a "reportable occurrence") is in force in respect of any defect or malfunctioning of an aircraft or its equipment in parallel with civil liability for damage caused by a defect in aircraft.\textsuperscript{84}

2.1 Factors Affecting Expected Losses

2.1.1 Manufacturer's care: Given the technological complexities of aircraft products, it is obvious that in design or manufacturing defect cases, there is a lack of parity of risk-avoiding ability between the manufacturer and the user of aircraft.\textsuperscript{85} The manufacturer, staffed by qualified engineers and technicians, is in a position to test and inspect fully his aircraft's potential defects before marketing them. By contrast, it is fair to say that passengers are devoid of correct information about risk created by different types of aircraft and thus unable to take risk-reducing steps or 'powerless to protect themselves'.\textsuperscript{86}

2.2 Passenger' Perfect Information

If the passenger has perfect information about risk caused by aircraft, the choice of a legal rule will not affect the achievement of efficiency and every legal rule will lead to the efficient outcome. Under strict liability, manufacturers will include their accident costs in the price of their aircraft and carriers will reflect aircraft price in their fares. Therefore, air fares will correctly reflect accident costs caused by the manufacturer, and passengers will be induced to buy the efficient amount of carriage by air service. Under the negligence rule, manufacturers will take optimal care to avoid liability, and passengers with perfect information will also take expected accident losses into account in deciding to buy carriage by air service.

\textsuperscript{82} Ibid.
\textsuperscript{83} Wade, n.43 above, at 826; Abramson, n.17 above, at 167.
\textsuperscript{84} See e.g. the Air Navigation Order 1983. SI 1985/1643, esp. arts 10, 15, 85(1)(e)(i)-(ii) & 85(2) & sch 7, paras 1(f), 2(f) & 3(f); Shawcross, V(24).
\textsuperscript{85} Abramson, n.17 above, at 175.
\textsuperscript{86} See Greenman v. Yuba Power Products Inc., n.81 above, at 901.
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2.3 Passengers' Imperfect Information

It is not realistic to assume that passengers have accurate information about accident risk caused by an aircraft that he happens to get on board. This is especially the case with casual tourists whose trips are arranged by travel agents. Even business travellers can hardly be expected to have accurate information about the risk involved in his trip, given the technological complexities associated with the production process and ensuing information asymmetry. A Boeing 747, for instance, has more than 4,500,000 parts and its electrical wiring alone is 135 miles long such that Boeing has to sign contracts with 1,500 prime, and 15,000 secondary suppliers from six countries worldwide as well as in America.\(^{87}\) Manufacturers, by contrast, have correct information about the costs of alternative safety devices and about the safety performance of competing aircraft.\(^{88}\) We now therefore reconsider the effects of passengers' imperfect information on a choice of the efficient liability rule. These effects can most clearly be seen by assuming that passengers underestimate the risk.

Example 3.2 Suppose an aircraft manufacturer produces several different types of commercial aircraft and that he has, in the course of his aircraft-producing activity, recorded a certain accident probability for those aircraft measured for every 100,000 kms. It is assumed that he has adequate information about accident propensity of a particular material or a design; and that he knows that if he exercises control of the quality or safety of his aircraft by supervising the work of his employees and component part makers, he could reduce accident frequency. Suppose also the manufacture can take one of the three options in relation to its safety record: taking low, medium or high care. In this Example, as Table 3.1 shows, the efficient outcome requires that the manufacturer take medium care if he is concerned with profit maximisation or cost minimisation.

2.3.1 Negligence rule and strict liability compared under risk neutrality: Under the negligence rule, assuming that the manufacturer will not be liable if he takes medium care, he will be induced to take medium care and be willing to sell his product for £800 for every 100,000 kms. However, since passengers misperceive and underestimate the risk, they will not add £200 to take expected loss into account in their decision to buy air travel. Consequently, they may be induced to buy too much of the service. In this situation, the important question is whether passengers, if fully informed of the possibility of uncompensated losses when optimal care is taken by the manufacturer,

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87. TT, 28 Dec. 1988, p.11.
88. Landes & Posner, n.8 above. at 544-45.
would still be prepared to buy the same amount of travel. Further, given technical, idiosyncratic features of the aircraft production process, courts will be burdened with making technical decisions without clear, objective standards of design defect and with determining the correct standard of due care applicable to each manufacturer.

Table 3.1

Aviation Accident Example: Manufacturer's Care Affects Expected Losses

| Manufac- | Average | Average | Loss to | Expected | Full Cost of |
| turer's | Cost of | Accident | Each | Accident | Production |
| Behaviour | Production | Probability | Passenger if | Loss | per 100,000 |
| (Level of | per | (Fatal | Accident | kms (£) |
| Care) | 100,000 | Accidents | per 100,000 |
| kms flown* | per 100,000 kms flown) |
| low | 650 | 0.0045 | 100,000 | 450 | 1,100 |
| medium | 800 | 0.0020 | 100,000 | 200 | 1,000 |
| high | 950 | 0.0010 | 100,000 | 100 | 1,050 |

* On the basis of an aircraft's expected life span of 60 million kms for 20 years.

The efficiency of strict liability is not affected by passengers' information about products risk. Under strict liability the manufacturer will be liable for actual passenger losses and will sell his product for £1,000 per 100,000 kms or above. Since the airline will reflect this cost in the price of his carriage by air service, the air fare he charges will correctly reflect the true cost of his service and passengers will be forced to buy the efficient amount of air service. Therefore, under the assumption that passengers have imperfect information and underestimate the risk inherent in aircraft, strict liability will have clear advantage over the negligence rule in achieving the efficient outcome with respect to the manufacturer's care and passengers' consumption decisions.

2.3.2 Constraints on the negligence rule: Under negligence, the court must determine, on the basis of risk-utility balancing, the manufacturer's negligence in the adoption of a specific design. Given the difficulty of taking into account all these factors and establishing product safety standards by which to gauge the manufacturer's
conscious design choices, it is not surprising for one commentator to argue that courts are inherently unsuited to such a task.\textsuperscript{89} If the court lacks correct information and makes errors in setting the efficient level of care applicable to each manufacturer in respect of a particular design, he will be uncertain of the right amount of care in design to meet the safety standards.\textsuperscript{90} The outcome will thus remain unpredictable under the negligence rule. This uncertainty and unpredictability would have an adverse effect on private initiatives of research and development of new, safer product designs.\textsuperscript{91} A firm that is not sure of whether a given degree of research or development efforts will later be seen by the court as adequate may decide to engage in research to a socially excessive extent.\textsuperscript{92}

2.3.3 Passengers' care and the defence of contributory negligence: In aircraft product risk, it is fair to say that passengers can hardly affect the probability and magnitude of damage by taking care or otherwise, since passengers have imperfect information and are liable to underestimate risk. By contrast, the manufacturer with his superior knowledge of the risks inherent in his products can better and more cheaply reduce or bear the risk.\textsuperscript{93} Contributory negligence will find its most cogent rationale where there is parity of risk-reducing ability between the manufacturer and the victim and the burden of risk avoidance can thus be shared between them (joint care situation).\textsuperscript{94} Where the victim is unable to do little to protect himself, there is no point to impose the rule of contributory negligence. Given the technological complexities of aircraft and the lack of parity in risk-avoiding ability, strict liability will be more efficient to avoid passenger damage. Under strict liability, contributory negligence is usually not available or recognised as a defence.\textsuperscript{95} For these reasons, the contributory negligence defence provided under the EC Directive,\textsuperscript{96} whether it prescribes strict liability or the negligence rule, is not necessary nor efficient in the context of aircraft product risk.

\textsuperscript{89} J Henderson, Judicial Review of Manufacturers' Conscious Design Choices: The Limits of Adjudication, 73 Colum LR (1973) 1531, 1543-44.
\textsuperscript{90} J Henderson, Renewed Judicial Controversy over Defective Product Design: Toward the Preservation of an Emerging Consensus, 63 Minn LR (1979) 773, 780.
\textsuperscript{91} Stapleton, Three Problems, at 273.
\textsuperscript{92} Shavell, 56-57.
\textsuperscript{93} Ribstein, n.12 above, at 354.
\textsuperscript{94} H Kalven, Torts: The Quest for Appropriate Standards, 53 Cal LR (1965) 189, 206; Abramson, n.17 above, at 175.
\textsuperscript{95} Montgomery & Owen, n.20 above, at 829.
\textsuperscript{96} Art 8(2): "The liability of the producer may be reduced or disallowed when, having regard to all the circumstances, the damage is caused both by a defect in the product and by the fault of the injured person or any person for whom the injured person is responsible". See also Consumer Protection Act 1987, s 6(4): Shawcross. V(35.6).
2.3.4 Risk aversion: Under the negligence rule, manufacturers will be induced to take optimal care and product risks will borne entirely by passengers, whereas under strict liability risk is entirely allocated to manufacturers. In this situation, if only imperfect third-party liability insurance is available to manufacturers because of the moral hazard problem and no first-party insurance is available to passengers, manufacturers bear some risk under strict liability, whereas passengers bear the entire risk under negligence. Thus, strict liability is preferred to the negligence rule to the extent that manufacturers are risk neutral and the passenger is risk averse or that passengers are more risk averse than manufacturers.

2.4 Regulatory Safety Standards and Optimal Deterrence

Apart from tort liability, manufacturers are also subject to regulatory obligations. For example, manufacturers are under obligation to market their products in compliance with the general safety requirement or safety regulations.\(^97\) We thus examine some of the typical product safety regulations and standards, their ability to produce optimal deterrence, and the relationship between regulation and civil liability.

2.4.1 Regulating product safety and quality through standards regimes: The first problem to be addressed is that there are few mandatory product standards concerned with quality per se, except to the extent of intervention in the form of information regulation.\(^98\) Given the impossibility for regulators to formulate detailed mandatory standards, the regulatory approach to product safety was on a selective, ad hoc and piecemeal basis.\(^99\) Safety standards are often too vague to provide sufficient guidance and often substantially inferior even to the industry's recommended standards.\(^100\) An aircraft manufacturer, for example, must satisfy minimum standards required in the interest of public safety for the design, material, workmanship, construction and performance of aircraft, aircraft engines and propellers.\(^101\) What constitutes minimum standards, however, is not always clear. Thus, the focus of regulatory standards was, in the case of the United Kingdom, placed in the 1970s on target standards that "goods

\(^{97}\) Consumer Protection Act 1987, ss 10 & 11.

\(^{98}\) Ogus. 198.

\(^{99}\) Ogus. 198.

\(^{100}\) E.g. in sec 2056(a)(1) of the US Consumer Product Safety Act 1972, 15 USC s 2051 et seq (1996), it is provided: "Requirements expressed in terms of performance requirements".

\(^{101}\) 49 USC s 44701(a)(1) (1996); 49 USC Appd s 1421(a)(1) & (2) (1988).
available to the public present no undue risk to consumers"; combined with an increased use of information regulation such as a certification system.\(^{103}\)

2.4.2 Target standards: The selective approach to product safety was eventually replaced with a general target standard adopted in the *Consumer Protection Act 1987*.\(^{104}\) Under the Act, consumer goods fail to comply with the general safety requirement if they 'are not reasonably safe having regard to all the circumstances', including *any published standards of safety*.\(^{105}\) The reference to any published safety standards indicates that compliance with such *voluntary* standards as issued by the British Standards Institution or in the US Federal Register is relevant to, but not conclusive of, the 'reasonably safe' criterion.\(^{107}\) The formulation of the general target standard under the Act is regarded as representing the economic goal of optimal safety.\(^{108}\) The constraint is on the difficulty with defining or determining what is 'reasonably safe'. Although a product may be regarded as reasonably safe if its risk can be corrected at a cost that makes the remedy worthwhile,\(^{109}\) this will inevitably lead regulators to engage in the complicated cost-benefit analysis. Therefore, only when there exist agreed community standards as to what is 'reasonably safe', the target standard will in practice produce optimal deterrence without much error costs.

2.4.3 Certification: Regulation through disclosure of information\(^{110}\) will generally increase information on the risky characteristics of a particular type of aircraft\(^{111}\) and may help passengers with their decision to buy the efficient amount of air travel. This may be the case with the requirement of publication of a notice\(^{112}\) or adequate warnings or instructions.\(^{113}\) However, it is doubted whether manufacturers will have an adequate incentive to disclose voluntarily information on potential defects of their aircraft in the absence of a regulatory sanction. Certification of aircraft may correct


\(^{103}\) Ogus, 198. For the certification regime, see ch 1: 8:1 above.

\(^{104}\) Ogus, 202.

\(^{105}\) S 10(2)(b); EC Directive 92/59 on General Product Safety, art 3.

\(^{106}\) *Consumer Product Safety Act*, 15 USC ss 2058(a) & 2056(b) (1996).

\(^{107}\) Ogus, 202.

\(^{108}\) Ogus, 202.


\(^{111}\) For the physical types of aircraft, see Shawcross. V(6).


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these inefficiency in information regulation.114 The manufacturer of an aircraft is thus
issued a certificate of airworthiness only when he satisfies the standards of design and
construction after the agency's necessary inspections, tests, experiments and flight
trials.115 Certification may thus induce manufacturers to take optimal care, provided
that regulators are equipped with accurate information on the characteristics of the
aircraft they certify; that they make public adequate information involving certification
of a particular type of aircraft; and that such information is made accessible to the
public without much costs.

2.4.4 Product ban or recall and revocation of certificate: As a form of product safety
regulations, product ban or recall, usually combined with suspension or revocation of
an airworthiness or type certificate,116 may induce aircraft manufacturers to take care
to avoid such a sanction and adverse publicity. It will also increases information on the
safety of a particular type of aircraft. Product ban or recall may be an effective safety
regulation where, as in an aircraft, there are involved very serious risks, where the
costs of an information failure in the market are very high, and where other less
restrictive forms of regulation cannot adequately deal with the problem.117 In other
words, under conditions of full information, product ban may cause a minimal loss in
consumer satisfaction and welfare. Thus, following a DC-10 crash near Chicago of
May 1979, the FAA took a series of measures designed to avoid similar accidents
including suspension of certificate of prototype of DC-10 and a ban on flight by any
type of DC-10 which drew much adverse publicity against the manufacturer.118 The
constraint on the optimal deterrence effect of product ban is that if the risk of a ban or
revocation of certificate ex post is considered not high enough, managers of a firm may
rationally choose to gamble on the tiny risk materialising.119

2.4.5 Relationship between safety regulation and civil liability: The EC Directive
1985 provides that the producer is not liable if he proves that the defect is due to
compliance with the product with mandatory regulations issued by the public
authorities.120 Likewise, the Consumer Protection Act 1987 permits manufacturers to

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114. Ch I: 8.1 above.
115. CivilAviation Act 1982, s 85(1); Shawcross, V(15)-(16) & II(58)-(59) & V(16).
I(504); ch 1: 8.1.5 above.
117. R Hirshhorn. Regulating Quality in Product Markets, in D N Dewees (ed), The Regulation of
Quality, 55: 69.
118. See E Denza. From Aerostats to DC-10s _ Recognition of Certificates of Airworthiness, in A
Kean (ed), Essays in Air Law, 39; Juglart, I(560); BritishCaledonian Airways, Ltd et al v. Longhorne
119. See ch I: 8.1.4 above, in fine.
120. Art 7(d).
invoke a defence that the defect is attributable to compliance with any requirement imposed by or under any enactment or with any Community obligation.\textsuperscript{121} No liability would thus arise under the Act if there is compliance with the general safety requirement imposed by or under any enactment or with any EC obligation\textsuperscript{122} or by any safety regulations or any safety standards.\textsuperscript{123} This latter provision, however, may cause conflict with tort liability of the aircraft manufacturer for defective design or manufacture. It is true that compliance with standard industry custom or practice may be adduced neither as conclusive evidence of being 'reasonably safe' under safety regulations nor as that of due care and no negligence under the negligence rule.\textsuperscript{124}

However, under the negligence rule, in order for the aircraft manufacturer to establish proper discharge of duty of care, it is not sufficient to prove that the design has conformed to mandatory standards and has been certified by the regulatory body.\textsuperscript{125} In aviation tort law, it is established that compliance with airworthiness or type regulations are intended to establish minimum safeguards of design against the most flagrant hazards and as such will neither provide conclusive evidence of due care nor afford the manufacturer a complete defence against a defective design.\textsuperscript{126} This is not to speak of a strict liability. The position is more or less similar in French law. Certificate of airworthiness creates a presumption which may be rebutted by proving to the contrary.\textsuperscript{127} In other words, the approval given by the regulatory agency does not exempt the air carrier or manufacturer of liability for an accident caused by a defective material used in maintenance or manufacture.\textsuperscript{128} In this sense, tort liability can create an even stronger incentive for the aircraft manufacturer to avoid and minimise risk than safety regulations or standards.

\textbf{2.4.6 Distributional consequences of regulation:} Obviously, despite the benefits of regulation of aircraft safety (increase in information, removal of externalities, and raising the quality of products, etc.), regulation is not without its costs. In extreme

\textsuperscript{121} Ss 4(1)(a).
\textsuperscript{122} S 10(3)(a).
\textsuperscript{123} Ss 10(3)(b) & 11 (Secretary's power to make safety regulations in general); Ogus, 203.
\textsuperscript{124} Maynard v. Stinson Airplane Corp., n.15 above, at 702; Quintin & Wyser-Pratte, n.16 above, at 331; sec 2.4.2 above.
\textsuperscript{125} C Mannin, n.64, at 249; Quintin & Wyser-Pratte, n.16 above, at 332; Pearson Report, I(1260).
\textsuperscript{127} Juglart, I(509).
\textsuperscript{128} See Juglart, ibid.
cases, the regulatory goal of optimal safety is one thing and its actual formulation and effect may be quite another. Nevertheless, if the public interest in regulating the safety of aircraft (and thus that of passengers) is greater than the sum total of the private interest of the travelling public, regulation may still be justified, even if it is not as efficient as it should be. In other words, if the public interest in enhancing aircraft safety is great enough to justify regulation, spending public (or taxpayers') money on the regulation of aircraft safety will be well worth it. If on the other hand the converse is true, then regulation may be less justified and the issue of aircraft safety should entirely be left to tort law's function. Although this question depends to a great extent on a particular society's goals and preferences, the former may well be the case, given the problem of market and private law failure.

2.5 Passengers' Imperfect Information and the Manufacturer's Duty to Warn

The Consumer Protection Act 1987 provides that in determining what the users of a product generally are entitled to expect, one must take into account all the circumstances such as any instructions or warnings with respect or in relation to the product.129 The EC Directive 1985 has a corresponding but less specific provision.130 However, since the Act does not provide any further, questions will arise as to whether the manufacturer's duty to warn (or to develop corrective steps) continues even after the sale of his product and what can be considered proper warnings. Recalling our discussion of the carrier's duty to give passengers adequate notice,131 we will assume here that passengers have imperfect information about aircraft product risk and that negligible administrative costs are incurred for the provision of warnings in the flight manual or service bulletins.132

2.5.1 Duty to warn under the two alternative liability rules: Under negligence, if passengers can affect expected losses by taking care but are not adequately informed of the risk of the aircraft they are using, they will underestimate risk and will not adequately be induced to take self-protecting steps.133 In order for the negligence rule to be efficient, therefore, the manufacturer must give aircraft users sufficient warnings about the characteristics of the plane so that they can take appropriate steps available (e.g. by using less of carriage by air and more of carriage by rail or ship or taking out

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129. S 3(2).
130. Art 6(1)(a).
131. Ch 2; 2.4 above.
133. Secs 2.3.1 & 2.3.2 above.
additional first-party insurance) whenever they take a trip by air. This is because average aircraft users with imperfect information will have no choice but to rely on the manufacturer's superior knowledge of his product as well as his research and development of his product. Indeed, warnings can make a product safer without limiting its utility, insofar as it does not incur much additional cost.

Under strict liability warning is not necessary and indeed immaterial, for even if passengers do not take care because of their imperfect information, the manufacturer will do his part by taking all justified steps to avoid liability or by purchasing insurance against his potential liability. Under strict liability the manufacturer is obligated to internalise accident costs incurred by his aircraft rather than merely to give warning to users. This explains the difference between the two alternative liability rules: in a negligence action the manufacturer's issuance of proper warnings to users in respect of the dangerous nature of a product would be admissible as a defence, but may not be relevant in a strict liability action. In fact, under strict liability proper, the manufacturer is already forced to remedy defects in an aircraft he has marketed and to develop and supply improved, safer devices.

2.5.2 Proper method of giving warnings: Under negligence, it was seen above, the manufacturer is required to give adequate warnings and instructions as to continued safe use of his product and failure to do so will give rise to liability. This is because the manufacturer holds the superior position and know-how to receive, comprehend, and disseminate information regarding the safety of its products. But firms in general lack appropriate incentives to provide information about the dangerousness of their products, especially where they perceive no effective way of reasonably discharging their duty. Thus, questions may arise as to what is considered adequate warning and how such warning should be given. The adequacy of warning is a question of fact. Although obvious dangers need not to be warned, general warning will not satisfy

135 See G M Fleming, The Duty of the Manufacturer to Recall Aircraft, 45 JALC (1980) 581, 584; ch 1: 7.1.2 & 7.3.1 above.
137 See Abramson, n.17 above, at 170.
138 The Model Uniform Product Liability Act 1979, s 104[c], provides for liability only where the defendant is proven to have been at fault, which does not conform to the efficiency norm.
139 Walton v. Avco Corp., [21 Avi 18,340, 18,346] 557 A 2d 372 (S Ct Pa 1989) (helicopter manufacturer held liable for failure to pass on to purchasers warnings he had received from its engine maker as to its defect)
140 Ibid, at 18,347, Shavell, 55.
141 Shawcross, V(34) n.10; Fleming, n.135 above, at 588.
the duty and warning must be adequate, specific and unambiguous to make aircraft safe.\textsuperscript{143} Raising the "spectre of danger under some circumstances" such as "prolonged operation in a slip...under low fuel condition" without their definitions was held ambiguous and inadequate to warn of fuel displacement within the fuel tank.\textsuperscript{144}

As regards the question of how warning should be addressed, no fixed, mandatory form can be proposed. But where warning is required, the manufacturer must provide such warning "in a form that will reach the ultimate consumer and inform of risk and inherent limits of the product".\textsuperscript{145} He may satisfy the duty by containing warnings in flight or owner's manual and delivering them to purchasers (i.e. aircraft operators and airlines) who will in turn pass them on to passengers. The manufacturer may also use its own service centres or other repair and maintenance shops as a 'convenient contact point' or contact directly, through the mail or otherwise, purchasers to communicate safety information and service instructions.\textsuperscript{146} The cockpit placard or instrument panel will supplement this with a warning light in case of any malfunctioning. He needs to continue to provide updated warnings through supplement service bulletins or letters.

2.5.3 Duration of the post-sale obligation to warn: Without prejudice to the efficiency of imposing on the aircraft manufacturer a post-sale duty to warn of danger under the negligence rule, for how long should a manufacturer be obligated to concern himself with the potential design defect of an aircraft he is marketing?\textsuperscript{147} In other words, the difficulty is with determining to what extent it is efficient and desirable to obligate the aircraft manufacturer to divert resources from ensuring safety of new aircraft to post-delivery surveillance on old aircraft. Another factor that should be taken into account in relation to the duration of the duty is administrative costs of issuing warnings in e.g. maintenance manuals. Obviously, given the rapid development in aviation technology, although one could hardly expect a 1952 aeroplane to be kept up to the latest standards,\textsuperscript{148} one may equally not expect it reasonable to impose the duty to warn for 30 years after sale.\textsuperscript{149}

2.5.4 Post-sale duty to warn in American law: In the United States it is established that when a manufacturer markets a product having knowledge of its danger in its use,

\textsuperscript{143} Kritser v. Beech Aircraft Corp., [12 Avi 17,940, 17,944] 479 F 2d 1089 (5th Cir 1973) (crash caused by a deficient fuel system).
\textsuperscript{144} Ibid, at 17,944. This deficiency was corrected by the subsequent wording, "prolonged operation (20 seconds or longer)...with the main tanks less than one-half full".
\textsuperscript{145} Berkebile v. Brantly Helicopter Corp., n.79 above, at 903.
\textsuperscript{146} Walton v. Avco Corp., n.139 above, at 18,346.
\textsuperscript{147} Stapleton, 249.
\textsuperscript{148} Bruce v. Martin-Marietta, n.70 above.
\textsuperscript{149} As recognised in Kozlowski v. John E Smith's Co, 275 NW 2d 915 (1979).
he owes a duty under the negligence rule to warn clearly the purchaser or user of the danger. Thus, one who supplies directly or indirectly a chattel for another to use is under obligation to exercise reasonable care to inform the users of its dangerous condition. Failure to give proper instructions as to safe use and to indicate dangers by clear and adequate warnings may make it 'defective'. The manufacturer's duty to warn under negligence has been aptly summed up by the court in *Bell Helicopter Co. v. Bradshaw* when it held that the manufacturer, Bell, was negligent in: 1) failing to use reasonable means available to replace the defective part on the helicopter; 2) failing to give the helicopter owner and its pilot adequate and proper warnings and instructions regarding continued use of the defective part; and 3) publishing a statement in a flight manual that the helicopter was capable of making an autorotative descent and landing following tail rotor failure.

American jurisprudence has nevertheless shown apparent confusion and inconsistency in the application of strict liability and negligence principles on the manufacturer's post-delivery duty to warn. Thus, the *Restatement* imposes on the seller a duty to give directions or warnings as to its use even under strict liability, and some case law imposed a similar duty on the manufacturer under strict liability. Further, some courts imposed a post-sale duty to remedy the defect under the negligence rule. In *Noel v. United Aircraft Corp.*, prolonged overspeed separated the No.2 propeller of a Lockheed Constellation from the engine to gash it into the belly tank to explosion. The court, imposing on the propeller maker a continuing duty to develop an improved propeller system paralleling a similar development in other aeroplanes, held the propeller maker negligent for failing to do so despite his awareness that continued use of the propeller system endangered the travelling public. The decision, however, was clearly not taken on a negligence standard but on strict liability principles. In *Braniff Airways, Inc. v. Curtiss-Wright Corp.*, which arose from the crash of a DC-7C airliner due to the negligent design of its engine, the court ruled that the engine maker had a duty either to remedy the defect in his product

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150. *DeVito v. United Airlines, Inc.*, 98 F Supp 88 (EDNY 1951) (negligent design of fire suppression equipment in a Douglas DC-6 airliner); Fleming, n.135 above, at 584-85.
151. *Restatement (Second) of Torts*, ss 388(c) & 389 (1965).
152. See Shawcross, V(38).
153. N.18 above, at 17,225 & 531.
154. See s 402A, comment h & j; *Nesselrode v. Executive Beechcraft*, n.19 above, at 17,232-33.
156. 219 F Supp 556, 566 (D Del 1963), rev'sd on other grounds, 342 F 2d 232 (3d Cir 1965). See also *Pan American World Airways Inc. v. United Aircraft Corp.*, 192 A 2d 913 (S Ct Del 1963), aff'd 199 A 2d 758 (1964) (negligent design of a propeller governor system).
157. Ibid. at 572 & 236-37; Fleming, n.135 above, at 585.
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previously marketed or, if complete remedy is not feasible, to give users adequate warnings and instructions concerning the methods for minimising the danger". The court, however, was certainly not ruling consistently on the negligence standard but on a mixture of negligence and strict liability tests.

Meanwhile, the decision in Kay v. Cessna Aircraft Co.¹⁵⁹ is flawed on different grounds. In Kay, where the pilot of the twin-engine plane was killed while attempting to take off because the rear engine, invisible from the pilot's seat, failed. Plaintiffs alleged that Cessna's instructions as to safe use were inadequate and rendered the aircraft dangerous and defective.¹⁶⁰ The court rejected plaintiffs' argument on the grounds that compliance with safe take-off procedures in the owner's manual would have alerted the pilot to the danger of engine failure and that his failure to do so was not reasonably foreseeable to Cessna. Nevertheless, if the court had based its decision on strict liability, as it purported to, it must have held Cessna liable regardless of adequacy of warnings or foreseeability of misuse. If, on the other hand, it had relied on the negligence rule, as is believed, it must also have held it liable. For, as the court conceded, the manufacturer failed on balance of evidence to draft more clearly the instructions and also to install a thrust warning light to alert the pilot to the fact of rear engine failure.¹⁶¹ Indeed, in the court's own words, "[I]f a products lacks warnings or instructions as to its proper and safe use and this absence renders the product "defective", its manufacturer is liable for any proximately caused injuries".¹⁶²

3. Causation

In order to succeed in an action and recover damages, the claimant must prove that 1) the aircraft was defective at the time it left the hands of the manufacturer; 2) the defect caused injury; and 3) that the defect was the proximate cause of the injuries suffered.¹⁶³ The burden of proof lies with plaintiff.¹⁶⁴ Thus, the EC Directive provides that the injured person must prove the defect, the damage and the causal relationship between them.¹⁶⁵ The Directive further provides, however, that the producer will not be liable if he proves that, "having regard to the circumstances, it is probable that the defect which caused the damage did not exist at the time when the product was put into circulation

¹⁵⁹. [14 Avi 17,671] 548 F 2d 1370 (9th Cir 1977).
¹⁶⁰. Ibid, at 17,672.
¹⁶¹. See ibid, at 17,672-73.
¹⁶². See ibid, at 17,672.
¹⁶⁵. Art 4.
by him or that this defect came into being afterwards. A combined reading of these two provisions leads one to conclude that the Directive (and the Consumer Protection Act 1987) prescribes not strict liability but the negligence rule, since the producer can always rebut presumption of a defect by producing evidence to the contrary.

Example 3.3 Imagine that one of the passengers smoked in an aft cabin lavatory and flung a smouldering cigarette butt into a trash receptacle in an aircraft approaching the destination on its long-haul international flight. The stub soon caught fire on the lavatory's plastic wall coverings and caused them to smoulder and smoke, emitting and circulating poisonous combustion gases throughout the cabin. By the time the pilots perceived the problem, lowered cabin oxygen masks and made an emergency landing in a field short of the airport, many passengers were already suffocated by deadly toxic fumes of carbon monoxide and cyanide emanating from the combustion of inflammable cabin fabrics and furnishings (synthetic fibre carpets and plastic cabin wall lining, etc.). It is assumed that the airline had posted a warning against the fire hazard of smoking in front of the lavatory; that cabin crew were quick to extinguish the fire and smoke, to no avail; and that certifying authorities were not negligent in issuing the type certificate and that no modification was conducted on the aircraft after certification.

It would be clear in this Example that a chain of causation that engendered suffocation of passengers started with a fire and smoke caused by a smouldering cigarette butt that was left unattended. Although the fire and resulting suffocation were in fact caused by one of the passengers, it would be inconceivable to hold liable the person who flung the cigarette butt recklessly, given his presumably insufficient assets to meet the liability and given the difficulties involved (consider that the suspect had already been suffocated to death). The airline also responded quickly to the in-flight fire to minimise losses, and the lowering of oxygen masks, even if it contributed to the spread of the fire and smoke, could not be regarded as the proximate cause of suffocation or as an independent cause to break the causal chain between the fire and asphyxiation. It would thus be reasonable to attribute the proximate cause of suffocation to the defective trash receptacle (and other furnishings) or to the defective

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166. Art 7(b); Consumer Protection Act 1987, s 4(1)(d); Hodges, Product Liability, 67.
168. The engine explosion on a jet about to take off at Manchester airport in 1985 poisoned the aircraft interior by fumes from melting plastic and burning seats and killed 55 people on board. See The Economist, 14 Jan. 1989, p.17. In the wake of that accident, the CAA ordered all British-registered aircraft to be fitted with fire-blocking materials on polyurethane seats.
169. See ch 6: 3.1.3 below.
cabin venting system designed to drive lethal gases out of the aircraft as quickly as possible, as further explained below.

3.1 Causal Link Between Defect and Loss

3.1.1 Constraint on causation: In order to satisfy his burden of proof, plaintiff must establish causal link between a defect and the damage suffered. In Example 3.3 above, if the causal requirement is strictly observed, liability would probably have to fall on the passenger who flung the smouldering cigarette butt into the trash receptacle without putting it out completely and not on the aircraft manufacturer. This is because his act was the cause in fact of the suffocation of many passengers. Nevertheless, imposing liability on the passenger in question would have little deterrence on the avoidance of similar future losses nor would it be feasible, as already explained. Only when liability is imposed on the manufacturer, he will adequately be induced to reduce in-flight fire hazard by using appropriate fire-resistant materials or by developing safer design and devices (e.g. providing an airtight receptacle cover that would contain any fire within it or installing a fire or smoke alarm system within the cabin).

3.1.2 Constraints on proof of a defect under negligence: In order for plaintiff to prove a defect under negligence, he must show not only that defendant failed to exercise due care in the adoption of design but that on balance an alternative safer design was feasible, both economically and technologically, in terms of its cost, overall design and operation. This is obviously onerous for plaintiff to prove, since most of evidentiary requirements relevant to determination of risk-utility balancing always involve information about highly technical matters which are mostly unavailable to injured users and peculiarly within the knowledge of the manufacturer. Again, if such a safer design had not been feasible in terms of development or operating cost (e.g. if fire-resistant material had been too expensive to develop or an aircraft built by such material had been too heavy to operate, etc.) at the time of manufacture, the component part cannot be held defective and its maker will not be liable. By contrast, the manufacturer is at least in a superior position to identify the risk inherent in his

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170. See in this context Wayne Tank & Pump Co. Ltd. v. Employers' Liability Ass Corp. Ltd. [1973] 2 Lloyd's Rep 237 (CA) (A fire was proximately caused by the dangerously defective condition of equipment and the negligent conduct of an employee of the insured).

171. This is not to speak of the possibility of the person responsible having already been killed or of the difficulty of identifying the person responsible.

172. Wilson v Piper Aircraft Corp., n.49 above; Keeton, n.9 above, at 34; Shawcross, V(38).

173. Wade n.43 above, at 826; Montgomery & Owen, n.20 above, at 809; Abramson, n.17 above, at 181; Barker, n.71 above, at 431, 435, 237; Quintin & Wyser-Pratte, n.16 above, at 331.
products and has much better knowledge of the costs of feasible alternative designs; and at most is almost in exclusive control of technologically complex features.

3.1.3 Constraints on presumption of defect and reversal of the burden of proof: From this vantage position, the manufacturer will have an incentive to cover up relevant vital evidence and information and can thus rebut the presumption of a defect and liability. This construction is apparent from the EC Directive's own language which allows the manufacturer to rebut the presumption of a defect and liability upon his production of evidence to the contrary, "having regard to the circumstances", knowledge of which is almost within his exclusive control. Further, if the defect develops after the sale, he will not be liable for damage caused by such a defect, which will not properly induce the manufacturer to take appropriate steps. In these circumstances, it is doubted what measure of certainty and predictability the presumption of a defect has brought about to determination of liability of the manufacturer under an alleged strict liability regime of the Directive. Nor is such presumption expected to induce adequately the manufacturer to take appropriate precautions for loss avoidance.

3.1.4 Restatement of causal requirement: One of the principal grounds for imposing strict product liability proper is to relieve an injured plaintiff of onerous evidentiary burden inherent in a negligence action and thereby to ensure that the costs of injuries resulting from defective products are borne by manufacturers. Defects in a product are often neither attributable to negligence as tested by risk-utility balancing nor easy to prove. Elimination of the requirement of proof of fault will not only alleviate plaintiff's burden and facilitate recovery but attribute losses caused by unsafe products to the manufacturer as the cheapest cost avoider. This will, through the price deterrence mechanism, the manufacturer to reduce his activity level, resulting in the incidence and amount of losses. Plaintiff needs only to show that the product was defective and that the defect was the proximate cause of the injury. Even under strict product liability there could arguably be circumstances where the airline, rather than the manufacturer, is the cheapest cost avoider of accident losses. But it will not be difficult to distinguish between losses attributed to a defect in the aircraft and those

174. Escola v. Coca Cola Bottling Co., n. 75 above, 24 Cal 2d 453, 461-62; Cronin v. J.B.E. Olson Corp., n. 74 above, at 1162; Barker, n. 71 above, at 455; Wade, n. 43 above, 826.
175. Keeton, n. 9 above, at 34; Wade, n. 43 above, at 826; Montgomery & Owen, n. 20 above, at 809.
176. Keeton, ibid, at 34; id. n. 76 above, at 1333-34: Prosser, n. 76 above, at 1119.
178. This is a point which Professor Terence Daintith drew my attention to during the revision.
ascribed to the airline's operation. A manufacturer would then be forced to take all justified steps to reduce risk before placing his products in the market.

3.1.5 Introduction of the notion of useful safe life: It may be not only conceivable but desirable that the average, useful safe life (life expectancy) of an aircraft is determined by the manufacturer and made public to users upon delivery of his aircraft.179 Thus, under the Model Uniform Product Liability Act 1979, the manufacturer will escape liability if he proves that the losses were caused after the expiry of the product's useful safe life.180 Ten years after the delivery of the product to the first purchaser, a presumption arises to the effect that the useful safe life has expired, which may only be rebutted by 'clear and convincing' evidence.181 Thereafter, the aircraft operator can make use of it for commercial purposes at his own risk, i.e. he must bear any losses if the harm were caused after the passage of the period. Similarly, the EC Directive has also introduced a ten-year statute of repose by providing that the rights conferred upon the injured pursuant to the Directive will be extinguished upon the expiry of a period of ten years from the date of his putting into circulation the product which caused the damage.182

3.2 Causation and Vicarious Liability

A modern commercial aircraft is manufactured usually by participation of a multitude of subcontractors (sous-traitants) or component part makers in the production process occurring even in different countries.183 This necessarily brings to the fore the issue of vicarious liability of the aircraft manufacturer for passenger damage that his subcontractors may cause due to a defect in their component parts.184 Although we referred to vicarious liability of the manufacturer for losses caused by his subcontractors, it may equally be applicable mutatis mutandis to the employer's liability for damage caused by his employees (i.e. airline-pilots, manufacturer-engineers or ATCA-controllers). It is assumed that the principal has some sort of relationships, contractual or otherwise, with the actor (they are not strangers with each other) and that the actor's assets are less than the principal's and than the losses he may cause.

179 Landes & Posner, n.8 above, at 566.
181 s 110[B][1]; Shawcross, V(41); Ribstein, n.12 above, at 356.
182 Art 11.
183 Margo, 183; Landes & Posner, n.8 above, 567; sec 2.3 above. Component parts of Airbus aircraft are manufactured in at least four different states in Europe.
184 Juglart, I(2160).
3.2.1 The notion of vicarious liability: Vicarious liability, also known as the doctrine of *respondeat superior* ("Let the master answer"), means liability imposed on the principal for all or part of the losses caused by the actual wrongdoer (actor). Since actors usually have insufficient assets to pay for entire losses to be awarded in a tort judgment, vicarious liability increases the chances of swift recovery by allowing the victim to gain access to the principal's 'deep pocket' without proving that the loss is attributable to the principal. The circumstances covered by *respondeat superior* would thus be those of unilateral precautions or alternative-care situation suitable for the imposition of strict liability for his subcontractors' unintentional torts, since the principal chooses his employees and subcontractors, assigns them appropriate tasks and oversees their work.

3.2.2 Effect of vicarious liability on the exercise of care by the principal and actor: In the manufacturer-subcontractor relationship, the former instructs the latter as to part specifications and can thus better identify component defects. Since components will in the end be incorporated and fitted into the final product, the manufacturer can inspect their functioning within the whole system. If a component fails to function as intended, the manufacturer can take appropriate corrective measures against his subcontractor or raise the price of his aircraft to make up for liability payments or increased insurance cost. The manufacturer may also devise and implement effective inspection procedures that will screen out defective parts (suppose in Example 3.3 above that the lavatory fittings as well as the trash receptacle were manufactured by a subcontractor). As such, given the principal's financial interest in accident avoidance, making the principal liable under the *respondeat superior* for the actor's tort will create adequate incentives for him to take appropriate precautions in selecting his subcontractors and in controlling their behaviour.

Likewise, in the manufacturer-employees relationship, the former as principal is supposed to, and actually does, exercise an extensive degree of control over the details of the work of his employees. He selects employees, assigns them various tasks,
issues safety instructions, and schedules and oversees their work. Because of this superior position, the manufacturer can better assess risk, choose to reduce or bear it, reflect losses into his production costs as regular costs of his business and distribute them among consumers. Again, since the manufacturer is in a position to discipline or dismiss his employees for their risk-increasing conduct, they will be motivated to take optimal care, whether the principal is made to bear initially entire losses or only the balance not paid by the actor. Whenever joint liability of the principal and the actor is set to equal full losses, they both will be induced to take optimal care.

It is arguable that since the employee's assets are usually less than the losses he may cause, he will lack adequate incentives to take optimal care. However, this potential dilution in the employee's incentives need be weighed against the countervailing incentive created from possible demotion or even dismissal in case of failing to use optimal care. Insofar as the principal's competitors are placed under a similar position, no one will suffer from a competitive disadvantage. Furthermore, since each passenger's proportionate share of the losses through fare increases resulting from aircraft price increases is considered quite small, passengers as a class can bear the burden more easily than the original victim. The optimal prevention of losses thus requires the principal to exercise optimal care as the cheapest cost avoider rather than requiring both to take care.

3.2.3 Indemnity and contribution under vicarious liability: In the principal-actor relationship, as explained, the cost of injuries resulting from a product defect will be minimised if the manufacturer were made liable for the consequences of a wrongful act of his employees or subcontractors. This, however, does not mean, in theory, that the existence of vicarious liability affects the liability of the actor to the victim. The act or omission of the employee is not only a but-for cause but the proximate cause of the victim's injury and he is thus liable for the latter's injury. Even if the principal were made to pay for full losses caused by his employee or subcontractor, he can, in theory, seek indemnity from the actor that may be allowed under the 'primary-secondary liability' test. Hence, the legal device of vicarious liability provides the victim with an

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191. Shavell, 173; Cooter & Ulen, 408. See in this context the ATC agency-controller relationship in ch 6: 2.0.1 below.
192. Y B Smith, Frolic and Detour. 456-57; P Atiyah, Vicarious Liability, 22-28; Calabresi, 50-54.
193. Shavell, 171.
195. James, Accident Liability Reconsidered, 550
196. Landes & Posner, Joint and Multiple Tortfeasors, 539.
additional guarantee for the compensation of his losses without prejudice to the liability per se of an actor who failed to exercise optimal care and caused injury to third parties. In this way, the rule of indemnity combined with the principal's disciplinary measures can correct any suboptimal results that may arise from the dilution in the actor's incentive to take optimal care.

Likewise, in the manufacturer-subcontractor relationship, if the subcontractor were the cheaper cost avoider and little transaction costs were incurred for bargaining, the manufacturer held vicariously liable would probably enter into agreement with the subcontractor under which the latter would indemnify the former for any liability arising out of defective component parts. The indemnity doctrine makes unnecessary this sort of explicit contractual shifting and thus economises on transaction costs. Nevertheless, if the manufacturer had also contributed to the injury caused by his subcontractor's defective component, he would not be entitled to seek indemnity from the latter but only contribution as one of joint tortfeasors. In essence, respondeat superior is the employer's strict liability for his employees' unintentional torts and may be more efficient than the negligence rule.

3.2.4 Case law on vicarious liability: In Goldberg v. Kollmann Instrument Corp., an action for damages was brought against the aircraft manufacturer and the aircraft's altimeter maker for the death of a passenger which resulted from injuries he suffered in a crash caused by the allegedly defective altimeter. The court ruled, "[A] breach of warranty is not only a violation of the sales contract out of which the warranty arises but is a tortious wrong suable by a noncontracting party whose use of the warranted article is within the reasonable contemplation of the vendor or manufacturer". The court further held that since adequate protection is provided for passengers by holding liable the aeroplane manufacturer who put into the market the completed aircraft, it is not necessary to extend strict tort liability rule to the altimeter maker. This result is the efficient outcome, although the court's reasoning was based on the breach of implied warranty.

3.3 Defect, Foreseeability and the State-of-the-Art (Development Risk) Defence

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198. This assumption is reasonable, given that the manufacturer and his subcontractors are no strangers. In this case, the Coase Theorem implies that liability will be shifted to the subcontractor by agreement regardless of the initial entitlement. See ch 1: 3.1 above.
201. Cooter & Ulen, 408.
203. Ibid, 82 (italics supplied), discussed in O'Keefe v. The Boeing Co., n.41 above, 1114.
204. At 83.
Another part of causal requirement, proximate cause, requires that the damage caused was foreseeable and resulted as the direct or immediate consequence of a defect in the aircraft in question. The EC Directive provides in this context that the producer will not be liable if he proves that "the state of the scientific and technical knowledge at the time when he put the product into circulation was not such as to enable the existence of the defect to be discovered". In order to hold the producer liable, the defect must be discoverable at the time of circulation either by the producer or by some other party. As in the carrier's passenger legal liability context, the question is whether it is efficient to hold the manufacturer liable for a defect in his product which was undiscoverable (or concealed) and thus unforeseeable and unknowable at the time of putting his product into circulation.

3.3.1 Constraints on determining foreseeability of a defect: Given the durability of a commercial aircraft usually having an expected life span of some 20 years, there exists a long time lag between putting it into service and an occurrence of injury. The trouble with this time-delayed tort is that it is often difficult or costly to establish the proximate cause. A defect in the design of a newly developed aircraft may be revealed only after the passage of a certain period of time, given rapid technology development. A manufacturing defect that was undiscoverable and thus 'unforeseeable' at the time when an aircraft was put into service may develop later in one of the numerous component parts. If the aircraft that caused injury were old or unique in design, there will be no easily-found basis for comparison of defects in different aircraft of the same type. Nor are the courts with limited information on the technicalities of aircraft design considered well-equipped to weigh the social costs and benefits of different design or to determine foreseeability of a defect. If courts were allowed to adjudicate on the foreseeability of a defect, they would inadvertently set foot in the realm of regulatory or legislative, rather than judicial, powers.

3.3.2 Incentive of the development risk defence on the manufacturer's exercise of care: Since it will be difficult to establish negligence in the design of an aircraft under the test of foreseeability of a defect, allowing the manufacturer the state-of-the-art
defence will leave any 'unforeseeable' risk of aircraft design and production outside the ambit of his liability (consider such a situation in Example 3.3 above). Consequently, he will underestimate the costs of safety research and development (R & D) and will not adequately be induced to invest the efficient amount of resources in safety R & D (externalities). As a result, the price of aircraft and that of carriage by air products will not correctly reflect their true costs and passengers, if they are not fully informed of development risk, will underestimate them and will be led to buy too much of air travel or to buy inadequate first-party insurance. This is the inefficient result and it is reasonable to assume that manufacturers can better assess development risk and choose between safety and losses by undertaking appropriate safety R & D or by buying adequate insurance.

This is why it is arguable that the manufacturer should be held liable for the full risks of his activity. Imposing liability for 'unforeseeable' losses will not affect the level of care to be exercised by the injurer, whether under the negligence rule or strict liability. Even if the manufacturer were held liable for an 'unforeseeable' or remote consequence of his negligence, he will not be induced to take extra care to reduce such risk, since he can not, even with extra care, avoid 'unforeseeable' losses which will occur anyway regardless of his level of care. Again, if the manufacturer were held liable for unforeseeable losses, he will duly reflect these costs into the prices of his products and the price deterrence mechanism will induce passengers to buy the efficient amount of carriage by air products. The foreseeability test is indeed arbitrary, since it is almost impossible to flesh out objective foreseeability standards. It also conflicts with the manufacturer's post-sale duty to warn dangers.

3.3.3 Distributional effects of the development risk defence: The development risk defence will in effect reduce the manufacturer's liability to that of negligence and redistribute income to the manufacturer. Whether allowing the defence is distributionally desirable and superior or not depends on the distributional preferences of a particular society. But the defence will make passengers bear most of the

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209. See Ogus & Veljanovski, 119 n.3; Cane, 55-58; id (1993) 42-45.
210. Ogus & Veljanovski, 119 n.3.
211. Shavell, 107-08; ch 2: 3.2 above.
212. Ch 2: 3.2.2 above.
213. Stapleton, 135 & 228.
214. Ch 1: 5.2.4 above.
215. Sec 2.5.3 above.
216. Since the manufacturer and passengers are in market relationship, efficiency is the sole criterion to assess the desirability of a liability rule and this is not the right place to examine distributional effects of the defence. Nevertheless, an examination of the distributional aspect of the defence will elucidate the relationship between efficiency and distributional goals.
217. Stapleton, 225 & 228.
development risk and force them into a position of 'guinea pigs' for development risk. And the argument that the imposition of liability for unforeseeable losses will expose the manufacturer to potentially crippling losses is a misguided attack, because he is better positioned to distribute the losses through liability insurance and price structures. This also accords with the idea of the free market system that since entrepreneurs and their insurers are entitled to take the unforeseeable profits of risk-taking, they must equally be called upon to shoulder the costs of unforeseeable losses (so-called moral enterprise liability).

3.3.4 Redundancy of the defence and restatement of foreseeability: The development risk defence based on foreseeability is not only arbitrary but virtually redundant, since the Directive provides, "[a] product shall not be considered defective for the sole reason that a better product is subsequently put into circulation." Similarly, the Consumer Protection Act provides that a defect is not necessarily inferred solely from the fact that the safety of a product supplied at a later date is greater than the safety of the product in question. However, since the benefits of a product are to be assessed by reference to the time of its supply or delivery, there would always be no defect insofar as the benefits outweighed its costs at that time. As a result, there is no need for the defence. As if to reflect this, the EC Directive provides for a caveat that individual Member States may derogate from and exclude the state of the art defence in their national legislation. In fact, in French law the manufacturer assumes development risk, since liability for a latent defect under French law is based not on the negligence of the manufacturer but on the defect of a thing.

The manufacturer should therefore be liable for any losses caused to passengers by a defect, whether it was not discoverable at the time when he put it into circulation. This is especially the case with strict liability under which price deterrence calls for internalisation of the full costs of production including those of unforeseeable risks.

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221. Art 6(2).
222. S 3(2).
223. Stapleton, 135 & 237.
224. EC Directive 1985, Art 15.1(b). Luxembourg is the only country that has excluded a development risks defence. See S N Hurd & F E Zollers, n.64 above, at 1350.
226. Stapleton, Three Problems, 268. See Beshada v. Johns-Manville Products Corp., n.20 above, at 549 (defendant liable for illness caused by unsafe asbestos products and by failure to warn of the danger, even if it were unforeseen and unknowable).
Indeed, foreseeability of any particular loss or event is largely a matter of probability, and any losses caused by an event (e.g. whether by accident or defect) must be attributed to it.\(^{228}\) From this standpoint, art 7(b) of the Directive should have been phrased like this: the producer shall be liable if it is probable that the defect which caused the damage did exist at the time when the product was put into circulation by him or that this defect came into being afterwards.

3.3.5 Foreseeability of a defect and aircraft crashworthiness: Some US courts have based their decisions of defective design cases on the theory of 'crashworthiness' ('second accident' or 'enhanced or aggravated injury') (e.g. passengers colliding with interior surfaces of aircraft after the initial crash).\(^{229}\) Under this theory an aircraft must be so designed as to withstand crash forces with minimal structural damage in such foreseeable uses of aircraft as hard landings and crashes. But it is difficult to justify why these cases must be treated differently from design defect cases for the purpose of determining legal liability,\(^{230}\) if the damage had been caused by a defect.\(^{231}\) Not only may the injury occur almost simultaneously with the initial crash, but will plaintiffs with imperfect information be burdened with proof that the crash was survivable.\(^{232}\) Although the court in McGee v. Cessna Aircraft Co.\(^{233}\) appears to have accepted the crashworthiness theory, its real meaning and value as a precedent remain to be seen, since the court decided on a design defect case on the basis of strict tort liability.\(^{234}\) Crashworthiness can indeed be more effectively dealt with by legislative and administrative action.\(^{235}\)

4. Compensable Damages

4.1 Liability Equal to Actual Losses

\(^{228}\) Cane (1993) 35; ch 1: 5.2.5 above.
\(^{229}\) D Donnelly, Aircraft Crashworthiness _ Plaintiff's Viewpoint, 42 JALC (1976) 57, 57-59; Shawcross, V(40) & cases cited therein; Galerstein, n.44 above, at 210-11.
\(^{230}\) Williams v. Cessna Aircraft Corp., 376 F Supp 603, 607-08 (ND Miss 1974) (manufacturer under no duty to design a seat and safety harness capable of withstanding a high speed crash); Phillips, n.31 above, at 109; Saba, n.5 above, at 182.
\(^{231}\) G C Sterns, IFR _ The Liability of the Airframe and Component Manufacturer, 44 JALC (1978) 367, 371.
\(^{232}\) Shawcross, V(40).
\(^{233}\) 82 Cal App 3d 1005, 147 Cal Rptr 694 (Ct App Cal 1978) (defective design of fuel lines and fuel retaining system). See Saba, n.5 above, at 187.
\(^{234}\) Ibid, at 1017 & 701.
Once causal link is established between the defect and personal injuries, the efficient level of damages must be determined. The EC Directive provides that damage for which the manufacturer will be liable means damage caused by death or by personal injuries, without prejudice to national provisions relating to non-material damage.\textsuperscript{236} The Directive also provides that the liability of the producer arising therefrom may not, in relation to the injured person, be limited or excluded by a provision limiting his liability or exempting him from his liability.\textsuperscript{237} Similarly, the Consumer Protection Act 1987 provides that 'damage' means death or personal injury\textsuperscript{238} and that liability of a manufacturer for personal damage caused by a defect in his product will not be limited or excluded by any contract term, by any notice or by any other provision.\textsuperscript{239} Since we have already discussed compensability of pecuniary v. nonpecuniary losses in the context of the carrier's liability,\textsuperscript{240} it will not repeated here.\textsuperscript{241}

4.1.1 Financial caps on damages: In order to provide the manufacturer with a right amount of incentive to take care, his liability should be made to equal actual or average losses he may incur from his activity. Although the Directive appears to impose unlimited liability on the manufacturer, it does allow Member States to make provision for limiting a producer's total liability for personal injury or death caused by identical items with the same defect to an amount of at least 70 million ECUs (approximately £50 million or $81 million).\textsuperscript{242} The Directive allows each Member State to apply its own law to the question of recovery of damages for nonmaterial (nonpecuniary) losses.\textsuperscript{243} The Consumer Protection Act 1987, however, does not contain any such ceiling, which may well be in conflict with the prohibition of unlimited policies of insurance in English law.\textsuperscript{244} Again, if, as under the Warsaw Convention system, the carrier benefits from liability limitation for causing personal damage to his passengers, he (or his liability insurer) would be at a comparative advantage over the manufacturer (or his liability insurer).\textsuperscript{245}

4.1.2 Insurance coverage and premium setting: Products liability insurance cover is usually written on a 'losses-occurring' basis\textsuperscript{246} which is efficient. Whereas older policies

\textsuperscript{236} Art 9.
\textsuperscript{237} Art 12.
\textsuperscript{238} S 5(1).
\textsuperscript{239} S 7.
\textsuperscript{240} Ch 2: 4.1 above.
\textsuperscript{241} See Juglart, I(2165).
\textsuperscript{242} Art 16(1). See Shawcross V(35.3) n.12.
\textsuperscript{243} Art 9. See Griffiths et al. n.4 above, at 368.
\textsuperscript{244} Insurance Companies Act 1982, s 36; Margo, 184 n.8.
\textsuperscript{245} See J J Kennelly, A Novel Rule of Liability: Its Implications, 37 JALC (1971) 343. 347-48; Mannin, n.64 above, at 251.
\textsuperscript{246} Margo. 190.
were expressed to indemnify the insured in respect of loss, damage or injury caused by accident, the preference nowadays is for products liability policies to cover occurrences taking place during the policy period. An occurrence is defined as 'an accident or incident (other than a grounding) which arises out of the products hazard and causes personal injury including bodily injury, sickness or disease, including death at any time resulting therefrom'. A series of accidents or incidents following as a consequence of one occurrence is deemed to be one occurrence. The cover is limited in amount and premium setting is more complex because of highly technological matters involving design or manufacturing defects, especially under the negligence rule. The adoption of strict liability proper will enable insurers to conduct efficient risk rating and premium setting based on the manufacturer's occurrence or claims record.

4.2 Wilful Misconduct and Punitive Damages

Since we have already dealt with the question of justifiability of a distinction between intentional and unintentional misconduct, only two questions mandate discussion here on the assumption that wilful misconduct is a form of intentional tort. First, does the manufacturer's wilful misconduct justify the award of punitive (exemplary or vindictive) damages on top of compensatory damages to deter him? Second, should liability insurance provide coverage for punitive damages? In other words, are punitive damages insurable?

4.2.1 Incentive of punitive damages: Under strict liability the manufacturer has already been given adequate incentives to take all justified steps to reduce risk. Punitive damages would unduly discourage the socially useful activity of aircraft manufacturer or force him to overinvest in safety. Under the rule of negligence, which means failure to take cost-justified precautions, the manufacturer will be induced to take these precautions to avoid the penalty of punitive damages. This, however, is true only if the court sets the negligence standard without consistent errors and thus leaves little ambiguity over the standard applicable to each manufacturer. If the level of compensation is too low or the probability of detecting and enforcing the correct standard is too low, it is necessary for the purpose of restoring deterrence to impose punitive damages on the manufacturer.

247. Margo, 185 n.14 & 191 n.67.
248. Shawcross, VII(80); Margo, ch 15.
249. Ch 2: 4.2 above.
250. See Shawcross, I(141-49); Margo, 294.
251. Landes & Posner, n.8 above, at 563.
252. Ibid.
In the context of general product liability cases, courts rarely award punitive damages, except in circumstances of reckless indifference to safety or concealment of the dangerousness of the product. However, it is hardly conceivable for an aircraft manufacturer to be recklessly or intentionally indifferent to safety, given penal sanctions and his financial and other interest (dislike of adverse publicity) in the manufacture of safe aircraft. And if the court finds it unable or costly to differentiate correctly 'ordinary' losses from reckless or intentional losses, it would rather be dealt with as normal losses. Furthermore, any incentive gain from the award of punitive damages must be weighed against the administrative costs of higher probability of litigation and appeal, since it is most likely that the larger the damages and the more uncertainty in the law, the more cases will be litigated and appealed.

4.2.2 Punitive damages under parties' risk aversion: From the insurer's point of view, the best way of deterring his insured from incurring wilful losses would be to exclude cover against such losses and to make the insured bear the entire losses caused as such. This, however, largely depends on the courts' ability and administrative costs to sort out correctly such 'intentional' losses and to determine the proper level of punitive damages. If the courts lacked correct information and make errors, which is more likely under the negligence rule, insurers could not impose the proper level of penal premiums on the wrongdoer responsible for wilful misconduct. Alternatively, the insurer may provide cover against 'wilful' losses, indemnify the victim and then recover the losses from his insured manufacturer. However, not only will this increase recourse actions but it is questionable whether such a practice is consistent with the proper function of insurance.

Therefore, unless any incentive gain from excluding coverage against wilful misconduct far outweighs combined administrative costs incurred to the courts and insurers, the insurer would rather not attempt a distinction between wilful and ordinary losses and simply subsume the former into the latter. The insurer then simply indemnifies the victim for any losses covered by policies and raise premium rates

257 This is the current aviation insurance practice. Margo, 289. See ch 2: 4.2 & 6.3 above.
chargeable on the basis of his insured's claims record. In either case, compensatory
damages, whether borne by the injurer himself or by the insurer, will suffice, because
punitive damages overcompensate.\textsuperscript{258} If there occurred a flagrant violation of safety
regulations, relevant regulatory authorities will duly impose penal or administrative
sanctions after investigation. This is why, from the economic analysis of torts, the idea
of intentionality can largely be dispensed with in much the same way as the idea of
causation.\textsuperscript{259}

4.2.3 Insurability of punitive damages: Most aviation policies do not explicitly
indicate whether punitive damages are covered, and some authors argue that any doubt
about this can be removed by making an express exclusion provision in policies.\textsuperscript{260}
Nevertheless, insurance policies usually exclude from cover injuries caused
'intentionally' by the insured to third parties.\textsuperscript{261} Given that the purpose of imposing
punitive damages is to deter the wrongdoer from committing 'wilful' misconduct, this
objective would be defeated if the manufacturer were allowed to insure against these
awards.\textsuperscript{262} If 'wilful' losses were covered by liability insurance, the manufacturer would
be allowed to shift the risk of punitive damages onto the insurer and he will not be
deterred. After all, there is no point of punishing the insurer who will in the end pass
the additional burden onto premium-payers.\textsuperscript{263}

4.2.4 Compensability and insurability of punitive damages under domestic laws:
Punitive damages had its origin in English common law and found their expression in
the punishment and deterrence of the wrongdoer in instances of malicious, oppressive
or reckless conduct and gross fraud.\textsuperscript{264} In view of this circumscription and even of 'a
marked disinclination' in English law to award punitive damages, it is doubted that
English courts will do so for passenger injury or death caused by defective aircraft.\textsuperscript{265}
As to the insurability of punitive damages, English courts will regard insurance against
punitive damages as against public policy.\textsuperscript{266} Some French authors have defended the
role of punitive damages, known as 'private punishment or penalty' (\textit{peine privée}),

\textsuperscript{258} Cane (1993) 148.
\textsuperscript{259} See Landes and Posner, Causation in Tort Law, at 110.
\textsuperscript{260} S Kenny, Punitive Damages in Aviation Cases: Solving the Insurance Coverage Dilemma, 48
JALC (1983) 753, 774; Margo, 295.
\textsuperscript{261} Margo, 189.
\textsuperscript{262} J J Kennelly, Punitive Damages and Insurance Coverage Questions _ Another View, 7 Air L
\textsuperscript{263} See Cane, 471.
\textsuperscript{264} Rookes v. Barnard, [1964] AC 1129, 1 All ER 367, 407 & 410-11 (HL); Griffiths et al. n.4 above,
at 394-95; Cane (1993) 359.
\textsuperscript{265} See P Barlow & H Kerr-Smiley, Recovery of Punitive Damages from Insurers in non-US
Jurisdictions. 11 Air L (1986) 58, 65 & 82; Griffiths et al. \textit{ibid}, at 396.
\textsuperscript{266} \textit{Ibid}, at 83 & references cited therein.
within the domain of civil liability. Refuting such a doctrinal defence, the Cour de cassation ruled that civil liability did not perform the penal function; that the gravity of fault would not justify award of damages much higher than actual losses because it would unduly enrich the victim; and that the absence or the degree of fault could not be taken into account for the purpose of reducing the level of compensation.

In American law, punitive damages may be awarded to punish and deter a person for his outrageous conduct as where the manufacturer 'deliberately' misrepresented aircraft safety. Punitive damages are not based on wilful or wanton misconduct and indeed have been held not permissible nor justified in wrongful death actions, since they are by definition not compensatory recovery. Indeed, punitive damages are rarely awarded in the context of products liability litigation as well as of tort litigation in general. The decision in *Kritser v. Beech Aircraft Corp.* is thus not considered an economically sound one, since the court awarded punitive damages for defendant's 'wilful act or omission'. The Ninth Circuit in *In re Paris Air Crash of March 3, 1974* thus reversed the trial court's decision and correctly held that disallowance of punitive damages serves the goal of placing reasonable limits on wrongful death actions. With regard to insurability of punitive damages, it is disputed whether punitive damages are insurable or not. But if the wrongdoer is permitted to shift the risk of punitive damages to the insurance company, the very rationale of punitive damages would be defeated.

5. Administrative Cost Reduction and Private International Law Issues

5.1 Cause of Action

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270. Haskell, n.235 above, at 611-13; Margo, 296 & nn. 102-03 for cases cited; Juglart, l(2166).
Although the EC Directive 1985 provides for a no-fault, strict liability of producers for personal damage caused by a defect in their products, this is without prejudice to other bases of action, whether contractual or noncontractual liability or a special liability system that may be available under the national law of a member State. The Directive thus does not preempt national laws; it merely supplements existing laws of Member States by superimposing its no-fault liability system on national law, insofar as they are not inconsistent with it. Thus, the Consumer Protection Act 1987 has created an independent cause of action, in addition to existing rights of action available at common law. Since both the Directive and the Act provides for an additional base of action on top of existing ones in national law, divergent causes of action coexist (e.g. breach of contractual warranty). This is not a desirable outcome, since it may well yield divergent results in different Member States and will not bring about predictability nor uniformity nor harmony in product liability law.

5.2 Choice of Law

Commercial aircraft production is concentrated in a dozen or so of countries, but an accident caused by a defect would occur in any country and often involves victims of diverse citizenship domiciled in different countries (and/or states in the case of the United States). These factors complicate determination of the law applicable to recoverable damages. However, since no choice of law rule is provided either by the EC Directive or by the Act, there exists uncertainty and unpredictability in this field of law, which is a cost to risk-averse parties. As in the previous chapter, our concern here is the choice between lex fori and lex loci.

5.2.1 The traditional lex loci delicti and the place of injury: The problem with lex loci delicti is whether it means the law of the place of injury or that of the place of the tortious conduct (e.g. defective design or manufacture). In an English case involving personal injuries caused allegedly by a defective machine, the Court of Appeal held that the mere manufacture in Germany of a defective product was 'not...even the beginning of tort'; the substantial wrongdoing was putting on the English market a defective product.  

278 Art 1.  
279 Art 13; Mannin, n.64 above, at 248.  
280 Directive, preamble; Mannin, ibid; Hurd & Zollers, n.64 above, at 1349.  
281 N M L Hughes, Aviation Liability Law: Recent Developments in the UK: Some Contrasts with the USA, 14 Air L (1989) 2, 7-8. Any action against the producer of a defective product is treated as action in tort [for the purposes of jurisdiction. Consumer Protection Act 1987, s 6(7).  
product with no warning as to its defects. In the United States, it is generally held that for liability insurance policy purposes, the time of the occurrence of an accident is construed as meaning the time when the claimant actually suffered injury and not when the wrongful conduct was committed.

In an aviation accident, however, the place of injury is often fortuitous and unpredictable with no substantial link to injured parties. This is why the Seventh Circuit in *In re Air Crash Disaster near Chicago, Illinois, on May 25, 1979* called for the need for uniform regulation of airline tort liability in disaster cases by federal legislation. The court, nevertheless, gave priority to the law of the place of injury, i.e. that of Illinois, and ruled against award of punitive damages with regard to the manufacturer (and airline), after labouring through a plethora of state laws to determine the law applicable to the question. However, the result of this case would have been the same even if the court had applied lex fori.

5.2.2 Lex loci and the place of tortious act: The fortuity and unpredictability of the place of injury rule had led French and US courts to apply the law of the place of tortious conduct. In France which has not produced much case law on this point, the traditional rule on choice of law is nevertheless to apply the law of the place where the tort (délit) was committed. In a case involving the liability (and not damages) for a fatal accident caused in France during the test flight of a US-made helicopter, the court held that the fault attributed to its manufacturer must be assessed according to the law of the place where the fault had been committed (i.e. the law of the place of the manufacture of the aircraft) and not according to the law of the place of the accident.

This rule has been further developed by US courts. In *Manos v. TWA, Inc. & Boeing Co.*, Judge Robson refused to apply the inflexible old lex loci rule, which meant the law of Italy, the crash site, because, although relatively simple to apply, it did injustices to some of the parties. He pointed out that since none of the persons entitled to

284. Margo, 191 & n.69.
285. Ch 2: 5.1.3 above.
286. N.271 above, at 17,140; Shawcross, I(93).
287. Juglart, I(2167).
damages are citizens of, or live or reside in Italy, Italy has little or no interest in having its law applied. In choosing the law of Washington as the applicable law, however, he demonstrated a rather unconventional understanding of lex loci that the law of the state where the article was manufactured, sold and delivered (Washington) defines and limits an action for damages. Similarly, the Kansas court in *Vrooman v. Beech Aircraft Corp.* confronted a Missouri plaintiff who was injured in an Indiana air crash caused by an aircraft defect. Without investigating the law of Indiana where the injury took place, the court chose the law of Kansas by construing the lex loci rule as designating the place "where the aeroplane was manufactured and repaired (Kansas), rather than...where the accident occurred".

Another modified version of the place of injury rule is provided by the Hague Convention 1973. Under the Convention, the law of the place of injury is applicable only if it is also either the law of the country where the injured person resides or the law of the country where the manufacturer has his principal office (*établissement principal*). Or the applicable law is that of the state where the injured person resides if the manufacturer also has his principal office there. These rules certainly have the advantage of avoiding the application of the totally unforeseen law of the place of injury in favour of the law having certain link with the manufacturer or the victim. Nevertheless, the problem still remains as to how to allocate the application between the law having a link with the manufacturer and that with the victim.

5.2.3 Lex fori: The unpredictability of outcome in lex loci can be overcome by applying lex fori, which may equally be fortuitous but which plaintiff has nevertheless voluntarily chosen. In *In re Paris Air Crash Disaster of March 3, 1974*, in which an alleged defect in a cargo door of a McDonnell Douglas DC-10 airliner allowed it to open in flight and caused crash, the court applied lex fori to determining the issue of damages for decedents who came from 36 foreign and domestic jurisdictions. The court noted that California as the forum had a definite interest in applying its own law to the issue of damages, citing such interests of California as deterrence of tortious conduct of resident defendants (the manufacturer and his subcontractor), avoidance of the imposition of excessive financial burdens on resident defendants and provision of

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293. N.33 above.
uniform rules of liability and damages under its strict product liability law. Although the court based its decision mainly on interest analysis aided by the place-of-the-wrong approach (California was the place where the aircraft was designed, manufactured and maintained), the result would have been the same if the court had applied lex fori.

6. Joint and Multiple Injurors

Since aviation accidents often involve a collision, there may well arise the problem of joint liability of multiple tortfeasors. The EC Directive provides that where two or more persons caused the same damage, they will be liable jointly and severally without prejudice to national law provisions concerning the rights of contribution or recourse and the rights of the injured person. Thus, national law will continue to govern the issue of rights of indemnity or contribution as between joint injurers and there is uncertainty as to how losses may be apportioned in different categories of joint torts. In theory, claims for indemnity or contribution as between joint injurers are no concern to the plaintiff, but, since these separate actions incur additional costs, they do affect administrative costs. We will now deal with efficient liability allocation such occurrences as caused jointly by two or more manufacturers (simultaneous, concerted or concurrent joint torts) or by a carrier and a manufacturer (successive joint torts).

6.1 Simultaneous Joint Torts Involving Two or More Manufacturers

If plaintiff chooses to bring an action against one of the joint tortfeasors and recovers in full from him, the joint injurers (or their insurers) would have to agree on a formula of liability apportionment as between them. Otherwise, one of the joint injurers who paid out compensation would seek indemnity or contribution in separate action(s).

6.1.1 Simultaneous joint torts and incentive of indemnity/contribution: In this type of losses, strict simultaneity of wrongful acts is not required, but separate and independent acts of the injurers usually concur to produce a single and indivisible injury (as in a collision caused by defects in both aircraft). A simultaneous joint tort, by definition, requires both parties to take care for optimal accident avoidance (joint

298. At 743.
299. At 732 & 740.
300. Art 5 & 13; Consumer Protection Act 1987, s 2(5); Hodges, Product Liability, 65.
301. Hodges, Product Liability, 85.
303. Ibid, 517-18; Oldham & Maynard, Indemnity and Contribution, at 247. For a single act constituting a tort of both injurers as in the manufacturer's vicarious liability for his subcontractor's tort, see sec 3.2 above.
care). In simultaneous joint torts, the rule of no contribution has thus been denounced, since deterrence would be maximised when each joint tortfeasor knows that he will bear some of the loss.\(^\text{304}\) Common law now recognises a right of contribution among joint injurers.\(^\text{305}\) Nevertheless, the Consumer Protection Act 1987 does not provide how contribution among them can actually be effected, except to the extent that there may arise claims under the Civil Liability (Contribution) Act 1978.\(^\text{306}\) The question is thus left to costly private contractual arrangements or courts' determination on a case-by-case basis.\(^\text{307}\) In America, some form of legislative reform proposals in the form of a Senate Bill is under consideration, among them a system of several but not joint liability of defendants.\(^\text{308}\) However, if this is applicable to simultaneous joint torts, it needs to be joint and several liability to allow for contribution.

6.1.2 Contribution between joint injurers for the same loss: Where two or more injurers are liable for the same loss, the amounts paid out will ultimately be shared between them (or their insurers), whether under the negligence rule or strict liability.\(^\text{309}\) The rule of contribution has at least two economic benefits: informational and insurance aspects.\(^\text{310}\) Under the rule of no contribution each potential joint tortfeasor will be uncertain of his share of expected accident costs he will bear. If because of this uncertainty the expected share of the losses borne by the joint injurers does not add up to one, misallocation of resources may follow in terms of their investment in safety precautions. Or there would follow a wasteful recourse actions with little incentive promotion.\(^\text{311}\) Insurers are also generally in favour of an internal claims-sharing agreement, since this will reduce their risk of bearing the entire losses alone, removes uncertainty and enhance predictability of their potential payouts.\(^\text{312}\) The risk-sharing approach will also promote speedy conclusion of the otherwise lengthy trial process, since it would make obsolete determination of causation and liability and reduce issues of litigation to the quantum of damages.\(^\text{313}\)

6.1.3 Accident probability-based liability apportionment: In effecting contribution among joint injurers, liability division according to the number of tortfeasors, as

\(^{304}\) Landes & Posner, 527 & 519-20; Comments, n.197 above, at 733-34, 746-47. By contrast, in alternative-care cases, it is efficient to require indemnity for deterrence. Landes & Posner, 532.

\(^{305}\) Ch 2: 6.2.4 above.

\(^{306}\) Shawcross, V(35.4).

\(^{307}\) Stapleton, Three Problems. 265.

\(^{308}\) See Shawcross, V(42)-(43).

\(^{309}\) Ch 2: 6.2.1 above.

\(^{310}\) Landes & Posner, Joint and Multiple Tortfeasors, 530-31.

\(^{311}\) See Cane, 229, in the motor collision context.

\(^{312}\) S Brise, Some Thoughts on the Economic Significance of Limited Liability, at 24.

\(^{313}\) Brise. ibid. See In re Paris Air Crash Disaster of March 3, 1974, in sec 6.2.2 below.
provided under the US Uniform Contribution Among Joint Tortfeasors Act,\(^{314}\) will obviously not create adequate incentives for joint injurers to take appropriate care. A more efficient method of division would be to apportion the losses by applying a mathematical contribution rule applicable to all joint and multiple tortfeasors.\(^{315}\) In this respect, liability apportionment by the relative accident probability of joint tortfeasors will not only create adequate incentives but significantly reduce administrative costs for courts, as long as objective occurrences or claims data are made available to courts.\(^{316}\) In this sense, this may be likened to a 'mechanical', rather than 'judgmental', rule.\(^{317}\) Although Professor Epstein's proposal for 'mechanical' division has been made in the context of comparative negligence, it can be applied *mutatis mutandis* to apportionment of actual losses under strict liability.

6.2 Successive Joint Torts Involving Manufactures and Carriers

Now, let us consider efficient liability allocation in the second type of joint torts where not only manufacturers but carriers contributed to passenger losses (successive joint torts).

Example 3.4 In the situation of Example 3.3 above, suppose that the aircraft's cabin crew had not posted specific warnings against the fire hazard of smoking inside the lavatory. Or suppose that passengers survived the toxic smoke but that after the successful emergency landing the cabin crew were so ill-trained that they were unable to evacuate passengers out of the plane quickly enough to minimise losses in such an emergency. In this case, although the emergency arose as a result of a defect in the aircraft (the trash receptacle), the crew (and his employer-airline) also contributed to or aggravated to the occurrence of losses. The efficient solution is thus to allocate damages in proportion to their relative accident record to induce both the manufacturer and the airline to take appropriate care.

6.2.1 Notion of successive joint torts and liability allocation: A "successive" joint tort refers to a situation whereby one tortfeasor aggravates an injury already inflicted by the other. In this type of losses, the first injurer should be liable for the entire losses, if the second injurer could not avert the first injury. The same must be said if negligent.

\(^{314}\) See Landes & Posner, Joint and Multiple Tortfeasors, 530, 539.
\(^{315}\) For actual application of this rule, see ch2: 6.2.3 above.
\(^{316}\) E.g. See R A Epstein, Plaintiff's Conduct in Products Liability Actions: Comparative Negligence, Automatic Division and Multiple Parties, 45 JALC (1979) 87, 112-16, arguing for liability division on the basis of relative fault under the comparative negligence rule. See also Landes & Posner, Joint and Multiple Tortfeasors, 530; Comments, n.197 above, at 735.
agravation by another was reasonably foreseeable.\textsuperscript{318} For in this case the first injurer could have avoided the incremental as well as initial damages at cheaper costs,\textsuperscript{319} and no deterrent purpose or allocative benefits would be obtained by making the latter liable for that injury.\textsuperscript{320} However, if the second injurer (the cabin crew or his employer-airline in our Example 3.4 above) could also have averted all or part of the losses, he should be liable for the aggravation of the plaintiff's injury. In this case, entire damages must be apportioned between the two joint injurers by their relative occurrence record.

6.2.2 Probability-based liability apportionment between airlines and manufacturers: The first major precedent of liability apportionment as between successive joint tortfeasors was set in \textit{In re Paris Air Crash Disaster of March 3, 1974}.\textsuperscript{321} A total of 211 actions were brought by 340 plaintiffs (1,123 claimants), while defendants - Turkish Air Lines, the manufacturer McDonnell Douglas and its subcontractor General Dynamics - filed cross-claims or third-party complaints against each other for contribution/indemnity.\textsuperscript{322} But since plaintiffs waived claims to punitive damages and defendants agreed on a formula for sharing damages between themselves, the trial process was greatly shortened (about three years) and the issue reduced entirely to the quantum of damages.\textsuperscript{323} The defendants' (or their insurers') loss-sharing agreement may have been facilitated by California's comparative fault rule in contribution and indemnity actions.\textsuperscript{324} Obviously, if all issues of liability (e.g. causation, fault), let alone the plaintiffs' claims to punitive damages and the defendants' cross-claims and third-party complaints, had been tried, administrative costs would have been enormous without any corresponding incentive gains for safety enhancement. This result can be justified only when we assume that manufacturers or airlines and their insurers have at least some acceptable knowledge of their accident probability\textsuperscript{325} and that they, as the cheapest cost avoider, can better be induced than victims to avoid or reduce risk.

In \textit{In re Korean Air Lines Disaster of September 1, 1983},\textsuperscript{326} defendants Boeing and Litton assumed a defect in the inertial navigation systems causing the aircraft to deviate from its envisaged course but argued that it was not reasonably foreseeable that Russian aircraft intentionally fired missiles upon a civilian aircraft. The court ruled that

\begin{footnotesize}
\textsuperscript{318} Landes & Posner, \textit{ibid}, 519, 529.
\textsuperscript{319} \textit{Ibid}, 519, 529 & 548-49.
\textsuperscript{320} \textit{Ibid}, 549.
\textsuperscript{321} N.297 above; Speiser, \textit{Lawsuit}, p.420ff.
\textsuperscript{322} Judge Hall, Memorandum, 3 AASL (1978) 615, 617 & 621: Juglar, l(2510).
\textsuperscript{323} A F Lowenfeld, \textit{Aviation Law; Cases and Materials}, 7-194-95; \textit{Hall}, \textit{ibid}, 619-20. See further ch 6: 6.3.2 for the 1977 Tenerife collision case.
\textsuperscript{324} See Hall, \textit{ibid}, at 621.
\textsuperscript{325} See Cane (1993) 91.
\textsuperscript{326} 19 Avi 17.853, 17,855 (DDC 1985).
\end{footnotesize}
The manufacturer's liability

the missile attack constituted an independent and intervening cause and that the defect in the navigation equipment was not proximate cause of the accident. The court ruled that Boeing and Litton had no duty to anticipate or guard against the attack because the risk was not reasonably foreseeable and that without such duty there could be no liability for plaintiffs' harm. But foreseeability of losses is not a relevant test for determining liability, especially under strict liability. Granted that without the Russian aircraft's 'unforeseeable' attack no loss would have occurred, it may nevertheless be true that without the defect, the aircraft would not have intruded into Russian airspace. The manufacturer should thus have been jointly liable for the loss. Or, even if the pilots had successively aggravated or contributed to the occurrence, the losses should have been apportioned between the airline and the manufacturer, Boeing.

Conclusion

The law of aircraft product liability is in the making and in the process of change, both in principles and in application. Criticised by a commentator as a wilful intervention in the free market and described as the dislocation of product markets, the present law of product liability in general and that applicable to the aircraft manufacturer in particular thus appears to defy the logic of uniformity and predictability and instead to defend inconsistencies and uncertainties. Whether this seemingly undesirable result has been precipitated by pragmatic considerations, political compromise or otherwise, there has arisen an obvious need for an overall review of the area of law on the basis of a 'sound theoretical basis'. And this is in the end likely to require 'a major rethinking' of the justification for product liability law.

Indeed, as we have already seen, the notion of defect has never been clearly defined either by the Restatement or by the EC Directive, nor has coherently been applied by the courts. The substance of the existing negligence rule and strict liability, as applied by courts, is so amorphous and confusing that one may well wonder what the real difference between the two is. The term strict liability as employed by the Restatement, EC Directive and Consumer Protection Act is an apparent misnomer, insofar as they

327. Ibid, at 17,855 & 17,858.
328. Ibid, at 17,856 & 17,858.
329. Ch 1: 5.2.3 above.
332. See P Asch. 139; Stapleton, 230.
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rely on the consumer expectation test or the risk-utility analysis. In fact, the scope of the alleged strict liability of the aircraft manufacturer for design defect under the *EC Directive* is more limited than that under the negligence rule and even under the *Restatement*.\(^{335}\) The manufacturer's duty to warn users of product risk, a requirement needed under the negligence rule to get passengers informed of the risks inherent in a particular aircraft, has been so abused by some American courts that such duty is now equally required under strict liability.

As regards certifying-licensing activities of the regulatory agency, since these regulatory activities are intended to prescribe minimum standards for safety, the regulatory body should not be made liable for 'negligent' certification or licensing. Even though holding it liable will not amount to turning the regulatory body into the virtual insurer of safety, it will have the effects of relieving manufacturers and carriers of their primary duty to take care and of shifting to general taxpayers the costs of negligent certification/licensing. This is not only inefficient because regulators are not very much interested in the reduction of production costs, but also undesirable and inequitable because taxpayers do not derive direct benefits from such regulatory activities. Nor do regulatory activities greatly add to the risk of injury by negligent certification/licensing or by failure to certify or inspect. Indeed, many of regulatory functions in respect of aircraft design, manufacture and maintenance have in fact been transferred to private sectors because of the lack of sufficient technical competence and expertise on the part of regulators. Case law invariably supports non-liability of the regulatory body for its act or omission.

Determination of causal connection between a defect and resulting injuries is still as difficult and murky a subject as it has been.\(^{336}\) Especially, the state-of-the-art test requiring the defect causing injury to be discoverable or foreseeable at the time of putting the aircraft into circulation unduly neglects or even frustrate the manufacturer's continuing duty to take appropriate precautions after the sale, i.e. the duty to warn under the negligence rule and the obligation to remedy the defect and develop a safe aircraft under strict liability. The development risk defence has also an undesirable effect on the manufacturer's incentive to allocate the efficient amount of investment to safety research and development.\(^{337}\) Further, since the *EC Directive* purports to create an independent cause of action and to superimpose it on national laws, there will continue to coexist diverse sources of action, including one based on breach of contractual warranty. This will not bring the laws of EC Member States on product

\(^{335}\) Stapleton, 249.

\(^{336}\) P Asch, 138.

\(^{337}\) Sec 3.3.2 above.
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safety into line with,\(^{338}\) and will indeed conflict with, the *Warsaw Convention* which requires any action against the carrier for passenger injury or death to be brought only within its terms and conditions.\(^ {339}\)

All these anomalies and inconsistencies in the changing law of product liability, however, belie the underlying movement keeping in step with the efficiency thesis as shown in some of the provisions of the *Model Uniform Product Liability Act 1979* (e.g. introduction of *useful safe life*). Vicarious liability of the manufacturer for his subcontractor's or employee's defective component parts can be cited as an example of efficient outcome. In essence, vicarious liability is a legal device for providing the victim with an additional guarantee for the compensation of his losses without prejudice to the liability of the actor who failed to exercise due care and caused injury to third parties.\(^ {340}\) Similarly, underlying the reluctance of the *EC Directive* and most American courts to enforce full strict liability without the development risk defence is probably the concern that it would unduly discourage innovative efforts of aircraft manufacturers towards the development of new designs and will put excessive financial burden on them. This observation is in line with the inference that the prevalence of the negligence standard in tort law is not so much a consideration of efficiency but a preference of judges 'to subsidize industry and risk-taking'.\(^ {341}\)

As in the carrier's passenger legal liability context, liability insurance against aircraft product liability has an important role to play in the tort process. It is indeed hardly conceivable that judges, especially American judges, would deliver a judgment awarding tens of millions of dollars in damages in a major air crash case without thinking about its effect on the defendant(s) and without knowing that the damages would not be paid by the defendants themselves.\(^ {342}\) Again, the reason why even American courts rarely award punitive damages in wrongful death actions may well have much to do with considerations of their uninsurability, in addition to the fact that most aviation losses are not intentional. As such, although the courts do not usually


\(^{339}\) Ch 2: 5.1 above.

\(^{340}\) Sec 3.2.3 above.


\(^{342}\) See Cane (1993) 207.
mention liability insurance in express terms in their judgements, judges duly recognise and take into account its impact in the tort process (compensation and deterrence) and in the formation of product liability rules.

As regards the choice of the law applicable to determination of damages, the courts have demonstrated their preference of the old rule, lex loci delicti, over lex fori. Nevertheless, the citadel once held by the law of the place of injury is no longer so imposing nor potent as it once was and is under increasing attack by the law of the place of tortious conduct (aircraft design and manufacture) for the vantage position. More importantly, the law chosen as such is almost invariably connected with the forum so that the economic interest of the forum state or country and its citizens can fully be represented. The long-term implications of this shift would be for lex fori to replace lex loci delicti. The efficiency-oriented reasoning of the courts has also been found in the common law rule of contribution among joint and multiple tortfeasors, although it still is not as predictable as it should be, a cost to risk-averse manufacturers. This uncertainty, however, will not matter very much, insofar as insurance companies effect contribution on the basis of the relative claims record of their insured manufacturers.
PART TWO

SURFACE DAMAGE RISK ARISING
FROM THE PARTIES IN STRANGER RELATIONSHIPS

Introduction to Part Two Research Design

In the first part of this study, we demonstrated how economic reasoning and its tools of analysis can usefully be applied to assessing the efficiency of liability rules in the context of passenger damage risk caused by the carrier and the manufacturer who are in contractual/market relationships with passengers. In this second part, we will be dealing with liability for damage caused to third parties on the surface by the aircraft operator. In this type of risk arising from the parties in stranger relationships, bargaining is further constrained than in passenger damage risk.

True or false, aircraft operation has been regarded, in respect of surface damage risk, as an \textit{abnormally dangerous} or \textit{ultra-hazardous} activity.\footnote{Restatement (Second) of Torts, s 520 \& comment f.} For this type of risk, it has been argued, liability will lie whether a particular damage is great or small, insofar as it arises from the risk which made the activity extra-hazardous.\footnote{See Landes \& Posner, The Positive Economic Theory of Tort Law, at 904-10; \textit{id}, A Positive Economic Analysis of Products Liability, at 560; Calabresi, Some Thoughts, 541.} On the other hand, despite great improvement in safety record, it still is not clear whether the risk has been reduced in such a significant manner (at least in terms of its severity) as to make the application of the negligence rule appropriate.\footnote{Restatement (Second) of Torts, s 520A, comment c.} We will therefore examine which of the two approaches is more efficient and whether the rule of contributory negligence makes economic sense in the context of surface damage risk.

Since the liability for surface damage is governed by the \textit{Rome Convention} system, our analysis will be focused on two Rome Conventions. Nevertheless, their importance and utility are limited, since neither can be regarded as a truly international agreement given the meagre number of ratifications.\footnote{Neither the United Kingdom, nor France nor the United States is a party to either Convention. Juglart, 1(I062)-(I063): see sec 1.1 below.} In the absence of international consensus on either of the two instruments, any analysis of existing liability rules governing surface damage risk would be incomplete without recourse to national laws and cases, if the purpose is to draw valid conclusions acceptable to as many parties (e.g. injurers, victims and insurers) as possible.
CHAPTER 4

LIABILITY OF THE AIRCRAFT OPERATOR FOR SURFACE DAMAGE UNDER THE ROME CONVENTION SYSTEM

The end of justice is to secure from injury.

-------- Adam Smith\(^5\)

The right of personal security consists in a person's legal and uninterrupted enjoyment of his life, his limbs, his body, his health and his reputation

-------- William Blackstone\(^6\)

Introduction

In the previous two chapters, while analysing the efficiency of liability rules governing passenger damage risk arising from the parties in contractual/market relationships, we argued for imposition of strict liability on the carrier and the manufacturer to minimise the sum of accident and its avoidance costs. In this chapter, we will deal with liability for personal or property damage caused to the surface of a state by an aircraft registered in another state ('foreign' aircraft). Although incidence of surface damage may not be as frequent as that of passenger damage, its magnitude cannot be underestimated, especially where the damage is to a densely populated area.\(^7\)

Although some earlier decisions were based, at least partly, on trespass for direct injury caused by the fall of an aircraft onto the plaintiff's land\(^8\) or by crash of an aircraft against an electric transmission tower,\(^9\) this approach is not relevant where the defendant's conduct was neither intentional nor negligent.\(^10\) Again, although the Rome Convention system governing the aircraft operator's liability for damage to third parties on the surface does not rule out the possibility of a contractual solution,\(^11\) it would be infeasible to resolve any surface damage dispute by contract. This is not only because of high transaction costs involved in bargaining between the parties in stranger relationships but because of inequality in their relative bargaining position. As such,
liability of the aircraft operator for surface damage is strictly delictual in nature and no contractual tie whatsoever exists between the party suffering damage and the party liable.

Before proceeding on to assess the efficiency of liability rules provided under the Rome Convention system, we will first outline its key features to argue in favour of strict liability with a defence of contributory negligence in the context of single-operator incidents. We will then defend the rationale of compulsory insurance, followed by an analysis of the causal requirement. After discussing the efficient level of damages and arguing against punitive damages for 'deliberate' damage, we will assess choice of law issues and argue for lex fori in determining heads of damages. As has been the case with previous chapters, we will finally take up efficient control of surface damage caused jointly by two or more aircraft operators as in a collision.

1. The Rome Convention System in Outline

1.1 Structure

The Rome Convention system is made up of two Conventions and two Protocols. The original Convention, Rome Convention on Surface Damage 1933 was adopted at the third International Conference on Private Air Law. The Convention had two distinctive objectives to achieve: to unify the rules of law relating to damage caused by aircraft to third parties on the ground and to ensure that aircraft flying over the territories of states other than those of their registry ('foreign' territories) must adequately be insured against liability for surface damage. The Convention, however, drew only five ratifications, the minimum needed to bring it into force, and as such is of limited practical value. It has been supplemented by the Brussels Insurance Protocol in respect of the compulsory insurance requirement. The Protocol was adopted to prevent insurers from repudiating coverage of their insured operators' liability arising under their insurance contracts relating to third party legal liability as provided

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17. Rome Convention 1933, art 24(2).
18. Protocol Supplementing The Convention for the Unification of Certain Rules relating to Damage Caused by Aircraft to Third Parties on the Surface, Rome 1933 (Brussels, Sept. 1938). For the text, see Shawcross, vol 2; Margo, 12; Matte, No.189; sec 2.4 below.
under the *Rome Convention 1933*. But with only two ratifications received to date, this Protocol is regarded as a dead letter.

The *Rome Convention 1952* has been adopted to supersede the earlier agreement as between states that have ratified both instruments. About 37 states have ratified the 1952 Convention, a number smaller than expected. The lack of adherence by states may be attributed to the unsatisfactorily low liability limits and their linking to the weight of aircraft, a factor not quite related to the extent of risk. Since these two Conventions and Brussels Insurance Protocol received limited ratifications, their practical effect is limited. The 1952 Convention was further revised by the *Montreal Protocol 1978* which has not yet received sufficient ratifications to bring it into effect. This, in the words of one commentator, is due to the fact that the Montreal Conference skilfully avoided confronting the basic differences of opinion and produced a compromise that satisfied nobody. As between the parties to the Protocol, it is to be read and interpreted in conjunction with the Convention as a single instrument, to be known as the *Rome Convention of 1952 as Amended at Montreal in 1978*.

### 1.2 Scope of Application

Both the 1933 and 1952 Conventions govern liability for surface damage caused in the territory of a contracting state by an aircraft registered in another contracting state ('foreign' aircraft). Damage caused by an aircraft registered in a non-contracting state or in the same state as that where the damage occurred, even if the aircraft has been chartered to, and is being operated by, an air transport undertaking based in another contracting state, is excluded from the scope of application. This is intended to confine the applicability of the Convention to 'international' flights and to prevent aircraft

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19. Shawcross, VIII(58); Margo, 12.
20. Shawcross, ibid.
25. Shawcross, V(110); Juglart, II(3529).
28. Matte, No.194. For possible action within the European Community in this field, see J Naveau, *La responsabilité du transporteur aérien à l’égard des tiers à la surface* (1990); Shawcross, V(110) n.9.
registered in non-contracting states from benefiting from liability limitation without granting corresponding benefits to aircraft of contracting states.\textsuperscript{31} Again, under the 1952 Convention no right to compensation arise, if the damage is caused to an aircraft in flight, or to persons or goods on board such aircraft.\textsuperscript{32}

1.2.1 Rome Convention 1933: The Convention applies to all cases of surface damage occurring in the territory of one contracting state by an aircraft registered in the territory of another contracting state.\textsuperscript{33} Liability falls on the 'operator' (l'exploitant) defined as any person who has the aircraft at his disposal and is making use of the aircraft on his own account.\textsuperscript{34} The reason for imposing liability on the operator and not on the owner of the aircraft is obvious: that the risk of surface damage is the result of its operation and not its ownership.\textsuperscript{35} An aircraft is deemed to be in flight from the beginning of the 'operations of departure' until the end of the 'operations of arrival',\textsuperscript{36} but their meaning is not all too clear.

1.2.2 Rome Convention 1952: Although the 1952 Convention adopted largely the same principles as the earlier instrument,\textsuperscript{37} it upgraded liability limits,\textsuperscript{38} revised the conditions of deprivation of those limits by replacing the term 'gross negligence' with 'deliberate' act or omission,\textsuperscript{39} and introduced changes to exclude certain categories of damage from the scope of application.\textsuperscript{40} The Convention gives a right to compensation upon proof only that the damage was caused by a "foreign" aircraft in flight or by any person or thing falling therefrom.\textsuperscript{41} An aircraft is considered to be 'in flight' from the moment when power is applied for the purpose of actual take-off (i.e. not for taxiing) until the moment when the landing run ends.\textsuperscript{42}

As under the 1933 Convention, liability under the 1952 Convention falls upon the aircraft operator defined as "the person who was making use of the aircraft at the time the damage was caused".\textsuperscript{43} A person is considered to be making use of an aircraft

\begin{itemize}
\item \textsuperscript{31} Drion, 77.
\item \textsuperscript{32} Art 24; Shawcross, V(112) & VIII(56); ch 2: 6.2 above.
\item \textsuperscript{33} Rome Convention 1933, art 20(1).
\item \textsuperscript{34} Ibid, art 4. This definition, however, is not without ambiguity, because it is conceivable to imagine situations where not a single person but a couple of persons may satisfy these conditions. Drion, 126.
\item \textsuperscript{35} Matte, No. 187.
\item \textsuperscript{36} Rome Convention 1933, art 2(3).
\item \textsuperscript{37} Matte, No. 192.
\item \textsuperscript{38} Rome Convention 1952, art 11.
\item \textsuperscript{39} Ibid, art 12.
\item \textsuperscript{40} Ibid, art 1(1). See sec 1.2.3 below.
\item \textsuperscript{41} Ibid, art 1(1).
\item \textsuperscript{42} Ibid, art 1(2).
\item \textsuperscript{43} Ibid, art 2(1) & (2)(a); Shawcross, V(110); Matte, No.193 A). See also the Civil Aviation Act 1982, s 105(1) [an operator means "the person having the management of the aircraft"].
\end{itemize}
when he is using it personally or when his servants or agents are using it in the course of their employment, whether or not within the scope of their authority. The registered owner of an aircraft is presumed to be the lawful operator, unless he proves that some other person was the operator. The importance of the notion of 'operator', however, has diminished under the 1952 Convention because art 9 enumerates, in addition to the operator, other persons on whom liability may fall, in order to avoid any problem arising from attempting to formulate an all-embracing concept of operator. In the case of the use of aircraft by any person without the consent of the person entitled to its navigational control, the latter will be jointly and severally liable with the unlawful user, each within the limits of the Convention.

1.2.3 Rome Convention 1952 as amended at Montreal in 1978: The Montreal Protocol 1978 introduces certain changes in respect of the scope of application. The Protocol provides that the Convention will apply not only to damage caused by an aircraft registered in another contracting state but equally to damage caused by an aircraft, whatever its registration, the operator of which has principal place of business or, if he has no such place of business, his permanent residence in another contracting state. The reference to 'permanent residence' is akin to the concept of domicile, and habitual residence or ordinary residence will not suffice. This provision may have been necessitated to cope with the growing possibility of joint or international registration of aircraft. The Protocol has also explicitly excluded nuclear damage from the scope of the Convention.

1.3 Liability Regime

In view of the risk aircraft operation creates against third parties on the surface, both the 1933 and 1952 Conventions adopt strict liability of the operator with the defence of contributory negligence.

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44. Ibid, art 2(2)(b). For example, a pilot who has been given instructions not to fly over certain property may still be acting in the course of his employment if he does so. Shawcross, V(117).
45. Ibid, art 2(3); Shawcross, V(117).
46. Drion, 125.
47. Ibid, art 4; Rome Convention 1933, art 5; Drion, 127.
48. Shawcross, V(126) & VIII(60).
49. Rome Convention 1952, art 23(1) as substituted by Protocol, art XII.
50. As used e.g. in the Carriage by Air Act 1961, sch 1, art 28(1).
51. Shawcross, V(126).
54. Rome Convention 1933, art 2(1) & Rome Convention 1952, art 1(1); Matte, No.187. For the defence of contributory negligence, see 2.3.3 below.
1.3.1 Rome Convention 1933: The operator is liable for each occurrence up to an amount determined at the rate of 250 gold francs for each kilogramme of the weight of the aircraft but within the margin between 600,000 to 2,000,000 francs. The 'weight' of an aircraft means its weight with total maximum load as indicated in the certificate of airworthiness or any other official document. Where the damage caused involves both personal and property damage, one third of the amount of the total liability applicable to the aircraft must be earmarked for compensation of damage to property, and the other two-thirds must be appropriated for that of personal injury or death, but the compensation payable for personal damage must not exceed 200,000 francs per person killed or injured.

1.3.2 Rome Convention 1952: The new Convention raised liability limits, with the limits again linked to the weight of aircraft. 'Weight' is defined as the maximum weight of the aircraft authorised by the certificate of airworthiness for take-off, excluding the effect of lifting gas when used. Liability of each aircraft per incident is limited between 500,000 francs for aircraft weighing 1,000 kgs or less and 10,500,000 francs plus 100 francs per kilogramme over 50,000 kgs for aircraft weighing more than 50,000 kgs. Liability for loss of life or personal injury, however, must not exceed 500,000 francs per person killed or injured. The Convention provides that contracting states will, as far as possible, facilitate payment of compensation in the currency of the state where the damage occurred, by converting the sums expressed in gold francs into national currencies.

Where total claims for personal damage exceed the aggregate liability limit applicable to the aircraft, the amount available will be distributed pro rata among the claimants. Where the only damage caused is damage to property and the property of more than one person is damaged and the total claims established exceed the total liability limit,

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55. *Rome Convention 1933*, art 8(1)-(2); Drion, 156ff; Shawcross, VIII(57). For the value of Poincaré gold franc and its conversion into national currencies, art 19 and ch 2: 5.2 above.
59. *Rome Convention 1952*, art 11(1); Juglart. I(1074); Matte. No.193 B). Using the exchange rates at the time of the *Carriage by Air (Sterling Equivalents) Order 1986*, 500,000 francs amounts to £27,266 ($40,000). 2.5 million francs £136,340, 6 million francs £327,216 and 10.5 million francs £572,628. Shawcross. V(118) n.3: Matte, p.521.
60. *Ibid*, art 11(2).
61. *Ibid*, art 27; Drion. 156. For the problems of conversion. see ch 2: 5.2 above; Juglart, I(1075).
62. Drion, 296; Matte, p.522.
the claims are reduced in proportion to their respective amounts.\textsuperscript{63} Where damage caused involves both personal and property damage and the total claims exceed the applicable liability limit in art 11(1), the amount distributable under that provision must be divided into two halves. One half is appropriated preferentially to meet personal damage claims and, if sufficient, is distributed proportionately, taking account of the maximum liability limit of 500,000 francs applicable to personal damage.\textsuperscript{64} The remaining half is then allocated proportionately among property damage claims and the portion of personal damage claims that have failed to be satisfied out of the first half of the sum divided.

1.3.3 Montreal Protocol 1978: The Protocol has substantially increased the liability limits which are expressed in SDR terms.\textsuperscript{65} And for the benefit of the states which are not member of the IMF and whose law does not allow for the use of SDRs, the limits are also expressed in terms of 'monetary units', which refer to the Poincaré gold franc.\textsuperscript{66} Under the Protocol, liability of each aircraft per incident is limited between 300,000 SDRs (4,500,000 monetary units) for aircraft weighing 2,000 kgs or less and 2,500,000 SDRs (37,500,000 units) plus 65 SDRs (975 units) per kilogramme over 30,000 kgs for aircraft weighing more than 30,000 kgs.\textsuperscript{67}

The Protocol affects the operation of the liability limits provided under the Convention in two ways. The limit of liability for personal injury or death has been raised to 125,000 SDRs (1,875,000 monetary units) per person killed or injured.\textsuperscript{68} If the claims established exceed the liability limit applicable to the aircraft and if the claims are both in respect of personal and property damage, the total sum distributable must be appropriated preferentially to meet proportionately the claims in respect of personal injury or death, and the remainder, if any, is distributed proportionately among property damage claims.\textsuperscript{69}

2. Simple Models for Single-Operator Incidents

2.1 Factors Affecting Expected Losses

\textsuperscript{63} Rome Convention 1952, art 14(a).
\textsuperscript{64} Ibid, art 14(b); Juglart, I(1085).
\textsuperscript{65} Shawcross, V(128); Juglart, I(1079): Matte, p.535.
\textsuperscript{66} Juglart, I(1080).
\textsuperscript{67} Rome Convention 1952, art 11(1) as substituted by Protocol, art III; Juglart, I(1079). By way of example, the liability limit would be 3,865,000 SDRs or 57,975,000 units for a DC 9-40, 9,000,000 SDRs or 135,000,000 units for a Boeing 707-300C and 23,430,000 SDRs or 351,450,000 units for a Boeing 747. Matte, p.536.
\textsuperscript{68} Rome Convention 1952, art 11(2), as substituted by Protocol, art III.
\textsuperscript{69} Rome Convention 1952, art 14(b), as substituted by Protocol, art IV.
2.1.1 Aircraft operator's care and aircraft weight: Assuming for the moment that victims cannot affect the probability or severity of surface damage, expected losses will largely depend on the aircraft operator's care. This is evident where an airline with a large fleet of aircraft may well register a low level of aggregate surface damage, whereas a small fleet holder may cause a relatively high level of losses. In other words, regardless of whether an aircraft is large or small, aggregate surface damage will be minimised when the operator exercises appropriate care. The Rome Conventions 1933 and 1952 both link the operator's liability limits to aircraft weight, but the risk of surface damage is not quite related to it. Although damage from a mid-air collision may more or less have to do with aircraft weight, even in this case greater incentives will be created for operators to reduce risk if the losses are apportioned in proportion to their relative accident record involving surface damage.

2.2 No Transaction Costs

If the parties involved in surface damage can costlessly bargain a mutually beneficial agreement, this will, by the main premise of economic approach, lead to the efficient outcome regardless of what the liability rule governing such losses is. Thus, liability rules are irrelevant to the achievement of efficiency under no transaction costs. The assumption of no transaction costs, however, is not realistic, given a usually significant number of victims involved in surface damage.

2.3 Positive Transaction Costs and the Courts' Imperfect Information

Example 4.1 Suppose an aircraft operator registered a certain surface damage record in the course of his activity. Suppose also he has three options in relation to his incident propensity: take high, medium or low care. It is assumed for the moment that victims can not affect the risk of surface damage (this assumption will be relaxed and reconsidered subsequently) and that parties are risk neutral. In this Example, as Table 4.1 shows, both the negligence rule and strict liability create proper incentive for the operator to take optimal care, and he will be induced to take medium care to maximise his total benefits minus total (incidents and their avoidance) costs.

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70. See sec 2.3.2 below.
71. Shawcross. V(110).
72. Ch 1: 5.2.5. ch 2: 6.2.3 above & sec 6.2, Example 4.5 below.
73. Secs 2.3.2 & 2.4 below
Table 4.1
Surface Damage Example: Operator's Care Affects Expected Losses

<table>
<thead>
<tr>
<th>Operator's Level of Care</th>
<th>Cost of Production including Cost of Care</th>
<th>Accident Probability per 100,000 kms</th>
<th>Losses to Ground People and Property per Incident</th>
<th>Expected Losses</th>
<th>Total Cost of Production (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>300</td>
<td>0.0005</td>
<td>1,000,000</td>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td>Medium</td>
<td>500</td>
<td>0.0002</td>
<td>1,000,000</td>
<td>200</td>
<td>700</td>
</tr>
<tr>
<td>High</td>
<td>650</td>
<td>0.0001</td>
<td>1,000,000</td>
<td>100</td>
<td>750</td>
</tr>
</tbody>
</table>

2.3.1 Negligence rule and strict liability: Under the negligence rule the operator will be liable only if it fails to meet the standard of care applicable to him. Assuming that this standard is determined by reference to the level of care exercised by the operator, this corresponds in the Example above to taking medium care. In this situation, the operator will be held liable only if he takes low care, in which case his production cost plus expected liability payments will amount to £800. If the operator exercises medium care, he will not be liable for losses and his production cost will be £500, whereas the comparable figure for taking high care with no liability will be £650. Given the costs of care with or without liability payments at each level of care, the aircraft operator will be induced to take medium care, the efficient outcome. In order to achieve this efficient result under the negligence rule, it is therefore necessary for courts to have correct information about the costs corresponding to each level of care and determine accordingly the due care level matching the efficient outcome. If courts have incorrect information and makes error in determining the efficient level of care, the operator will not properly be induced to take optimal care. It is nevertheless important to note that the incidence of judicial errors in determining the level of care is problematic only to the extent that such errors are asymmetrical, that is to say, courts make errors consistently on too much care or too little care.74

Under strict liability the operator will be liable for any losses on the surface whether he takes low or high care. Given the production costs including liability payments at each level of care in Table 4.1 (800, 700 and 750, respectively), the operator will be motivated to take medium care. In order for strict liability to be efficient, it is essential

74. Ch 1: 5.1.2 above.
that courts have correct information about the victim's damages. If the court under-estimates them, the operator will be induced to take lower-than-optimal care. Assuming the court's imperfect information and parties' risk neutrality, the optimal choice between the negligence rule and strict liability depends on which rule will better induce the parties to avoid losses and incur least administrative costs. Thus, to the extent that the operator has better information about risk than the victim and has more incentives to avoid losses, strict liability is preferred to the negligence rule.\textsuperscript{75}

2.3.2 Victim's care: Aircraft operation involves a fair chance of substantial damage to the people and their property on the surface through the falling objects from aircraft in flight or by debris from mid-air explosion or collision. If anything goes wrong with the flight, it is highly likely that it would end up in disaster not only to passengers but to the people on the surface. Thus, a \textit{prima facie} case may be made to the effect that persons on the ground, by contrast, may not foresee, and have no place to hide from, falling aircraft debris (e.g. tons of flaming gasoline)\textsuperscript{76} and are helpless to select any locality for their residence or business where they will not be exposed to the risk.\textsuperscript{77} Nevertheless, subjacent people can affect the occurrence of surface damage as in the case where the owner of a tall building rising in the regular approach path failed to light it at night which contributed to the collision of an aircraft with it.

2.3.3 Rome Conventions 1933 and 1952: Although the two Rome Conventions impose strict liability on the operator for damage on the surface,\textsuperscript{78} both allow for the defence of contributory negligence. Under the 1933 Convention the liability may be diminished or set aside if the damage has been caused or contributed to by the negligence of the injured party.\textsuperscript{79} The 1952 Convention elaborates this by providing that the aircraft operator will not be liable for damage if he proves that the damage was caused solely through the negligence or other wrongful act or omission of the injured party or of his servants or agents.\textsuperscript{80} If the operator proves that the damage was contributed to by the negligence or wrongful act or omission of the victim, the

\textsuperscript{75} In a similar context, the \textit{Space Liability Convention 1972} holds a launching state absolutely liable for damage on the earth by its space objects. \textit{Convention on International Liability for Damage Caused by Space Objects 1972} (29 March 1972), 961 UNTS (1975) 187; TIAS No.7762, p.2389 (1972), art II.

\textsuperscript{76} For the Lockerbie disaster, see TT, 22 Dec. 1988. For surface damage caused by an all-cargo jumbo aircraft in the heart of Amsterdam, see The Economist. 10 Oct., 1992, p.98.

\textsuperscript{77} \textit{Restatement (Second) of Torts}, s 520A, comment c.

\textsuperscript{78} Sec 1.3 above.

\textsuperscript{79} Art 6(1). Drion. 110 & 210.
compensation payable will be reduced to the extent to which such negligence or wrongful act or omission contributed to the damage.81

2.3.4 Domestic laws: Both English and French law impose strict liability, while at the same time recognising the defence of contributory negligence. In English law liability for surface damage is governed by strict liability under the Civil Aviation Act 1982, which provides:

"Subject to subsection (3) below [relating to the owner's rights of indemnity], where material loss or damage is caused to any person or property on land or water by, or by a person in, or an article, animal or person falling from, an aircraft while in flight, taking off or landing, then unless the loss or damage was caused or contributed to by the negligence of the person by whom it was suffered, damages in respect of the loss or damage shall be recoverable without proof of negligence or intention or other cause of action, as if the loss or damage had been caused by the wilful act, neglect or default of the owner of the aircraft."82

English law thus recognises the defence of contributory negligence, and if the aircraft operator establishes that the negligence of the injured party contributed to the damage, the operator's liability will be reduced and losses will be apportioned between them.83 Droplets of aviation spirit have been held to be within the meaning of 'article'.84 'In flight' is construed as meaning airborne, and an aircraft will be in flight even if it is in tow of another aircraft.85 As regards the duration of take-off, the position of English law appears to be in line with that of the Rome Convention 1952.86 Thus in Blankley v. Godley,87 which concerned a collision between a car and an aircraft on the cross-wind runway, the court seems to have taken the view that take-off did not commence until the pilot halted at a position on the runway, carried out his take-off drill and began the take-off run.

French law, like English law, imposes strict liability (responsabilité objective) on the operator with a defence of contributory negligence.88 Art L.141-2 of the Code provides: "L'exploitant d'un aéronef est responsable de plein droit des dommages

81. Ibid.
82. S 76(2) [Italics added].
83. Law Reform (Contributory Negligence) Act 1945, s 4. The victim's contributory negligence will not entirely exonerate the defendant's liability. Shawcross, V(144).
85. Shawcross, V(143).
86. Art 1(2); sec 1.2.2 above.
87. [1952] 1 All ER 436.
causés par les évolutions de l'aéronef ou les objets qui s'en détacheraient aux personnes et aux biens situés à la surface. Cette responsabilité ne peut être atténuée ou écartée que par la preuve de la faute de la victime". The provision therefore allows for the defence of contributory negligence, and reduces or exonerates the liability upon proof of contributory negligence on the part of the victim. This provision applies to damage caused by an aircraft in movement to a stationery aircraft.

In America where there is no uniform federal statute governing the liability for surface damage, most states apply some form of the negligence rule for surface damage. The rationale cited is that an aircraft itself is no longer regarded as inherently dangerous nor flying is such an ultra-hazardous activity. Thus, in Wood v. United Air Lines, the court ruled that absolute liability could only be imposed on a finding that aviation was an ultra-hazardous activity, which was no longer the case. Although it is conceded that aviation today is much safer than it once was and that flying is no longer abnormally dangerous, this alone will not automatically lead to application of the negligence rule. The point is who has more accurate information about risk and is thus in a superior position to take appropriate action and which rule will better induce the parties to reduce or avoid the risk of surface damage at cheaper costs. Obviously, strict liability is preferred, but with the defence of contributory negligence to take account of the victim's role in avoiding damage.

2.4 Courts' Imperfect Information and the Requirement of Compulsory Insurance

The 1933 Convention requires every aircraft of a contracting state to be insured against its liability for damages arising thereunder in order to fly above the territory of another contracting state. If an operator is not properly insured to meet the claims arising under the Convention, the operator may not avail himself of the benefits of liability limitation. Under the 1952 Convention, any contracting state may require the aircraft operator of another contracting state to be insured against his liability to third
parties on the surface up to the limits applicable according to the Convention. The insurance is accepted as satisfactory if it conforms to the provisions of the Convention and has been effected by an insurer authorised under the laws of the state of the aircraft's registry or of the state of the insurer's residence or principal place of business, provided that his financial responsibility has been verified by either of those states. Since third-party liability insurance cover is often combined with passenger liability cover into a 'combined single limit' for indemnification of both categories of risk, we will include in the discussion below compulsory insurance against passenger damage risk. It is assumed that penal-administrative sanctions (e.g. fine, suspension or revocation of the permit) is in force against the operator's failure to insure.

Example 4.2 Suppose an aircraft operator is capable of causing surface and passenger damage of up to £100 million per incident but that his assets total only £50 million. Supposing also that his accident probability stands at 0.01, expected losses will be £1 million. Hence, provided that he is willing to pay the actuarial risk of £1 million, this operator must be allowed to participate in the carriage by air service, since this premium will cover his losses of up to £100 million. To require this operator to have assets of at least £100 million would be tantamount to denying him an access to the carriage by air market despite his willingness to pay £1 million in insurance premiums to cover his potential liability.

2.4.1 Dilution in incentive of the injurer with insufficient assets to take optimal care or to buy liability insurance: If the injurer has insufficient assets to pay for the losses he may cause, his incentive to take optimal care may be diluted, whether under the negligence rule or strict liability. Such an injurer may thus choose to expand his activity level beyond his solvency limit, since the price of his service will not correctly reflect his expected liability payments. If he were risk-averse, the insolvent injurer may not be induced to buy adequate insurance, because whatever amount of losses he may cause, his assets are all with which to pay for the losses. However, these dilution in the injurer's incentive to take optimal precautions or to purchase adequate liability insurance must be balanced against the possibility that he may derive significant

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96. Rome Convention 1952, art 15(1); Juglart, II(3529). The insurance obligation may also be discharged by means of securities, such as a cash deposit or a guarantee given by a bank or by the contracting state where the aircraft is registered. Rome Convention 1952, art 15(4); Rome Convention 1933, art 12(2); Juglart, I(1089)ff.


98. Margo, 167, 293ff; Shawcross, VIII(77) & (79).

disutility from being declared insolvent. This deserves due consideration, given the possibility that an insolvent injurer may also be subject to licensing or even penal sanctions to be publicly stigmatised and ostracised from the market and society.

2.4.2 Threshold asset requirement: As another means of alleviating the problem of incentive dilution in an injurer with insufficient assets, it may also be conceivable to prohibit the operator whose resources are less than the average passenger and surface damage he caused per incident, from engaging in the carriage by air activity. But this solution is not without defects, because it is desirable for society to allow a party to participate in a risky activity, if the benefits he will derive from it outweigh the costs he may cause. Requiring another, different criterion of assets at least equalling or surpassing actual losses may unduly discourage prospective entrepreneurs from providing a socially beneficial service and deprive society of its benefits. Another practical difficulty is that it would be difficult to agree on the maximum threshold amount of assets which will entitle an operator to engage in his activity. In extreme cases, it is conceivable that an injurer may cause a series of big losses before he pays out the losses from the first accident.

2.4.3 Requirement of compulsory insurance: The efficient solution to the injurer's inadequate assets is to impose compulsory insurance on injurers for their legal liability. If the injurer fails to insure, especially under strict liability, social welfare will be reduced because risk-averse parties must bear the risk. It is therefore essential that international airlines are adequately insured against their passenger and third-party legal liability. Compulsory insurance will protect the operator's financial position, since in the absence of liability insurance his entire assets would be put at risk upon his engagement in the activity. It will also enhance the injurer's incentive to take risk-reducing actions for premium reductions.

2.4.4 Dilution in the operator's incentive to buy liability insurance: Given the limited market for third-party liability insurance and relatively infrequent incidence of surface damage, insurers may find it difficult to predict and calculate correctly the risk of surface damage created by individual aircraft operators or airlines. If in this case the insurer links premiums to aircraft weight as actuarial risk, it will dissuade operators with a large fleet of aircraft but with relatively low loss-causing record from taking out insurance because of relatively high premiums charged on them (adverse selection).

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100. See ch 1: 4.1.2 above.
101. Shavell, 169.
102. Shawcross, VIII(61); Margo, 14.
103. See ch 1: 6.3.3 above.
For low-risk operators and airlines will perceive that the utility they will obtain from purchasing liability insurance is less than the value of premiums they will pay and that taking out insurance is not worth it. They may thus forgo private insurance and choose to self-insure. This is not the efficient outcome, since risk-averse injurers have to retain risk instead of shifting it to the insurer who is better placed to reduce and spread risk.

2.4.5 Administrative feasibility and costs: One may question the feasibility of enforcing compulsory insurance against 'foreign' aircraft operators, given the lack of an effective means of checking on the details of an insurance certificate (e.g. the insurer's solvency or coverage exclusions). This, however, can be resolved if each contracting state undertakes to oblige 'foreign' operators to show evidence of adequate insurance cover or other satisfactory financial arrangement against both passenger and surface damage risk upon application for grant or renewal of their operating permit. Indeed, certifying-licensing authorities usually require such evidence against passenger damage risk as a condition to the issue of an air transport certificate or licence to their national carriers. Aircraft operators may thereafter be required to carry on board certificate of insurance and that of endorsement issued by the appropriate authority certifying the insurer's financial responsibility. A contracting state may request additional evidence of financial obligation if it has reasonable grounds for doubting the financial responsibility of the insurer or of the bank. It may also attach similar conditions to the aircraft which it authorise to overfly its territory without landing.

2.4.6 Compulsory insurance under international and domestic laws: The feasibility of introducing compulsory insurance against the carrier's liability for passenger damage was first raised during the Warsaw conference of 1929. Although the Convention did not adopt a mandatory insurance scheme for passenger damage, it has been held as compatible with the objective of the Convention and national laws have adopted different compulsory insurance schemes requiring their national carriers to take out insurance against passenger damage risk. The rationale is that passengers with imperfect information will not be certain of whether he would need additional self-protection by purchasing travel insurance before he boards an aircraft.

104. See Nilsson, Liability and Insurance for Damage Caused by Foreign Aircraft to Third Parties on the Surface, at 186 & 193.
105. Shawcross, VIII(61); Margo, 14.
106. See the Rome Convention 1952, art 15(5).
110. E.g. Germany, Austria, Spain, Italy and Switzerland. See Matte, p.586; Juglart, II(3458).
111. See Juglart, II(3500).
In English law, although an aircraft owner or operator is strictly liable for surface damage without proof of negligence, there is no general rule which holds insurance obligatory for third-party risks. The original provision of compulsory insurance was repealed before being brought into force, and was not reinstated in subsequent legislation. There is now thus no general rule of compulsory insurance against surface damage risk in English law. Nevertheless, compulsory insurance has virtually been made enforceable by the provision that the CAA should refuse to grant the applicant (or to renew) an air transport licence if it is not satisfied that his resources and financial arrangements are adequate for discharging his actual and potential obligations. The CAA is also under duty to revoke, suspend or vary a license if it is not or no longer satisfied with the licence holder's resources or financial arrangements.

In the United States federal law makes passenger and third party liability insurance compulsory for US and foreign air carriers engaging in international carriage by air, and some states have adopted a compulsory insurance scheme. Thus, foreign as well as national air carriers engaging in domestic or international carriage by air are under statutory obligation to take out insurance against passenger and third party liability. Certain states have adopted compulsory insurance laws, and in some cases local airport operators are empowered to enforce the law as a prior condition to the use of the airport or its facilities.

In France, although the state does not officially declare that insurance against surface damage risk is obligatory. Nevertheless, such insurance has virtually been made obligatory by ministerial decrees and orders (arrêtés ministériels d'autorisation) which have since 1956 made adequate insurance against passenger and surface damage risk a condition of granting or renewing an operating permit to French enterprises applying.
for such a permit.\textsuperscript{120} By the same token, relevant national authorities should be allowed to require 'foreign' aircraft operators to insure against surface damage risk according to the its own law as a condition of their flying over its territory.\textsuperscript{121} Sanctions against failure to insure include suspension or revocation of the operating permit authorising carriage by air service.\textsuperscript{122} Air France is exempted from the duty to insure, since it has long guaranteed passengers an individual automatic insurance\textsuperscript{123} and has never left accident victims without compensation by providing more assured solvency than an insurance company through the prestige of the state.\textsuperscript{124}

3. Causation

3.1 Causation, Burden of Proof and Presumption of Liability

The 1933 Convention holds the aircraft operator liable for damage caused by his aircraft in flight to persons or property on the surface "on proof only that the damage exists and is attributable to the aircraft ('provient de l'aéronef')."\textsuperscript{125} The comparable provision in the 1952 Convention stipulates that a victim is entitled to compensation "upon proof only that the damage was caused by an aircraft in flight or by any person or thing falling therefrom".\textsuperscript{126} Thus, neither the 1933 nor the 1952 Convention links, as a condition of liability, a certain behaviour of the injurer (e.g. the operator's fault) to the occurrence of damage. Under either Convention, it is sufficient for the victim to establish that the damage was proximately caused by the aircraft in question or the aircraft in flight, any person or thing falling therefrom.

This \textit{prima facie} appears to have removed all the intricacies of proof of causal link between the injurer's behaviour and damage in an action on surface damage before the courts of a state either where the damage occurred or where defendant has the principal place of business.\textsuperscript{127} Far from it. This is because there are still a very limited number of states parties the Rome Convention system. For example, in the United States where there is no federal statute governing uniformly the aircraft operator's liability for surface damage, only a fraction of state jurisdictions are now adhering to

\begin{itemize}
\item \textsuperscript{120} Juglart, II(3461) & (3467).
\item \textsuperscript{121} Juglart, II(3496).
\item \textsuperscript{122} Juglart, II(3461).
\item \textsuperscript{123} Juglart, II(3475).
\item \textsuperscript{124} Juglart, II(3461).
\item \textsuperscript{125} Art 2(1)
\item \textsuperscript{126} Art I(1). See Drion, 104 n.1.
\item \textsuperscript{127} Sec 5 below for jurisdictional questions.
\end{itemize}
strict liability principles. This means that most states are adopting some forms of the negligence rule, aided in some cases by the maxim of *res ipsa loquitur*. Example 4.3 Suppose a mid-air explosion of a passenger aircraft on an international flight caused massive personal and property damage to the surface underneath. Suppose also later investigation established that the explosion had been caused by plastic explosives planted on board the aircraft's cargo compartment. For simplicity, it is assumed that victims on the surface could not affect or reduce the risk. It is also assumed that the aircraft operator had taken all proper steps to prevent such an act of sabotage during usual baggage checking procedures (e.g. by using the state-of-the-art explosives detection or alert system including X-ray screening of baggage), but was unable to screen out the explosive device at the time of embarkation.

3.1.1 Difficulty with establishing proximate cause under the negligence rule: In Example 4.3 above, if one of the two Rome Conventions is applicable, little problem will arise in respect of proof of proximate cause, since damage occurred to the surface and was caused by an aircraft in flight as required by one of them. Under either of the Conventions, it is not relevant to inquire into the cause of the incident giving rise to the damage (e.g. the operator's negligence, terrorists bombing, sabotage, crash landing, or mid-air collision). The situation will be different, however, if the negligence rule is applicable as in most US state jurisdictions. Under negligence, it will be a burden for the victim to establish causal link between the operator's negligence and the damage suffered, not to speak of proof of the operator's duty to take due care and his breach of that duty. In Example 4.3 above, was the explosion and resulting surface damage proximately caused by the operator's negligence or by the act of sabotage?

If, as the above Example tried to demonstrate, the damage had occurred without the operator's fault and if the causal requirement were insisted on, liability would probably fall on the saboteur rather than on the aircraft operator. This is because the wrongful act of the saboteur proximately caused damage and but for his act, no damage would have occurred (necessary and proximate cause). Nevertheless, apart from the difficulty and costs involved in identifying the saboteur, liability on him would not properly induce the aircraft operator to avoid similar losses in the future. Only when liability is attributed to the operator for his failure to check baggage properly, he will be induced.
to take appropriate risk-reducing steps (e.g. by conducting physical inspection of passengers, baggage and cargo before allowing them on board). The saboteur, when apprehended, would rather be brought to penal punishment, since he would probably have insufficient assets to meet the liability.

3.1.2 Presumption of liability and res ipsa loquitur: Plaintiff's burden of proof in a negligence action is often enormous. Such a burden is alleviated to some extent by the application of statutory presumption of liability or greatly by that of the common law maxim, res ipsa loquitur, as already explained in the carrier's passenger legal liability context. It is true that presumption is often rebutted and the application of res ipsa loquitur is denied. Again, for res ipsa loquitur to be applicable, the incident causing damage must be a type giving rise to an inference of negligence. Nevertheless, given that the operator has superior information about the cause of incident and is thus in a vantage position to rebut the presumption, res ipsa loquitur, if it were applied, will restore the balance and give much benefits to plaintiff. As such, res ipsa loquitur will create an adequate incentive to the aircraft operator to take optimal care, and the practical effect of its application will amount to strict liability.

3.1.3 Restatement of causal requirement: In establishing causal link, as already explained above, it would be pointless to inquire whether the incident was caused by the operator's negligence or by an act of sabotage or otherwise. The important point is therefore not whether the damage claimed was caused by the operator's negligence or otherwise but whether there has in fact occurred any physical harm to the people and their property on the surface by an aircraft in flight or by any person or object falling therefrom. For the real issue in causation is how the law can, by attributing properly the proximate cause of harm, induce the parties, especially the injurer, to reduce the risk and minimise the sum of surface damage losses and their avoidance costs. This goal can be achieved by attributing the losses to the aircraft operator as the cheapest cost avoider in Example 4.3 above.

3.1.4 Domestic laws: In English law the Civil Aviation Act 1982 holds the aircraft operator liable, without proof of negligence, for material damage to persons or property on the ground caused by, or by a person in, or an article, animal or person falling from, an aircraft. Thus, the victim or claimant needs not to prove the

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133. See ch 2: 2.5.6 & 3.1.1 above.
134. Kreindler, ibid, s 6.01[3]-[4]; ch 2: 3.1.2 & 3.1.3 above.
135. Ibid, s 6.01[4].
136. Ch 2: 3.1.2 & 3.1.3 above.
137. Ch 1: 5.2.5 above.
138. Civil Aviation Act 1982, s 76(2); Shawcross. V(138).
operator's negligence but has only to establish causal link between the damage and the particular aircraft operation. In the case of loss of life, damages will be recoverable under the Fatal Accidents Act 1976\textsuperscript{139} or the Law Reform (Miscellaneous Provisions) Act 1954\textsuperscript{140} as amended. Similarly, in French law, by reason of strict liability imposed on the operator for surface damage under art L.141-2 of the Code, it is sufficient for the victim to establish causal connection between the aircraft operation and the damage sustained.\textsuperscript{141}

As observed above, most of US state jurisdictions adopt the negligence rule as the basis of the operator's liability for surface damage. Thus, in a case where a falling auxiliary gasoline tank from a Navy aeroplane hit the plaintiff's fruit stand in the market on the surface and caused damage,\textsuperscript{142} the court applied the Maryland statute providing for a rebuttable presumption of liability. And the maxim of \textit{res ipsa loquitur} was applied to a case involving an aircraft's collision with a building during daylight.\textsuperscript{143} However, where an incident involved an experimental type aircraft, application of \textit{res ipsa loquitur} has been denied, since the incident having caused surface damage was not considered a type justifying an inference of negligence.\textsuperscript{144} Similarly, the Restatement (Second) of Torts imposes strict liability for surface damage caused during the test of an experimental aircraft.\textsuperscript{145} But as already explained, strict liability should be applied not merely to damage caused by an experimental aircraft but to damage caused by other aircraft.

### 3.2 Damage, Proximate Cause and Direct Consequence

Under the \textit{1933 Convention}, foreseeability of damage is not generally required as a condition of holding the operator liable.\textsuperscript{146} Under the 1952 Convention, on the other hand, no right to compensation will arise if the damage is not a \textit{direct} consequence of the incident giving rise to it or if the damage results from "the mere fact of passage of the aircraft through the airspace in conformity with existing air traffic regulations".\textsuperscript{147} The 1952 Convention thus requires \textit{directness} between the damage and the incident

\textsuperscript{139} 31 Halsbury's Statutes 251.
\textsuperscript{140} 17 Halsbury's Statutes 356.
\textsuperscript{141} Juglart, I(2015).
\textsuperscript{142} D'Anna v. US, [3 Avi 17,171] 181 F 2d 335 (4th Cir 1950).
\textsuperscript{143} Northwestern National Insurance Co. v. US, 2 Avi 14,962 (DC III 1949).
\textsuperscript{144} Kreindler, Aviation Accident Law, s 6.01[4] & n.40 for cases.
\textsuperscript{145} S 165, Illustration 8.
\textsuperscript{146} Drion 104, n.1. But the Convention allows the operator to benefit from liability limitation if he proves that he has taken "all proper steps to prevent the damage" in respect of his servants or agents. Art 14(a).
\textsuperscript{147} Art 1(1); Shawcross, V(112); ch 5: 1.1.4 below.
causing it, and excludes, from the scope of its application, damage resulting from or caused by normal flights (e.g. noise/vibration/pollution). What is more, it exempts the operator from liability if he proves that "the damage is the direct consequence of armed conflict or civil disturbance". On the face of it, the restriction of recoverable damages to a direct consequence of the incident giving rise to the damage does not appear to present much difficulties in connection with establishing proximate cause.

Nevertheless, in the situation of Example 4.3 above, if the damage had been caused as the direct result of an armed conflict between warring factions of a country in civil war, victims on the ground who did not commit any contributory negligence would be denied any compensation from the operator under the 1952 Convention. The problem is that if the victim, despite the difficulties involved, succeeds in identifying the party responsible and in bringing an action, the court must determine whether the damage sustained was the direct result of the usual sabotage or that of armed conflict. This will not be an easy task in some borderline cases. For these reasons, it is questionable whether the requirement of a direct consequence is really necessary. Nor is it considered necessary to exempt the aircraft operator from liability if the damage is the direct consequence of armed conflict or civil disturbance.

Indeed, as we have seen, both English and French law neither impose a requirement that the damage be the direct consequence of an incident giving rise to it nor make a provision for exempting the operator from liability for damage arising as the direct result of an armed conflict or civil disturbance. These position is also consistent with the insurance market underwriting practice. Thus, although the London insurance market introduced and inserted into every aviation hull and liability policy a war and hijacking risk exclusion clause, certain of the war risks excluded by the clause will be written back into a hull and all risks policy in the aviation market. Furthermore, the remainder of these war risks or 'full war risks' will be insured in the specialist war insurance market. A combined war, hijacking and political risks policy is also available in the London war market and is primarily used in relation to airlines. The policy covers risks of war, hostilities, civil war, rebellion, insurrection, strikes, riots, civil commotion and any act of sabotage.

148. Art 5.
149. Sec 2.3.4 & 3.1.4 above.
150. For the notions of a war, civil war, insurrection, civil commotion and act of sabotage, see Margo, 236ff and references esp. in n.87.
151. Margo, 223-225.
152. Margo, 225.
153. Margo, ibid.
4. Compensable Damages under the Rome Convention System

Neither the 1933 nor 1952 Convention contains any provision relating to the heads of damages damages recoverable. In the absence of such a provision, recourse may have to be had to national laws in respect of the measure of damages. Equally, there is no economically sound reason to accord special treatment in this respect to the people on the surface suffering damage from aircraft operation, in contradistinction to passengers sustaining similar damage.

4.1 Liability Equal to Actual Losses

4.1.1 Level of liability equal to physical damage: As in the passenger damage context, in order to create the right amount of deterrence on the injurer, it is necessary to set the level of liability to equal the actual losses he caused. Actual losses in this context are taken to mean material losses, i.e. certain and direct physical damage including pecuniary and nonpecuniary losses suffered by the victim as the result of his injury. Nonpecuniary losses from mental pain and suffering which are not related to, or resulting from, the physical injury sustained, however, will not be recoverable. And if the assessment of nonpecuniary losses in each case incurs high costs to the courts, they may be replaced by the average losses incurred over a given period.

Again, as in passenger legal liability context, liability limitation enables the aircraft operator (and his insurer) to calculate correctly the amount of risk involved in his activity and to allocate his resources to loss prevention or insurance so that his service can be provided at reasonable costs. Thus, liability limitation is more a matter of precision than restriction, in respect of the maximum liability to be incurred. As to the related issue of the award of interest, the 1952 Convention allows the court to award interest not exceeding 4% per annum on the amount due from the date of the judgment in respect of which execution is granted. This, as we have seen already, is efficient, since otherwise it is to the defendant's benefit to delay or not to co-operate in court proceedings. The Montreal Protocol further permits the court to award interest on the judgment amount without fixing the rate.

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154 Drion, 111.
155 Ch 2: 4.1.1 & 4.1.2 above.
156 Sec 4.1.3 below.
157 Drion, 110: ch 2: 4.1.3 above.
158 Matte, No. 187 B).
159 Art 20(11); Matte, p.531.
160 Ch 2: 4.1.7 above.
161 Rome Convention 1952, art 20(11), as substituted by Protocol, art X; Matte, p.539.
4.1.2 Extent of liability in case of collision under the *Rome Convention 1952*: A question may arise under the *Rome Convention 1952* whether a person suffering injury (or his dependants in case of his death) from a collision between two or more aircraft is allowed to recover twice the personal injury or death limit provided for in art 11(2). Since the Convention provides in art 13(2) that the person suffering damage will be entitled to recover 'up to the aggregate of the limit applicable to each aircraft involved' in the collision, it is without doubt that the total liability limit applicable to each aircraft as provided in art 11(1) will all be cumulated. As such, the cumulation of the limits provided in art 13(2) refers to the limit applicable to the aircraft and not to the personal damage limit and no cumulation of the personal limit will be allowed.\(^\text{162}\)

4.1.3 Domestic laws: In English law the *Civil Aviation Act 1982* entitles a victim of surface damage to recover damages for *material* loss to him or his property, which includes loss of life or personal injury.\(^\text{163}\) The term *material* must be interpreted to mean 'physical' or pecuniary losses to a person or his property on the surface.\(^\text{164}\) If a person suffered only non-physical losses (i.e. nonpecuniary losses such as mental pain or emotional distress), he will not be allowed to recover under that section, and he may base his action on negligence or other causes of action.\(^\text{165}\) Thus, the question remains in English law as to whether non-physical, consequential losses which result from physical damage suffered on the surface can also be recovered. This should be decided by applying the rules governing tort liability in general which, as we have already seen in the carrier's liability context, allow recovery of nonpecuniary losses.\(^\text{166}\) We have also seen there that French law's position is close to that of English law in this regard and that US courts are most liberal toward the award of nonpecuniary losses accompanied by physical injury.

4.2 'Deliberate' Damage and Punitive Damages

Under the *1933 Convention* the operator will be deprived of the benefits of liability limits if: a) it is proved that the damage was caused by the gross negligence (*faute lourde*) or wilful misconduct (*dol*) of the operator or his servants or agents, except where he proves that he had taken all proper steps to avoid the damage.\(^\text{167}\) The *1952 Convention* provides for two sets of circumstances where the defendant cannot avail

\(^\text{162}\) Drion, 155; Juglart, I(1084).
\(^\text{163}\) *Civil Aviation Act 1982*, ss 76(2) & 105(1); sec 2.3.4 above.
\(^\text{164}\) See Shawcross, V(139).
\(^\text{165}\) Shawcross, *ibid*; ch 2: 4.1.1 above.
\(^\text{166}\) Shawcross, *ibid*; ch 2: 4.1.6 *in fine* above.
\(^\text{167}\) *Rome Convention 1933*, art 14(a); Shawcross, V(107); Matte, No.188 D).
himself of limited liability: intentional act of the operator or unlawful taking and use of the aircraft. In the former case, liability will be unlimited if the person who suffers damage proves that it was caused by a deliberate act or omission of the operator, his servants or agents, done with intent to cause damage. In the latter, liability will be unlimited if the defendant has wrongfully taken and made use of the aircraft without the consent of the person entitled to use it. Unlawful use alone is not sufficient for imposition of unlimited liability and there must, in addition, be an unlawful taking.

4.2.1 Meaning of deliberate act or omission with intent to cause damage: In order to get unlimited compensation, the claimant must prove that the damage was caused by a deliberate and not merely an involuntary or reflex act or omission; and that the act or omission was done with intent to cause damage, and not to achieve some other objective. Damage caused by the jettisoning of cargo in order to avoid crash and a greater damage will not deprive the operator of liability limits, since, although the operator may well know the consequence, the intent was not to cause damage but to avert a crash. The operator will thus still be allowed to avail himself of liability limits provided for in art 11. In other words, in order to deprive an operator of liability limits, the claimant must prove his intention to cause damage to people or property on the ground, that the damage was the proximate cause of the deliberate act or omission done with intent to cause such damage, and mere knowledge that damage will result is not sufficient.

The wording 'intent to cause damage' needs careful reading, since it does not speak of 'the damage'. If the operator intended to cause damage to A's property on the surface but also, or instead, caused damage to B's property, B could recover full compensation on the basis of art 12(1) despite liability limits, provided that he could prove the operator's intent to cause damage. Likewise, unlimited liability would apply if damage to property was intended, but personal injury resulted. As long as intent to cause damage can be established, unlimited liability will apply regardless of whether or not the intended type of damage actually resulted. On the other hand, if an aircraft operator executed very low flights over a crowded beach for the fun of

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168. Arts 12(1) & 9; Juglart. I(1087). See the parallel provision under the Warsaw Convention in ch 2: 4.2 above.
169. Art 12(2).
170. Shawcross, V(122).
171. Drion, 194; Shawcross, V(122).
172. Drion, 194; Shawcross, V(122).
173. Drion. 193 & n.2.
174. Shawcross, V(122).
frightening the people but resulted in crash and killed some people, liability limits will still apply, since there was no intention to cause damage.¹⁷⁵

4.2.2 Irrelevance of distinction between an intentional and unintentional misconduct: In the field of delictual liability governed by the Rome Convention 1933 and 1952, the situations where deliberate damage by the operator (or his employees) will be much more limited, compared with those covered by the wilful misconduct of the carrier under the Warsaw Convention.¹⁷⁶ Leaving aside the deliberate throwing of articles out of the aircraft,¹⁷⁷ the only conceivable case of deliberate act may include damage suffered as a result of sabotage by the operator or his employees or by third parties.¹⁷⁸ It is inconceivable for a pilot to make a crash landing with intent to cause damage to persons and property on the surface. This is because the pilot already has adequate incentives not to cause damage, let alone deliberate damage, since his career as well as his life itself is at stake. Distinction between an intentional or ordinary damage will also incur high administrative costs for the courts.

4.2.3 Efficient sanction for 'deliberate' act: It would indeed be difficult for the victim to prove the operator's intent by subjective criteria such as the injurer's state of mind. It must always be proved by reference to its consequence or external effect. Nevertheless, if there has really been found an apparent intention to cause damage on the part of the operator or his employees, it would be an act of a criminal nature and as such would rather be dealt with by penal sanctions.¹⁷⁹ For if penal sanctions cannot deter the operator from committing such an intentional act, it is doubted whether deprivation of liability limits or punitive damages can do it.¹⁸⁰

4.2.4 Rome Convention and domestic laws: In English law, the Civil Aviation Act 1982 reflects well the efficient result as discussed above. The aircraft operator is liable for surface damage as defined by the Act, without proof of negligence or intention or other cause of action, as if the loss or damage had been caused by the wilful act, neglect or default of the owner of the aircraft.¹⁸¹ This demonstrates that in English law it is immaterial for the purpose of entertaining the liability of the operator whether the damage has been caused by the negligence, intention or the wilful act.

¹⁷⁵. Drion, 193, Example (c).
¹⁷⁶. Ch 2: 4.2 above.
¹⁷⁷. Even in this case, if the throwing were for the safety of aircraft operation, it will not constitute a deliberate act with intent to cause damage.
¹⁷⁹. See Drion, 193.
¹⁸⁰. Ch 2: 5.2.1 above.
¹⁸¹. S 76(2); sec 2.3.4 above.
No provision in the French *Code de l'aviation civile* specifically addresses liability for surface damage caused by a 'deliberate' act with intent to cause damage. The *Code* merely provides that in the case of the throwing for *force majeure* or statutory ballast (*jet de lest réglementaire*) causing surface damage, the liability of the operator will be governed by the same rule relating to the liability for ordinary surface damage (i.e. strict liability with the defence of contributory negligence). It is in this context to be recalled that the French Supreme Court has consistently ruled against civil liability performing a penal function. Similarly, the Rome Convention 1933 made a provision to this effect by stipulating that damage caused in the event of the proper discharge of ballast or of jettison made in case of necessity is included in the ordinary damage giving rise to a right to compensation subject to its liability limits.

5. Jurisdiction and Choice of Law

Under the 1933 Convention, a plaintiff claiming surface damage may, at his choice, bring an action either before the courts of the contracting state of the defendant's ordinary residence or before those of the state where the damage was caused. If the action were brought before the courts of the state of damage, the courts can without difficulty apply lex fori. However, if the action were brought before the courts of the state of defendant's ordinary residence, the courts will have to choose between lex fori and the law of the state of injury for determination of the law applicable to heads of damages recoverable. In this case, the court must apply lex fori from the consideration of administrative costs reduction and predictability of the outcome.

Under the 1952 Convention, a victim or claimant can bring an action only in the courts of the contracting state where damage occurred, although it does not bar taking action before the courts of any other contracting state upon agreement with any one or more defendants. Since only the courts of the place of injury are competent, lex fori and lex loci delicti will be the same and possible jurisdictional and choice of law problems have been almost removed under the Convention. Each contracting state is under duty to ensure that all actions arising from a single incident are

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182. Art 141-3, para 2; sec 2.3.4 above.
183. See ch 3: 4.2.4 above.
184. Art 2(1) & (2).
186. Art 20(1); sec 1.2. above; Drion, 103. For the position under the Warsaw Convention, see ch 2: 5.1 above.
188. Drion, 103
consolidated in a single proceeding before the same court, a provision mindful of administrative costs reduction.

6. Joint- and Multiple-Operator Incidents

As in passenger damage caused by two or more carriers, surface damage caused by two or more aircraft operators justifies separate discussion. This is because there arises the question whether and how joint injurers can be motivated to take optimal care under different liability rules. This is also because neither of the two Conventions specifies on what basis liability will be apportioned between joint injurers. This uncertainty over liability division between joint injurers may well be the source of additional actions for indemnity and contribution and will only increase administrative costs without comparable incentive gains.

6.1 Collision, Costs and Care

Example 4.4 Suppose tons of inflamed fuel tanks from a mid-air collision between two aircraft Alpha and Beta registered in state A and B, respectively, plummeted to hit high-voltage power cables or crowded buildings in the heart of a city in state C. It is assumed that states A, B and C are all contracting states parties to the Rome Convention 1952, that victims did not contribute to the collision and that the collision was caused jointly by the two aircraft. It is also assumed that the damage caused on the surface was the direct consequence of the mid-air collision and that no deliberate act or omission was committed by either aircraft. In this situation, the negligence rule and strict liability both create adequate incentives for the joint injurers to take optimal care, as already seen in the context of passenger damage caused by multiple carriers.

6.1.1 Notion of collision: A collision here will refer to an occurrence or event where two or more aircraft collided or interfered with each other in flight, whether in the air, on the ground or otherwise, and caused damage on the surface (or damage to passengers on board the aircraft, to their belongings or to the hull) for which a right to

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189. Rome Convention 1952, art 20(3).
190. Ch 2: 6.2 above.
191. See D'Anna v. US, n.142 above.
192. The Montreal Protocol 1978, not yet in force, has excluded damage to nuclear facilities on the ground from the scope of the Convention (art XIV inserted as new art 27 into the 1952 Convention). Surface damage to nuclear installations are governed by the Convention on Civil Liability for Nuclear Damage (Vienna 1963), 2 ILM (1963) 727.
193. Ch 2: 6.1 above.
194. See in this context the Draft Convention on Aerial Collisions prepared by the ICAO Legal Committee, Signed on 18 Sept. 1964, art 1(1); Matte. Nos.200-01 & Appendix XII for the text.
compensation arises.  

Although a clash between an aircraft in flight and a stationery one may also be called collision, this will not cause difficulty in liability attribution, since in this case the operator of the aircraft in flight should solely be liable for any damage caused.

6.1.2 Negligence rule and strict liability: In Example 4.4 above, both the negligence rule and strict liability induce multiple injurers to take optimal care. Indeed, the avoidance of a collision or other incident causing surface damage will certainly call for joint care by the two or more aircraft involved. Under the negligence rule each operator will be induced to take optimal care, since each knows that he would otherwise be held liable for the entire losses. Under strict liability, insofar as both operators act in concert to minimise their joint expenses, they will all choose to take optimal care whatever the liability apportionment between them. Again, strict liability is preferred to the negligence rule to the extent that there is uncertainty over the relative degree of fault of the joint injurers and the court is likely to make errors in determining it.

6.1.3 Domestic laws: In English law strict liability under s 76(2) of the Civil Aviation Act 1982 does not apply to damage to passengers on board the aircraft or their baggage or to the hull caused by a mid-air collision. But it does apply to damage to persons or property on the surface from a collision, e.g. by falling debris. It also applies to cases of collision between two aircraft on the surface where one of the aircraft is in flight, taking off or landing, or between such an aircraft and some other vehicle or structure on the surface. Therefore, for purposes of the subsection, it does not matter whether it is an aerial or ground collision or whether a collision is between two aircraft or between one aircraft and a ground vehicle, insofar as at least one aircraft involved in the collision is in flight, taking off or landing.

French law makes a distinction between two types of surface damage which may arise from a collision (collision aérienne) and give rise to a right to compensation. The first type of 'collision aérienne' involves an incident between a moving aircraft...

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195. *Rome Convention 1952*, art 7. For the notion of 'in flight', see sec 1.2.2 above.
196. See ch 2: 6.1, Example 2.3.
197. Ch 2: 6.1.1 above.
198. Ch 2: 6.1.2 above.
199. Sec 2.3.4 above.
200. Shawcross, V (138) & (146).
surface damage

including seaplane) and a vehicle or any other object other than an aircraft on the ground or water. This type of incident is what French law regards as surface damage proper, and the aircraft operator is strictly liable for damage caused to persons and property on the surface by the application of art 141-2 of the *Code de l'aviation civile*. The second type of 'collision aérienne' relates to damage done by a moving aircraft to a stationery one. There is no applicable provision in the *Code* nor established rule governing this kind of damage. In a 1955 decision the Cour de cassation held liable the operator of the moving aircraft applying general civil law principles without specifying whether such renvoi was based on the application of art L.141-1.

But as French authors argue, there is no reason not to apply art L.141-2 to the second type of surface damage. It is indeed not clear nor justified why this distinction should be maintained between these two types of collision. Uncertainty is also created by the lack of provision in the Code applicable to surface damage resulting from an *abordage aérien* which refers to an incident involving two moving aircraft. For in this case, as already explained, the only relevant provision of the Code, art L.141-1, is not applicable, since it is intended to govern only damage to passengers, to their belongings or to the aircraft hull and not surface damage as such.

### 6.2 Indemnity, Contribution and Liability Apportionment

The *1933 Convention* provides that in the case of surface damage caused by a collision between two or more aircraft, their operators are "jointly and severally liable to third parties suffering damage", the liability of each operator being subject to the provisions of the Convention. The *1952 Convention* provides that when two or more aircraft have collided or interfered with each other in flight and surface damage as contemplated by the Convention resulted, or when two or more aircraft have jointly caused such damage, each of the aircraft concerned will be considered to have caused the damage and the operator of each aircraft will be liable, each of them being liable
within the liability limits of the Convention. However, since the Convention does not specify how such joint liability can be effected, there is uncertainty over the question of indemnity and contribution between joint injurers.

Example 4.5 In the joint liability situation of Example 4.4 above, suppose Alpha was registered in state C (where the damage occurred) with Beta registered in state B. In this situation, the Convention applies only to liability for damage caused by Beta registered in the contracting state of B. The liability for the portion of damage caused by Alpha ('national' aircraft) will be governed not by the Convention but probably by the law of state C. Similar disparity in liability attribution will arise where Alpha was registered in state A with Beta being registered in state D not a party to the Convention. Apart from disparate liability regime applicable, if the court has imperfect information and makes errors in determining the relative degree of fault of each operator, the negligence rule will not properly induce them to take optimal care. The efficient solution is therefore to apportion liability between operators of Alpha and Beta in proportion to their relative accident probability rather than on the basis of their relative degree of fault or of relative aircraft weight.

6.2.1 Problems of disparate liability regime applicable to joint and multiple injurers: As Example 4.5 above demonstrates, disparate liability regime will apply to the liability for the similar category of losses caused jointly by two or more aircraft. This result, apart from administrative costs of possible recourse actions, does not satisfy one's sense of equitable outcome. Although the exclusion from the scope of the Convention does not necessarily mean that the injurer-operator in each situation is allowed to escape liability, this will create uncertainty over the respective liability of joint injurers and will not induce them to take appropriate measures. This will also raise the issue of efficient risk bearing between them. The similar must be said about surface damage resulting from collision caused concurrently by aircraft operators and the ATCA.

211. Both the 1933 and 1952 Conventions apply only to damage caused by the aircraft registered in a contracting state other than that of the occurrence. Rome Convention 1952, art 23(1); sec 1.2 above.
212. In this case, only the portion of damage caused by Alpha will fall under the scope of the Convention.
213. Art 1 of the Draft Convention on Aerial Collisions prepared by the ICAO Legal Committee, Signed on 18 Sept. 1964, restricts its applicability to cases where 1) the collision or interference occurs in the territory of a Contracting State and at least one of the aircraft involved is registered in another Contracting State, or 2) where two or more of the aircraft involved are registered in different Contracting States, irrespective of where the collision or interference occurs.
214. Drion, 77.
6.2.2 Indemnity and contribution under the negligence rule and strict liability: Assuming that the rule of indemnity and contribution between joint injurers does not dilute incentives for them all to take optimal care under the negligence rule, the court must determine the relative degree of fault committed by each aircraft operator. If in this case the relative contribution to the damage caused cannot exactly be ascertained (e.g. because of uncertainty over the exact cause of the incident), the court cannot set the optimal level of care applicable to each injurer. And if this happens, the negligence rule will not properly induce the multiple injurers to take optimal care and one or more of the injurers who compensated the victims may sue the other joint injurer(s) in separate action(s) for indemnity and contribution to recover the damages paid out.

This inefficiency under the negligence rule can be corrected by allocating losses in proportion to relative surface damage record of joint injurers as evidence of the average level of care exercised by the respective operator. Similarly, if damage was caused jointly by aircraft operators and the ATCA, their liability should be determined by reference to their respective surface damage probability. In this case, accident probability of the aircraft operators and the ATCA responsible for providing air traffic control service within a particular state can commonly be predicated on incidents per year involving surface damage.

6.2.3 Indemnity and contribution under international and domestic laws: The Rome Convention 1952 is silent on how indemnity and contribution will be effected. In English law, although s 76(2) of the Civil Aviation Act 1982 applies not only to material damage caused by a single aircraft in flight but to damage caused jointly by two or more aircraft, it merely provides for the aircraft owner's rights to indemnity and does not specify on what basis or how concurrent liability will be apportioned between joint injurers. Although the relevant statute recognises a right of one of joint injurers to recover contribution from the other injurer(s), the amount of contribution recoverable will be determined by the court as it thinks just and equitable having regard to the extent of his own responsibility for the damage caused.

216. Ch 2: 6.2.1 & 6.1.1 above.
217. Ch 2: 6.2.2 above.
218. Ch 1: 6.3.4 above.
219. See ch 6: 6.3 below in the context of joint liability for passenger damage.
220. See art 7: Matte, p.519.
221. See sec 2.3.4 above.
222. S 76(3).
224. Ibid. s 2(1).
Nevertheless, the court, not to speak of the victim or claimant, will find it difficult in many cases to determine exactly respective contribution of joint injurers to the damage caused. Hence there is uncertainty in English law over the method of effecting contribution among joint injurers. In French law, granted that French law generally permits liability division and that art L.141-2 of the Code imposing strict liability on aircraft operators is applied to both types of 'collision aérienne', problems similar to English law will arise. These uncertainty can be overcome only by a mechanical liability division on the basis of the relative surface damage record of joint injurers.

Conclusion

Whether or not the framers of the two Rome Conventions had efficiency in the terms discussed above as their goal, they overall produced an efficient outcome as already demonstrated. However, despite the unpredictable, and potentially disastrous, consequences of surface damage, the Rome Convention system as a whole has failed to attract sufficient recognition of its rationale from international community. One of the plausible reasons for this neglect can be found in the linkage of liability limits to aircraft weight. Whatever the exact reason for the cool response, the consequence is clear: little uniformity and predictability has been achieved as to substantive rules relating to the 'foreign' aircraft operator's liability for surface damage. In order to provide a set of pointers to a new regime of wider acceptability, we undertook to evaluate the efficiency of existing liability rules of the two Rome Conventions on the basis of simple economic models. In so doing, we have included as the factor affecting expected surface damage losses the aircraft operator's care but not aircraft weight.

We have established that strict liability with the defence of contributory negligence, as adopted by the two Rome Conventions, is efficient, as long as courts have correct information about the victim's damages. The defence of contributory negligence is necessary to take account of the victim's ability to affect or reduce risk by taking care (e.g. owners of tall buildings rising in the flight path can light them at night). The courts will not experience much difficulty in sorting out rather obvious cases of the victim's negligence. English and French law both adopt strict liability with the defence, whereas most American state jurisdictions adopt the negligence rule on the grounds that flying is no longer an ultra-hazardous activity. But the fact that aviation is much safer today does not necessary warrant the application of the negligence rule. The important points are who has more accurate information about risk and is thus better

225. Shawcross, V(140).
226. Ch 2: 6.2.4 above.
227. Secs 2.1.1 & 2.4.4 above.
positioned to take appropriate action at cheaper costs and which rule will better induce
departies to take optimal care with least administrative costs.

The foregoing analysis has enabled us to establish that compulsory third-party (and
passenger) legal liability insurance as required by both Conventions reflects the
efficient outcome. If aircraft operators with assets insufficient to cover their potential
liability were allowed to participate in carriage by air without taking out adequate
insurance, some operators may choose to expand his activity level beyond the optimal.
Some risk-prefering operators may even risk significant disutility that may be derived
from being declared insolvent and being ostracised from the market and society,
insofar as they see a chance for windfall profits. This is obviously an inefficient and
undesirable situation. Here, compulsory insurance will not only protect the operator's
financial position from catastrophic losses and promote his incentive to take risk-
reducing actions for premium reductions, but also enhance the victim's chances of
recovery.

In order to avoid moral hazard and adverse selection problems, however, the insurer
should base actuarial risk on aircraft operators' relative surface damage record,
registered by their aircraft engaged in international operation, as evidence of the
average level of care he exercised over the given period of time. If liability (and
insurance premiums) is determined according to total aircraft weight (as provided
under the Rome Conventions), aircraft operators with a large fleet but with low
accident record will pull out of the risk pool they belong to, leading to the unravelling
of the pool and adverse selection. Compliance with the compulsory insurance
requirement can be checked in respect of foreign operators upon their application for
grant or renewal of an operating permit, as is the current practice with English, French
and American law.

As to the requirement of causation, there will not arise much problems of proof of
causal link under the Rome Convention system and in English and French law, since
they adopt some form of strict liability. However, in America where there is no
uniform federal legislation governing the liability for surface damage, since most of
state jurisdictions adopt some form of the negligence rule, victims may be faced with
difficulties in establishing causal link between the operator's negligence and resulting
damage. This is the case where the damage occurred without the operator's fault or
despite his due care. Even the presumption of liability or the doctrine of res ipsa
loquitur will not help the victim very much to discharge the burden of proof, because it

228. See sec 2.4.1 above.
is rebuttable or inapplicable in some cases. If as a result the victim fails to establish causal link, the operator will not adequately be induced to take due care to reduce risk.

In relation to proximate cause under the 1952 Convention, we argued against the requirement of directness between the damage and an incident giving rise to it. It is indeed questionable whether such a requirement is necessary. Similarly, the aircraft operator should not be exempted from liability even if the damage is the direct consequence of an armed conflict or civil disturbance. This is because it would be quite difficult for courts to distinguish in borderline cases between the damage caused as the direct consequence of a usual incident and of an armed conflict or civil disturbance.

Indeed, in both English and French law, there is imposed no requirement of the direct consequence of an incident giving rise to the damage nor is there any distinction made between the damage resulting from the incident and that from an armed conflict or civil disturbance. The insurance market also provides aircraft operators with a cover for the risk of losses suffered on the surface from an armed conflict or civil disturbance.

Neither the 1933 nor 1952 Rome Convention contains any provision as to the heads of damages recoverable and in the absence of such a provision, the level of compensable damages should be set to equal actual damage including pecuniary and nonpecuniary losses related to the former. This will create the right amount of deterrence on the aircraft operator and will also get the operator's liability for surface damage in line with the carrier's liability for passenger damage. Again, as in the carrier's passenger legal liability context, the aircraft operator needs not be deprived of liability limitation for a 'deliberate' damage, given the very limited conceivable scope of intentional wrongdoing in the surface damage context. If there has really been found an obvious case of the operator's intention to cause damage, this must be dealt with by penal sanction. No serious problem will arise as to jurisdiction and choice of law under the 1952 Convention, since lex fori and lex loci delicti will be the same under the Convention.

Finally, in the case of surface damage caused jointly by two or more operators as in a collision, although both the negligence rule and strict liability will induce them to take optimal care, the latter is preferred to the former inasmuch as there is risk of the court making errors in determining their respective degree of fault. The 1952 Convention provides no specific method of attribution of losses in cases of collision. Although it may well be conceivable that total damages will be apportioned by reference to the

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229. Sec 3.2 above.
230. Sec 3.2 in fine above.
231. Ch 2: 4.1.1 & 4.1.2 above.
relative weight of the aircraft involved in collision, this will not create adequate incentives for operators to take proper care. Instead, total damages should be apportioned between the operators involved in collision in proportion to their relative average surface damage record registered by all of their aircraft engaged in international carriage by air over a given period of time as evidence of the average level of care they exercised during that period. A similar method should apply to a collision caused jointly by an aircraft operator and the ATC agency, in which case their incident record can commonly be based on surface damage caused for the past couple of years.

232. Sec 4.1.2 above.
PART THREE

ENVIRONMENTAL AND PASSENGER DAMAGE RISK
ARISING FROM THE PARTIES IN STRANGER RELATIONSHIPS

Introduction to Part Three Research Design

In Parts One and Two, we argued for imposition of strict liability without the defence of contributory negligence on airlines and manufacturers for passenger damage and of strict liability with the defence on aircraft operators for surface damage to minimise the sum of accident/incident costs and their avoidance costs. In this last Part, we will be dealing with liability for environmental damage caused around airports by aircraft noise, vibration and pollution which affect health and quality of life of not only airport residents but the general public. We will also analyse the efficiency of the alternative liability rules governing passenger damage caused by airport operators within their premises or by the ATC agency in the course of performing their respective service activities. Both categories of risk arise from the parties in stranger relationships, which makes the possibility of bargaining more remote and costly than in contractual/market relationships.

What is characteristic of these passenger damage and environmental harm is that the activities of airport operators and ATC agencies expose to unreasonable risk a wide spectrum of people and their property without comparable benefits to those affected by the risk. Another defining characteristics of these risk are that they may involve the activities of public bodies conducted ostensibly in the public interest. Since public bodies' activities are usually financed or subsidised by general tax revenues, the price of their services will not correctly reflect the true costs of their activities. Furthermore, environmental damage causes special problems with respect to its valuation, since even scientific knowledge may not establish the long-term effects of aircraft emissions on human health and the environment. As for passenger damage caused by the ATC agency, high technicalities involved in ATC service present victims with substantial difficulties in establishing causal link and may allow the agency to get away with liability, causing externality.

These characteristics of the activities of airport operators and ATC agencies act as constraints on the efficiency of liability rules. In these circumstances, it is questionable whether the activities of airport operators and ATC agencies can lend themselves to the efficiency-only analysis, just as do those of private firms. Indeed, if efficiency is
insisted on as the sole criterion to determine the desirability of legal rules governing environmental and passenger damage risk created in stranger relationships, this may unduly discriminate against general taxpayers. This is because the activities of airport operators and ATC agencies are partly funded or subsidised by the general tax revenue and taxpayers are already bearing the costs of their operational inefficiency without direct, comparable benefits. These constraints on efficiency norms may justify distributional consideration for equitable risk distribution in choosing a desirable legal rule.

From this perspective, if as assumed, carriage by air is a product of teamwork and if airport operators and ATCAs cause environmental and/or passenger damage, they should be made to bear such portions of risk as they may cause in the course of their activities. This is because no injurer or polluter should be allowed to get richer than he is entitled to or without due compensation to the victim. In this way, distributional considerations will affect the setting of initial entitlements and will rectify inequitable wealth distribution in society. Since tort liability administered in practice by liability insurance is intended neither for equitable wealth distribution nor for elimination of externalities, taxation of these risk is preferred to liability rules. The tax approach will put airport operators and ATCAs on an equal footing with the carrier and manufacturer in terms of risk bearing.2

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1. *Northwest Airlines, Inc. v. Minnesota*, INTRODUCTION, above, n.1; Hjalsted, Passenger Liability in International Carriage by Air & ch 2, research design, above.

CHAPTER 5

LIABILITY OF THE AIRPORT OPERATOR FOR ENVIRONMENTAL HARM AND PASSENGER DAMAGE

"Teacher, is it lawful for us to pay taxes to Caesar or not?"...He said to them, "Then pay to Caesar what belongs to Caesar and to God what belongs to God".  ------ The Bible

If a man grazes his livestock in a field or vineyard and lets them stray and they graze in another man's field, he must make restitution from the best of his own field or vineyard.  ------ The Bible

Introduction

Just as the popular demand for air travel is burgeoning, so is the demand for larger airports and for larger, faster and more powerful jet airliners. Indeed, given the increasing congestion and general shortage of runway capacity at major international airports, smaller aircraft can hardly make any economically sound sense for coping with the estimated long-term annual world passenger air traffic growth rates of 5-6 percent. The phenomenal growth of commercial carriage by air also mandates a smoother flow of traffic in the air as well as on the ground. These factors have contributed to the transformation of the role of airports in carriage by air, since a faster flow of larger aircraft can only be made possible by efficient provision of airport facilities and services. Indeed, airport services and facilities constitute a vital component in international carriage by air. As such, an airport produces and distributes enormous benefits to airlines, passengers and international community at large.

At the same time, however, an airport causes, if incidentally, harmful effects of noise-pollution to the residents living around it and to the general public. The commissioning of the first jet aircraft (Comet) into commercial aviation in 1952

5. Shawcross, II(30). The next generation of larger aircraft with its seating capacity of 600 to 1,000 is expected in service within seven years. See TT, Bigger Jumbo on the Way, 7 Oct. 1993, p.20.
7. Baccelli, n.2 above, at 5.
presaged an era of conflict between the aviation industry and airport neighbours. Apart from noise-pollution, the sheer immensity of an airport itself poses a big threat to the natural environment. Since an airport has such a far-reaching environmental impact on local life and landscape, any new airport construction or expansion project has been greeted with strong opposition in many countries. Airport operators create largely two types of risk through their activities. One is environmental damage and the other is risk towards passengers using airport terminals and premises which are caused by improper provision of airport security and safety facilities.

In this chapter, adopting Professor Coase's path-breaking approach premised on the goal of minimising the combined costs of nuisance and its avoidance, we will first review two typical legal approaches, i.e. trespass and nuisance, to argue against the former. We will then assess the respective efficiency of the injunctive and damages remedy under the nuisance approach and argue for the damages remedy based on liability rules. After briefly discussing the issue of causation under liability rules, we will examine the effects of a public body's activity (externality) on efficient control of environmental harm and on society's wealth distribution. By taking these issues into due account, we can correct and improve earlier models. We will finally take up efficient control of passenger damage risk caused at airport terminals (e.g. terrorist attacks) or around airport premises (e.g. bird strike).

1. Economic Approach to Aircraft Noise, Vibration and Pollution

1.1 The Province Defined and the Problems Delimited

1.1.1 Notions of aerodrome, airport and airport operator or proprietor (propriétaire): The term 'aerodrome' (aérodrome) is used to mean any defined area of land, water or lake (including any buildings or installations) specifically designed, equipped and intended to be used for the arrival, departure and surface movement of aircraft. A more common term 'airport' (aéroport) is used to denote, in addition to

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the proper meaning of 'aerodrome', technical and commercial facilities necessary for smooth operation of air traffic such as workshops (ateliers), hangars (hangars) and terminals (aérogares) used for the embarking and disembarking of passengers.\textsuperscript{12} The term 'airport' therefore involves the whole undertaking connected with the use of an organised, permanent place intended for that purpose. In French terminology, the term aéroport may equally be used to refer to a body corporate (personne morale) usually having the status of a public body (airport authority) and charged with management of certain installations (e.g. Aéroport de Paris).\textsuperscript{13} An airport operator or 'manager' will mean the person or organisation, public or private, who is in charge of running and managing one or more aerodromes.\textsuperscript{14}

1.1.2 Notions and effects of airport noise, vibration and pollution: Ever-increasing movements of larger and more powerful aircraft create considerable noise-vibration around residential areas close to aerodromes. Especially, the development and commissioning of supersonic jets have caused extensive vibration called sonic boom.\textsuperscript{15} The harmful effects of aircraft noise and vibration are manifold: physical damage to subjacent buildings, depreciation in the value of affected properties,\textsuperscript{16} emotional distress, discomfort or annoyance,\textsuperscript{17} and even loss of hearing.\textsuperscript{18} In addition to noise-vibration, an airport also causes pollution (e.g. smells and vapours of kerosene burning, smells of de-icing agents contaminating the water table and flights threatening wildlife areas).\textsuperscript{19} Much of air pollution are related to such noxious gases emitted from aircraft fuel burning as carbon monoxide, hydrocarbon and nitrogen oxide.\textsuperscript{20}

\textsuperscript{12} Airports Act 1986, s 82(1); Juglart, I(706) & (751)-(52); Shawcross, III(2).

\textsuperscript{13} Juglart, \textit{ibid}; Code, arts L.251-1 to 251-6 inclusive, L.252-1, R.252-1 to 252-21 inclusive, 253-1, 254-1 & 254-2.

\textsuperscript{14} See the Civil Aviation Act 1982, s 73(10); Airports Act 1986, s 82(1); 49 USC Appd s 2101(2) (1988).

\textsuperscript{15} Sonic boom (Le bang sonique) is defined as an "explosive phenomenon of the air caused by shock waves generated at supersonic speeds" or as "the acoustic event which is a manifestation of the shock wave system generated by an aircraft when it flies at a speed greater than the local sound velocity". See ICAO Doc 9064, SBC/2 (1973) 3.2; J R Montgomery, The Age of Supersonic Jet Transport, its Environmental and Legal Impact, 36 JALC (1970) 577; Margo, 171 n.10; Shawcross, III(30).

\textsuperscript{16} Greater Westchester Homeowners Association et al v. City of Los Angeles, 26 Cal 3d 86, 91, 603 P 2d 1329, 1331, 160 Cal Rptr 733, 734 (Cal S Ct 1979).

\textsuperscript{17} Ibid. Noise levels exceeding 45 decibels (dB) are sufficient to disrupt indoor oral communications and interfere with sleep. Some 4 million residents in the United States are affected by airport noise exceeding 65 dB. See R J Rockett, Airport Noise: Did the Airport Safety and Noise Abatement Act of 1979 Solve the Problem?, 52 JALC (1986) 499, 499-500 & nn.3-6 for references; E du Pontavice, Le bruit aux abords des aérodromes dans la jurisprudence et la législation françaises récentes, 6 AASL (1981) 115, 117. In France, an estimated number of a half to one million people are affected by aircraft noise. Juglart, I(2024-25).

\textsuperscript{18} Shawcross, III(30).

\textsuperscript{19} Juglart, I(337); TT, 20 July 1993, p.9 & 5 July 1993. p.36.

\textsuperscript{20} TT, 10 March 1994. p.23 (Aircraft Pollutants Fear).
noise and pollution damage is taken to involve property damage and personal injuries causing grave physical and mental inconvenience or constraints.\textsuperscript{21}

1.1.3 No essential difference in the nature of the problem between noise and pollution: Analytically speaking, the problem of air pollution is no different from that of aircraft noise arising from conflicting land uses. Indeed, there exists a striking similarity between noise and pollution cases. In both cases, the harmful effects on victims' peace and health are not confined to the residential communities close to airports but spread into a larger area and population. For a sonic boom may be felt in a region even as remote as 40-80 km away,\textsuperscript{22} just as air pollution affects a vast area through the movement of the air. Both noise and pollution damage need therefore to be seen in the context of massive proliferation of attacks on the interdependent ecological system, and the issue in both cases is how to minimise the social cost of noise-pollution and their avoidance for the benefit of international society.\textsuperscript{23}

1.1.4 Irrelevance of the Rome Convention system: Whatever the exact definition or effect of aircraft noise-pollution, the Rome Convention 1952 on surface damage\textsuperscript{24} is basically an inappropriate regime for governing these damage. For the Convention does not purport to address the damage resulting from "the mere fact of passage of the aircraft through the airspace in conformity with existing air traffic regulations".\textsuperscript{25} In fact, it aims essentially at redressing direct damage caused by an object falling from an aircraft to third parties on the surface, the occurrence of which is more related to the operator's care than his activity level. By contrast, aircraft noise-pollution is something of an unavoidable consequence incidental to aircraft operation and has much more to do with the aircraft operator's activity level than with his care.\textsuperscript{26} Further, pollution from aircraft engine emissions has a more extensive effect in terms not only of its geographical impact but of the number of the people affected, and its long-term harmful effects are much harder to establish scientifically.

1.2 Trespass and Inverse Condemnation

\textsuperscript{21} Juglart, I(2029); Nice and Orly cases in sec 2.4.4 below. See further sec 3.1.4 below.
\textsuperscript{22} Juglart, I(2025) & (2005).
\textsuperscript{23} In order to avoid confusion with an accident situation, the creator of airport noise, vibration and pollution may be termed the polluter rather than the injurer.
\textsuperscript{24} Ch 4: 1.2 above.
\textsuperscript{25} See art 1(1); Juglart, I(2000).
\textsuperscript{26} Separate liability insurance cover is available to the aircraft operator for noise-vibration damage and associated phenomenon. Margo, 171 & 173: Shavcross, VIII(79); Posner, 140.
Environmental damage caused by aircraft noise-pollution is approached in law from two typical solutions: trespass (or inverse condemnation) and nuisance. The difference between the two is that the invasion of property and resulting interference with its use and enjoyment is direct in trespass but consequential in nuisance, although this distinction is often blurred as will be shown below.

1.2.1 Notions of trespass and inverse condemnation: Under the trespass approach any physical intrusion of the airspace of a land through direct overflight is actionable per se notwithstanding the fact that little damage was actually caused. Trespass to the airspace is a legacy of the Roman law maxim that "[h]e who owns the soil owns everything above" (cujus est solum, ejus est usque ad coelum). A trespass may arise where an aircraft physically encroached on the airspace of a land without lawful justification and interfered substantially with the use of the land or its superjacent airspace. Similarly, under the inverse condemnation approach the landowner is entitled to recover for a taking of property if he were actually displaced through direct overflights from space within which he was entitled to exercise dominion. Before there occurs a taking of an easement, there must be continued trespasses to the plaintiff's airspace through direct overflight.

1.2.2 Efficiency of the trespass or inverse condemnation remedy: Under the trespass approach the landowner is entitled to enjoin intrusion without negotiation and recover damages for the invasion even without proving actual damage to the court's satisfaction. However, an immediate difficulty will arise with the determination (and proof) of what constitutes a trespass, since it is not practically feasible to fix the altitude(s) an overflight below which will constitute a trespass. Trespass is an invasion of possessory rights as distinguished from that of interest in the use and enjoyment of

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31. Fifth Amendment to the US Constitution. 'Inverse condemnation' refers to a cause of action against the government agency to recover the value of property taken by the agency, although no power of eminent domain has formally been exercised and completed. Black's Law Dictionary; L C Dolley & D G Carroll, Airport Noise Pollution Damages: The Case for Local Liability, 15 Urb L (1983) 621, 628.
33. Freeman v. US, 167 F Supp 541, 544 (WD Okla 1958); Portsmouth Harbour Land & Hotel Co. v. US, 260 US 327 (1922); Anderson. n.28 above. 353-54.
such rights (as in nuisance), and one thus cannot speak of trespass on the airspace that
is incapable of being reduced to possession or occupation save to the extent of actual
use.\textsuperscript{34} Again, since a trespass relates to a direct intrusion of the airspace, it may not be
applicable to indirect flight causing, nevertheless, equally substantial noise.

More importantly, inefficient land use will result under trespass from the fact that the
landowner is not required to prove that his use of the land is more valuable than the
airline's or that he is willing to pay more for the use of the land.\textsuperscript{35} Courts need not to
compare the values of conflicting land uses. And court-determined damages may not
equal the opportunity cost of land, since the measure of damages under trespass or
inverse condemnation is limited to depreciation in the market value of the property and
other physical damage without regard for nonmarket costs of intrusion (e.g.
discomfort, annoyance and disturbance).\textsuperscript{36} The market value of land should take
account of the costs of such "discomfort, annoyance and disturbance", if they do not arise from an isolated event or are idiosyncratic. Again, if the property market fails to
operate competitively, uncertainty will ensue about the value of the property under
trespass (e.g. unforeseeable fluctuations), which is a disutility to a risk-averse party.\textsuperscript{37}

1.2.3 Ordinary or indirect overflight and constraints on the trespass approach:
Suppose overflights are conducted merely as part of ordinary and normal operations of
flight at sufficiently high altitudes making normal or nominal noise and interference. Or
suppose the wing tip of aircraft frequently passes just an inch outside plaintiff's land\textsuperscript{38}
at low altitudes and causes noise and vibration. In both cases, the respective property
owners may not, by definition, condemn the flight as trespass. So they may not enjoin
such flights and have to suffer the noise or soundproof their houses without redress. In
this situation the landowners involved may choose to bribe the airline in order to
reduce or discontinue flights. But the transaction costs of all the residents getting
together and agreeing on common strategy will be high enough to preclude the
efficient solution.

Faced with the prospect of a dispute, the airline would have two choices to continue
flights: to adopt noise abatement steps or to negotiate and buy off all of the

\textsuperscript{34} See W Blackstone, Commentaries, vol 2. 14; Hinman v. Pacific Air Transport, n.30 above, at 757-
58. Anderson, n.28 above, at 348 n.42.
\textsuperscript{35} Posner. 39-40 & 47.
\textsuperscript{36} Posner. 43. See US v. Causby. n.46 below, at 261.
\textsuperscript{37} Ibid. 38-39; ch 2: 1.1.1 above.
\textsuperscript{38} See Martin v. Port of Seattle, n.32 above.
landowners' property rights in the path of flight. If in this case noise abatement procedures are more expensive, the airline would have to buy off the rights. Knowing this, property owners would have incentive to hold out for a price in excess of the opportunity cost of the land. The airline would then be unable to buy at reasonable market prices all the rights of landowners and would have either to discontinue its flights or to take noise abatement steps, the inefficient result. Thus, in the case of aircraft noise caused by indirect or ordinary overflights, again, high transaction costs for bargaining or the holdout problem will prevent the trespass approach from achieving the efficient outcome. Therefore, the trespass approach alone will not produce the efficient outcome without blending with nuisance elements. This is why one author argued for discarding the trespass approach to the aircraft noise problem.

1.2.4 Trespass under domestic laws: In English law the 'ad coelum' doctrine of property ownership extending indefinitely above one's land was first questioned in Pickering v. Rudder where the court held that normal use of, and ordinary interference with, the column of the air above one's land would not constitute a trespass. This was affirmed in Lord Bernstein of Leigh v. Skyviews and General Ltd. which arose from the plaintiffs claim that defendants committed a trespass by flying at several hundred feet above his land to take aerial photographs without his permission. Defining the problem as that of balancing the rights of a landowner to enjoy the use of his land against the rights of the general public to utilise all the scientific inventions, the Bernstein court dismissed the plaintiff's claim on the grounds that the balance is best struck by restricting the rights of a landowner in airspace to such a height above the land as is necessary for the ordinary use and enjoyment of his land. The Bernstein decision clearly showed the court's reluctance to entertain trespass for 'ordinary' use of airspace by aircraft. But the court has failed to make clear how and by what criteria one can distinguish direct and substantial interference under trespass from normal, 'ordinary' interference. Especially, the court's reliance on the balancing of conflicting interests showed its reasoning to be grounded on nuisance rather than on trespass.

American jurisprudence has relied mostly on the trespass and inverse condemnation approach to aircraft noise damage, the inefficient solution. In the leading case of

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39. Requiring the airline to pay damages under the trespass approach will yield the inefficient outcome for reasons explained in sec 1.2.2 above.
40. Posner, 47.
42. Anderson, n.28 above, at 347-48.
43. Campbell 219 (1815), per Lord Ellenborough, Shawcross, V(131).
45. Ibid. at 488 & 907, per Griffiths, J.
Causby v. US,46 plaintiff alleged that his property was illegally taken for public use without just compensation, since military aircraft taking off from a nearby municipal aerodrome leased to the federal government used to fly some 80 feet above his house and chicken barn. Justice Douglas, delivering the opinion of the court, recognised the conflicting interests between the rights of the public in the use of airspace and those of landowners to the use and enjoyment of their land.47 Declaring that the airspace, apart from the immediate reaches above the land, is part of the public domain, the court stated, "The air is a public highway...were that not true, every transcontinental flight would subject the operator to countless trespass suits".48 It thus effectively rejected the old common law doctrine of ownership extending to the far reaches of the universe.49

The court, however, held that frequent invasions of the superjacent airspace at low altitude would amount to a direct and immediate interference with the enjoyment and use of the surface of the land and thus constitute an unconstitutional taking of property rights.50

Despite its merits, the Causby decision may be criticised in several respects. The court started off with the notion of owned airspace as the space within the immediate reaches above the land that the landowner can actually occupy or use in connection with his land. But it failed to flesh out, and apply consistently, the notion in determining trespasses and resulting takings, if any.51 The court thus skirted round the vexing question of fixing the precise limits, if any, on airspace ownership.52 Nor was the court faithful to the test of trespass and expropriation of an aviation easement, for it identified an intrusion on the owned airspace with that of the surface and an interference with the enjoyment and use of the land, a criterion normally associated with nuisance.53 After Causby, attempts have been made to define a trespass by reference to the notion of navigable airspace meaning airspace above the minimum flight altitude needed for safe take-off and landing,54 but the notion itself is still unclear.

The Supreme Court then adopted as the measure of recoverable damages diminution or loss in the fairly determined market value of the land and other physical damages

47. Ibid, 261 & 264.
48. Ibid, at 260-61 & 266.
52. Causby v. US, n.46 above, at 266.
53. See the Restatement (Second) of Torts, s 159(2)(b) (1965): Anderson, n.28 above, at 349.
54. 49 USC Appd s 1301(29) (1988); 14 CFR s 1.1 (1989); Aaron v. US, 311 F 2d 798 (Ct Cl 1963); Laird v. Nelms, 406 US 797 (1972); Cahoon. n.41 above; Anderson, n.28 above, at 342, 351 & 354; Shawcross, V(131) nn 15-17.
The airport operator's liability

(e.g. damage to livestock), ignoring nonmarket values (annoyance and discomfort, etc.). This is why Justice Black in his dissent objected to the majority's defining of unconstitutional taking in terms of actual damage and stated that the noise and glare resulting in damages might be recovered only if they constituted a nuisance. Similarly, the inverse condemnation approach taken by the same court in *Griggs v. County of Allegheny* may not yield the efficient result, despite its correct ruling that the County was solely liable as the owner of Greater Pittsburgh airport for the noise caused by aircraft using the airport through low and frequent overhead flights.

In French law the proprietor of a land is not the owner of airspace above his land but enjoys a certain right to use its superjacent airspace. The landowner's rights in airspace is thus limited to such a height as is necessary for the enjoyment of effective ownership. Likewise, although aircraft are free to fly over private lands, the right of overflight should not be exercised in such a manner as to interfere with the exercise of the landowner's rights. Thus, French law again, like English and American law, merely tries to reconcile the conflicting interests of the aircraft operator and the landowner under the trespass approach without defining clearly their respective rights to the use of superjacent airspace.

1.3 Nuisance

In the previous section, we argued that the trespass approach is not the efficient method of controlling aircraft noise-vibration, especially those caused by ordinary overflights or indirect flights. Under the nuisance approach, all the landowners affected by aircraft noise and pollution will be placed on the same footing vis-à-vis the airport operator, regardless of whether the overflights were direct or indirect or conducted at low or high altitudes. Indeed, the more relevant issue would be the actual effect of such overflights on the landowner's use and enjoyment of the land.

1.3.1 Notion and rationale of the nuisance remedy: A landowner unable to establish trespass may seek redress for damage in an action based on nuisance, a harmful externality. In order to establish nuisance, there must be some unreasonable or
unwarranted, albeit not direct, interference with the use and enjoyment of property or of personal rights and privileges. In nuisance, it is the consequence of an unlawful disturbance that is actionable, and continuity or recurrence of invasion is often considered a constituent element. Under nuisance, the court must determine in whose hands the land and its superjacent airspace would result in the highest value among competing uses or who is willing to pay more for the use. This approach may be justified because aircraft noise and pollution are incidental to airport operation and it essentially takes on the characteristics of a dispute arising from incompatible land uses between neighbouring landowners. And since aircraft are required to fly in compliance with relevant rules and regulations on and around an aerodrome, their operators, if held liable, would be 'innocent' tortfeasors.

More importantly, the airport proprietor is better positioned than anybody else to take various noise and pollution abatement options. He may install at his own expense such equipment (e.g. noise-pollution sensor) as is necessary to monitor aircraft movement at the aerodrome and to measure their noise levels. The airport proprietor is privileged to choose the airport's location, the length and direction of runways, which puts him in the best position to implement whatever realistic and reasonable navigational easements necessary for noise-vibration reduction. He may also, by exercising regulatory power to impose and enforce its own permissible noise emission levels, restrict entry by, or levy higher user charges on, aircraft emitting an unduly high level of noise, insofar as such measures are not unreasonable, arbitrary or discriminatory.

1.3.2 Typical legal remedies under nuisance: A nuisance dispute can be resolved in two steps. First, society must choose whose entitlement is to prevail. The airport operator may be given an entitlement to make noise, or the residents may be awarded

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63. Anderson, n.28 above, at 342.
65. Juglart, 1(801).
69. Griggs, n.57 above, at 89-90 (air carriers using the airport in compliance with the federal regulations not liable); Air Transport Association v. Crotti, 389 F Supp 58, 61-64 (ND Cal 1975); Luedke v. County of Milwaukee, 521 F 2d 387 (7th Cir 1975).
70. British Airways Board and the Compagnie Nationale Air France v. Port Authority of New York and New Jersey. 437 F Supp 804 (SDNY 1977), aff'd 564 F 2d 1002, 1011 (2d Cir 1977); sec 2.5.5 below. Note, however, the rule of federal pre-emption in sec 2.5.6 below.
71. Calabresi & Melamed, at 1090-91; Polinsky. 15-16.
an entitlement to be free from noise. Next, society must decide how to protect or enforce these entitlements. The law has relied on two typical remedies to resolve such a dispute: property (grant of injunctive relief) and liability (award of damages) rules.\(^\text{72}\) Under the injunctive approach, the airport operator may not cause noise-pollution save under the residents' consent. An injunction does not necessarily mean forcing a firm out of business but just an end to a particular process or method of production.\(^\text{73}\) Under the damages approach, the airport operator may make noise and pollute but must pay the residents in damages. If an entitlement to damages is granted to the residents, they are entitled to get monetary compensation for the harm caused, although they cannot stop the airport operator from causing harm. Under liability rules, it is unusual, though not wholly impossible, to award the entitlement to the polluter.\(^\text{74}\)

Example 5.1 Consider a residential community situated with such proximity to a major international airport that its residents are constantly disturbed, annoyed and harmed by aircraft noise-pollution. Suppose the airport operator's entitlement to make noise, by allowing him to dispense with noise-pollution abatement equipment, increases the value of his property by £10,000 but incurs a combined cost of £8,000 by reducing the value of the residents' properties and causing personal injuries (e.g. discomfort and annoyance).\(^\text{75}\) It is assumed for simplicity that negligible transaction cost is incurred for bargaining between the parties.

1.3.3 The injunctive and damages approach outlined: Under the injunctive remedy, suppose the residents are given an entitlement to tranquillity and clean air. Since the operator would get £10,000 from his activity against the residents' collective damages of £8,000, both would be better off if the residents sold their entitlement to the operator and were in return compensated for a sum between £8,000 and £10,000. Under the damages approach, suppose the residents are given an entitlement and that the court holds the airport operator liable for the residents' actual damages. Then the airport operator will pay the residents their collective damages of £8,000 and continue his activity, which will bring him the benefits of £2,000. Thus, in competing land use situations where transaction costs are low, both the injunctive and damages remedy lead to the most valuable land use and result in the same resource use: The airport operator will make noise and the residents will suffer. And regardless of the relative

\(^{72}\) Posner, 39; Polinsky, 15-16; Cooter & Ulen, 170. A third possibility is an entitlement to pollute at will (no nuisance) and the residents can only stop noise-pollution by bribing the airport operator. This will not be examined here, since it is against distributional justice. See 4.2 below.

\(^{73}\) Calabresi, Some Thoughts on Risk Distribution, at 535 n.94.

\(^{74}\) Polinsky, 16.

\(^{75}\) For the method of measuring the cost incurred to the residents, see sec 4.3 below.
values of the competing land uses, the initial allocation of entitlement will not determine the ultimate use.

2. Simple Models for Airport Noise and Pollution Damage

2.0.1 Assumptions: It is first of all assumed that the airport operator is a private firm and that the international aerodrome market operates in a relatively competitive environment. This assumption will later be relaxed and reconsidered to take into account the possibility of airport authorities providing public service and operating in a monopolistic setting. Secondly, it is also assumed that the airport operator's activity causes physical harm to airport neighbours and undercuts the market value of subjacent properties but that they can do little to reduce noise-pollution caused around aerodromes. Thirdly, it is further assumed that the goal of the law of civil liability governing airport noise and pollution is to minimise the combined costs of noise and pollution and their avoidance. Fourthly, it is yet further assumed that in parallel with civil liability, administrative regulations and penal sanctions are in force against aircraft or airport operators for noise and pollution emissions exceeding the prescribed standards.

2.1 Factors Affecting Estimated Noise/Vibration/Pollution Damage

2.1.1 The airport operator's activity level (output) and the court's information: Assuming that the social goal in respect of environmental damage is to minimise the sum of noise-pollution and their avoidance costs, the estimated noise and pollution damage will depend on the airport operator's activity level and the court's information about risk. An airport operator's activity level can be measured by total aircraft movements at the aerodrome for a given period. Here, one unit of 'movement' will mean one landing and take-off by an aircraft at a particular airport.

2.1.2 The airport operator's care: Given the state of present technology, it would be practically almost out of the question to eliminate aircraft noise, vibration and pollution. Even if the airport operator (and aircraft operator or manufacturer) takes extremely high care, he could not remove the harm completely. Even if that were possible, it would be too costly to be any worth doing it or to yield any allocative

76 See Posner, 47-48 & 121.
77 Sec 4.1.2 below.
78 See W F Baxter & L R Altree, Legal Aspects of Airport Noise, 15 J L & Econ (1972) 1; W F Baxter, The SST: From Watts to Harlem in Two Hours, 21 Stan LR (1968) 1; Posner, 140.
79 See sec 2.5 below.
80 Civil Aviation Act 1982, ss 77(1) & 78(3)(a)(b) & Airports Act 1986, ss 29(1), 32(1) & 32(5).
benefits. In short, environmental damage caused by aircraft operation has little to do with the airport operator's care.

2.2 No Transaction Costs

Assuming no transaction cost which means co-operative behaviour between the parties, it is immaterial in terms of efficient resource use whether the airport operator is given the entitlement to make noise and pollute or the residents are given the entitlement to clean air and tranquillity. Efficiency will be achieved under either rule, since the parties will costlessly negotiate a mutually beneficial agreement which is by definition efficient. It is, however, inconceivable that any agreement is reached costlessly, given the significant number of victims affected by airport noise-pollution. As the number of the parties whose consent is required for any bargaining to be struck increases, transaction costs will increase sharply. In addition, each resident has an incentive not to participate in costly negotiations (freeloader problem) or to resort to strategic behaviour which means a behaviour of holding out to take as much gains as possible or a bigger share of the co-operative surplus of bargaining.\(^1\)

2.3 Positive Transaction Costs and Strategic Behaviour

Under the more realistic assumption of positive transaction costs, suppose in the situation of Example 5.1 above that any bargaining costs £3,000 for the parties to reach an agreement. Then, because of this bargaining cost, it is no longer true that the parties will negotiate a mutually beneficial agreement.

2.3.1 Property rule: Under this rule with the residents having an entitlement to tranquillity and clean air, they may hold out for £8,000, whereas the airport operator may be reluctant to pay above £7,000, given the bargaining cost of £3,000. Accordingly, the residents will enforce an injunction to shut down the airport, which means a net loss of £2,000 to the operator, and this resource misallocation will not be corrected by negotiation because of the transaction costs of £3,000 which is higher than the loss. Thus, where an entitlement is protected by a property rule under positive transaction costs, the court must not award the residents an absolute or exclusive entitlement to help avoid strategic behaviour and must instead choose an intermediate entitlement corresponding to the efficient outcome.\(^2\)

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\(^1\) See Polinsky, 18; Ogus & Veljanovski, 84; Posner, 45-46.

\(^2\) Polinsky, 18-19; Posner, 46.
As such, the correct choice of an initial entitlement is important under a property rule, given high transaction costs incurred to correct a wrong choice of the initial entitlement through market transactions.\(^{83}\) If the cost of trading the initial entitlement on the market is too high, transactions for its rearrangement will not occur, nor will any valuation of the entitlement through market transactions be available.\(^{84}\) It will thus promote efficiency under a property rule to assign the entitlement to the party who would buy it out with least transaction cost on the market (the airport operator in our case), were it given initially to the other party.\(^{85}\)

2.3.2 Damages remedy: Under this approach, suppose that the residents have an entitlement to clean air and tranquillity and that the court makes the airport operator liable for their actual damages. Knowing this, the airport operator will clearly prefer to pay the residents £8,000 and to continue his activity, but the bargaining costs of £3,000 will prevent this transaction from occurring. In this situation, the problem of strategic behaviour will not affect the efficient outcome, provided that the court has correct information about the residents' actual damages and sets the liability to match them. For, in the face of the liability equal to actual damages, there is less of a need for bargaining which would incur high transaction costs.\(^{86}\) This will create adequate incentives for the airport operator to reduce noise-pollution, internalise the costs attendant upon his activity, and produce the efficient level of output.\(^{87}\)

2.3.3 The two remedies compared: Under a property rule entitlement the airport operator must negotiate with all the residents to buy out their entitlements, were the entitlement to be free from pollution granted to the residents.\(^{88}\) The operator would then be placed in almost the same position as the trespasser-airline,\(^{89}\) and some residents will hold out for a higher price than the opportunity cost of their land. Conversely, were the airport operator initially given the entitlement to pollute freely,\(^{90}\) the residents would have to get together, decide on their common strategy and buy out the operator's entitlement, which would incur even higher transaction costs.\(^{91}\) And some residents would in this case have an incentive not to participate in the costly negotiation (freeloader problems). As such, transaction costs are not necessarily

\(^{83}\) Posner, 36.
\(^{84}\) Calabresi & Melamed, at 1106.
\(^{85}\) Posner, 36; Calabresi & Melamed, 1097.
\(^{86}\) Polinsky, 19.
\(^{87}\) Calabresi & Melamed, 1096-97: ch 1: 3.2.3 above.
\(^{88}\) This is rule 1 in the Calabresi-Melamed taxonomy. See Calabresi-Melamed, 1115-16 & 1118; Posner, 50-51.
\(^{89}\) Sec 1.2.3 above.
\(^{90}\) This is rule 3 in the Calabresi-Melamed taxonomy. See Calabresi-Melamed, 1116 & 1118.
\(^{91}\) Calabresi & Melamed, 1119.
symmetrical under the converse property rule entitlements and the choice of the efficient entitlement largely depends on the magnitude of transaction costs for the market correction of a wrong entitlement.\(^2\) Again, where transaction costs are high, market valuation of a property rule entitlement is likely to produce a less efficient outcome than collective valuation under liability rules with little hold-out problems.\(^3\)

Under liability rules, the only costs to be incurred would be those of society's valuing collectively the damages to the parties involved and of enforcing that valuation.\(^4\) If in this case the entitlement were given to the residents,\(^5\) the court would have to value the damages payable by the operator to each resident, to inform all the residents of their entitlements and to get them into the court, which would incur considerable costs.\(^6\) On the other hand, if the entitlement to pollute were granted to the operator (a kind of partial eminent domain combined with a benefits tax),\(^7\) the court must assess the damages payable by the residents to the operator for the latter's foregoing of his pollution. In this case, even if the court could practicably measure the operator's injuries, it would face a difficult task of apportioning the duty of compensation among the residents.\(^8\) In other words, the court's cost of assessing the operator's damage for his foregoing of pollution may be cheap, but that of assessing the benefits to the residents from the operator's foregoing of pollution may not be cheap.

2.3.4 The two converse liability rule entitlements assessed: As such, just as there is asymmetry in transaction costs under the two converse property rule entitlements, so also the liability rule equivalents of transaction costs — the cost of collective valuation and of enforcing that valuation — are not necessarily symmetrical under the two converse liability rule entitlements.\(^9\) Under these circumstances, it would be difficult to determine which of the two liability rule entitlements would incur lower costs for their collective valuation and enforcement. We can only say that if an entitlement to make noise were granted to the operator and thus if he were given damages for his foregoing of making noise, there will be a dilution in his incentive to reduce nuisance damage insofar as the costs of its abatement are greater than its benefits to him.\(^10\)

\(^2\) Calabresi & Melamed, 1120.
\(^3\) Calabresi & Melamed, at 1106-07, 1109-10 & 1119ff; Posner, 51; ch 1: 3.2.2 above.
\(^4\) Calabresi & Melamed, 1119-20. See sec 2.4.2 below.
\(^5\) This is rule 2 in the Calabresi-Melamed taxonomy. Calabresi & Melamed, 1116.
\(^6\) Calabresi & Melamed, 1120.
\(^7\) This is rule 4. Calabresi & Melamed. \textit{ibid}.
\(^8\) Calabresi & Melamed, 1116.
\(^9\) Calabresi & Melamed, 1120.
\(^10\) See Posner, 47.
operator's entitlement to make noise would also have adverse distributional effects, since he would be better off at the expense of the residents.\textsuperscript{101}

Having tentatively concluded that an entitlement to no noise would be more efficient (in incentive creation) and more desirable distributionally than an entitlement to make noise, nevertheless, it should be borne in mind that airport noise and pollution are characterised by \textit{a large amount of damage thinly spread over large numbers of residents}. This has at least two implications for assessing the desirability of liability rules as a device for resolving an airport nuisance dispute. First, given the high costs involved in bringing legal action on his own and given the difficulties associated with causation, each individual resident may not have an adequate incentive to sue the airport operator for a small, scattered amount of damages (externalities).\textsuperscript{102} Secondly, there is a problem involving the court's administrative costs for processing so many scattered claims. Indeed, if the costs of assessing and enforcing an entitlement to no noise and pollution exceed the corresponding benefits, it would be better not to allow the residents an action for damages for normal noise and vibration caused around airports, without prejudice to an entitlement involving airport pollution.\textsuperscript{103}

\section*{2.4 Courts' Imperfect Information}

As we have noted above, it is important for the court to have correct information in order to achieve the efficient outcome under a liability rule. But this is also the case under a property rule, if the court were to enforce the efficient injunctive remedy under positive transaction costs.\textsuperscript{104} We now thus reconsider the implications of the court's imperfect information on the achievement of efficiency under the two different rules.

Example 5.2 Suppose an airport operator produces a daily average of 100 units of landing as measured by aircraft movements at his airport and that it uniformly charges £3,000 per landing. For simplicity, it is assumed that the operator is a private firm and that it makes no distinction in charging landing fees between peak and off-peak periods or between different types of aircraft.\textsuperscript{105} Suppose also that the operator spends a daily average of £100,000 for payment of wages, airfield maintenance, equipment investment and insurance. In this situation, as Table 5.1 shows, if the operator produces 100

\textsuperscript{101} See sec 4.2 below.
\textsuperscript{102} Ch 1; 7.2.2 above.
\textsuperscript{103} Sec 2.4.4 below.
\textsuperscript{104} Sec. 2.3.1 above.
\textsuperscript{105} See W Pennington, Airport Restrictions: A Dilemma of Federal Pre-emption and Proprietary Control, 56 JALC (1991) 805. 819. A differential fees system seeks to relieve congestion and secure efficient airspace utilisation.
units daily, he will get £100,000 daily in net profit, given his liability payments and other spending. If this operator increases his output by 50 units, he would incur damages to the residents totalling £400,000 with the resulting net loss of £50,000, and so on. The efficient outcome thus requires the operator to produce only 100 units daily, and at this level of output both the injunctive and damages remedy will produce the efficient outcome.

### Table 5.1

**Airport Noise-Pollution Example: Airport's Activity Affects Estimated Costs**

<table>
<thead>
<tr>
<th>Daily Activity*</th>
<th>Airport's Revenue (1)</th>
<th>Airport's Total Revenue (2)</th>
<th>Residents' Total Damages (3)</th>
<th>Airport's Other Spending (4)</th>
<th>Airport's Daily Net Profit (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>300,000</td>
<td>300,000</td>
<td>100,000</td>
<td>100,000</td>
<td>100,000</td>
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<td>400,000</td>
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<tr>
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<td>150,000</td>
<td>600,000</td>
<td>600,000</td>
<td>100,000</td>
<td>-100,000</td>
</tr>
</tbody>
</table>

*Movement of aircraft as measured by reference to the units of aircraft landing and take-off at a particular airport for a specified period.*

2.4.1 **Injunctive remedy:** In order to achieve the efficient outcome under the injunctive remedy, the court must have adequate information not only on the residents' damages but on the airport operator's profits at various levels of his activity. If the court has information only on the residents' schedule of damages but not on that of the airport operator's profits, it is liable to commit an error in its determination of the operator's efficient activity level and this will create incentives for the parties to hold out. Accordingly, the court cannot enforce the injunctive remedy inducing the parties to strike a bargain leading to the efficient activity level. In Example 5.2 above, the injunctive remedy can produce the efficient outcome, if and only if the court awards the residents an *intermediate* entitlement to clean air and tranquility corresponding to

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106. Sec 2.1.1. above.
100 units of output rather than zero unit (absolute entitlement) or more than 100 units. It would be against mutual benefits for the operator to produce 150 units, since this will bring him only an additional benefit of £150,000 against additional damages of £300,000 incurred to the residents. At this efficient level of activity (100 units), therefore, both parties would have little incentive to behave strategically.

2.4.2 Damages remedy: Under this approach, the court's imperfect information on the airport operator's schedule of profits will not affect the achievement of the efficient outcome, provided that the court chooses an entitlement equivalent to the lowest possible activity level with the liability set equal to actual damages. To see why, suppose in our Example 5.2 above that the court awards the operator an intermediate entitlement to make noise and pollute, which is equivalent to 150 units (thus up to this level of service he is not liable for the residents' damages). Then, the operator will not be motivated to produce 200 units, since it will incur additional damages worth £200,000 against the additional revenue of £150,000. But the residents would have an incentive to bribe the operator in an attempt to reduce his activity (and thus resulting damages) from 150 to 100 units. In order to avoid this incentive to bargaining and ensuing transaction cost, the court must choose an entitlement equivalent to 100 units of output, the lowest possible output, and set liability equal to actual damages.

The analysis above demonstrates that under the court's imperfect information, the injunctive remedy can produce the efficient outcome, if the court awards the airport operator an intermediate entitlement. Nevertheless, to the extent that the court has imperfect information on the airport operator's schedule of profits, the damages remedy is preferred to the injunctive remedy, provided that the court chooses an entitlement corresponding to the minimum output with the liability set equal to actual damages. It is essential under the damages remedy that liability be set equal to actual damages, for if the court underestimates the residents' damages, the operator will be induced to produce an excessive output.109

2.4.3 Strict liability v. the negligence rule under the damages approach: Assuming that victims cannot affect the level of aircraft noise and pollution, which seems reasonable, strict liability will better induce the airport operator to weigh up a host of risk-reducing precautions and to minimise the risk. This is because if the court with imperfect information fails to set the correct negligence standard, the airport operator will be induced to engage in more or less than the optimal level of activity. And if a

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108 Polinsky, 21-22.
109 Id, 22, 24.
110 See Posner, 140.
rigid standard is enforced, airport operators may argue against the technological feasibility of meeting it or against the proposed timetable. Indeed, any person making non-natural use of his land (e.g. storing of large quantities of water in reservoirs) may do it at his own risk and must be answerable, regardless of fault, for all the natural consequences of his activity causing damage to his neighbours.\textsuperscript{111}

2.4.4 Injunctive and damages remedy under domestic laws: In English law, the \textit{Civil Aviation Act 1982} provides: "No action shall lie in respect of trespass or in respect of nuisance, by reason only of the flight of an aircraft over any property at a height above the ground which, having regard to...all the circumstances of the case is \textit{reasonable}, or the \textit{ordinary incidents} of such flight".\textsuperscript{112} Ordinary incidents of a flight include a reasonable level of noise attendant upon normal operations of flight.\textsuperscript{113} Furthermore, no action may be brought by the residents in respect of nuisance \textit{by reason only of the noise and vibration} caused by aircraft at an aerodrome.\textsuperscript{114} Thus, English law does not allow an action for damages for noise and vibration, as opposed to an action for surface damage which is allowed without proof of negligence.\textsuperscript{115} This, however, does not mean that airport operators are given an absolute entitlement in English law or that residents are denied any entitlement. English law relies on economic instruments allowing airport operators to tax airlines for noise to cover the costs of paying to the residents grants towards insulating noise-affected buildings.\textsuperscript{116} American law also attempts to balance carefully conflicting interests between the airport proprietor and residents. Thus, an airport is not necessarily a nuisance \textit{per se}, although it might become such from the manner of its construction or operation.\textsuperscript{117} The use of the injunctive remedy is also restricted in American law as in English law, the efficient outcome. Thus, in \textit{Antonik v. Chamberlain},\textsuperscript{118} the court dismissed plaintiff's petition for an injunction against airport operation, ruling that in the absence of substantial, tangible injury resulting in material, physical discomfort, airport

\textsuperscript{111} \textit{Fletcher v. Rylands}, LR 1 Ex 265, 279 (1866) (per Blackburn, J), aff'd \textit{Rylands v. Fletcher}, LR 3 AC 330, 339-40 (HL 1868) (per Lord Cairns); Shawcross, I(126)-(127).

\textsuperscript{112} S 76(1) [Italics added]; 31 Halsbury's Statutes, p.994 & 4 Halsbury's Statutes, p.200; Shawcross, IV(81) & V(137). This immunity from a trespass action for the aircraft operator, however, is subject to conditions that statutory and other requirements have been duly complied with and that there has been no dangerous flying. \textit{Civil Aviation Act 1982}, ss 62 & 81.


\textsuperscript{114} \textit{Civil Aviation Act 1982}, s 77(2).

\textsuperscript{115} Ch 4: 2.3.4 above.

\textsuperscript{116} Sec 4.3.5 & 4.3.6 below.

\textsuperscript{117} \textit{E.g. Delta Air Corp. v. Kersey, Kersey v. City of Atlanta}, 20 SE 2d 245, 248 (S Ct Ga 1942); \textit{Thrasher v. City of Atlanta}, 173 SE 817, 818, 99 ALR 158 (1934).

\textsuperscript{118} 78 NE 2d 752, 759 (Ct App Ohio 1947).
neighbours must submit to annoyances consequent upon the reasonable use by the airport operator of his property.

In *Greater Westchester Homeowners Association et al. v. City of Los Angeles,* plaintiffs alleged that noise caused by jet aircraft using the airport interfered with person to person communications causing annoyance, discomfort, inconvenience and emotional distress. The plaintiffs sought damages for these injuries under the nuisance theory and for diminution in the market value of their properties under an inverse condemnation theory. The California Supreme Court ruled that federal pre-emption did not bar the nuisance cause of action. The court, holding liable the City as the proprietor of Los Angeles international airport, allowed for recovery for both personal injuries and depreciation in property value. Nevertheless, as Chief Justice Bird correctly pointed out in his concurring opinion, the majority opinion is flawed not in its result but in its reasoning, since it appears to have relied more on federal pre-emption and inverse condemnation than on nuisance.

In French law again, the airport operator may be liable for nuisance damage, but the injunctive remedy is rarely given by the court. This is the efficient result, provided that the court chooses an intermediate entitlement to clean air and tranquillity. To be more specific, French law makes two different bases of action available to victims of aircraft noise-vibration under the Code: one against the aircraft operator for 'surface damage' (art L.141-2) and the other for trespass or taking of property (art L.131-2). However, since the latter provision does not define precisely who is liable, there existed uncertainty as to the basis and extent of liability of the airport operator for causing nuisance-pollution.

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119. N.16 above, at 91, 1331 & 734.
120. Ibid, at 100, 1336 & 739.
122. Ibid, at 1341.
123. Shawcross, III(36) n.4.
124. Sec 2.4.1 above.
125. Juglart, I(2044). See ch 4: 2.3.4 above for the text of the provision.
126. "Le droit pour un aéronef de survoler les propriétés privées ne peut s'exercer dans des conditions telles qu'il entraînerait l'exercice du droit du propriétaire".
127. Juglart, I(1978), (2037), (2043) & (2045). The difference is that an action against the aircraft operator is entertained in ordinary courts, whereas an action against the airport authority can only be brought before administrative courts. Juglart, I(1978), (2009), (2070) & (2077).
For these reasons, most of earlier actions were brought against airlines on the basis of art L.141-2. In Cie Air France c. Sté E.R.V.E (the Nice case),\textsuperscript{129} the plaintiffs— the construction company and proprietors of apartments built near Nice airport—sought both compensatory damages and an injunction. Both the trial and appellate courts refused to grant an injunction against the operator of aircraft flying in conformity with relevant navigation rules and making normal noise. The courts reasoned that an injunction would amount to an interference by the judicial organ with the enforcement of administrative acts relating to the establishment and operation of airport and to air navigation rules and regulations. This ruling was not challenged in the appeal. As to the merits of the damages action, the French Supreme Court found that if the overflights diminished property value or interfered with the otherwise peaceful life of its owner or tenant, the operator would be held strictly liable under art L.141-2. At the same time, the court circumscribed the scope of recoverable damages by requiring that the damage caused by aircraft operations must have exceeded the \textit{normal} level of inconvenience, having regard to the conditions prevailing in the neighbourhood.\textsuperscript{130}

Granted that the \textit{Nice} decision demonstrated correct reasoning based on the nuisance approach, it would make sense only if the actions had been brought against the airport operator. For whereas one can talk about the troubles of 'neighbourhood' in airport-residents relationships, it is totally improper to do so in relations between airlines and residents.\textsuperscript{131} The French Supreme Court in Cie Air France et al c. Communes de Villeneuve-le-Roi et d'Orly (the Orly case),\textsuperscript{132} taking again this hybrid nuisance approach, applied the \textit{abnormal} and \textit{grave} inconvenience requirement as the measure of liability against aircraft operators. In so ruling, the Court stated that the residents of a community are exposed to various inconveniences which they should endure and must not be demanding more of airlines than of users of the public highway (\textit{la voie public}) such as road users.\textsuperscript{133}

In a third major case of its kind, 58 residents living around Charles-de-Gaulle airport at Roissy (the \textit{Roissy} case)\textsuperscript{134} brought class actions against airlines to allege that the intense noise and the fall of polluting residues caused by overflights of low-flying

\textsuperscript{130} See Mankiewicz, n.66 above, at 241; Juglart, I(2046).
\textsuperscript{131} Juglart, I(2046). \textit{in fine}.
\textsuperscript{132} (Cour de Paris, 6 July 1971), 25 RFDA (1971) 308; (cass 2e ch civ, 17 Dec. 1974), 29 RFDA (1975) 185; E du Pontavice, n.17 above, at 118. This case in fact consists of an ensemble of 30 judgments involving Air France, TWA and Pan Am on the defendant side and different communities around Orly and Duchemin on the plaintiff.
\textsuperscript{133} The Duchemin case, Juglart, I(2046). For criticism, see \textit{ibid}, I(2047).
\textsuperscript{134} (Trib de Gde Inst de Paris, 16 May 1979); Pontavice, n.17 above, at 132; Juglart, I(2053).
aircraft did harm to the quality of their life and health. The plaintiffs also claimed economic damage resulting from depreciation in the value of their properties because of the proximity of the airport. The trial court, applying the test of grave inconvenience resulting from the 'urban environment', held the airlines liable under art L.141-2 and designated experts to determine the number and hours of overflights conducted by each of the defendant airlines. This was affirmed by the Court of Appeal. This decision, like the Nice decision, would have been flawless if it had been rendered against the airport operator under the nuisance remedy. This problem has finally been resolved in *Aéroport de Paris v. Villeneuve-le-Roi*, where the airport authority was ordered to compensate, for nuisance damage it had caused, the local association acting on behalf of its people. The Aéroport has since undertaken to take charge of nuisance damage and assign compensation through the intermediary of the mayor of Villeneuve-le-Roi.

2.5 Regulation of Noise and Pollution Through Standards and Certification Sanctions

From the discussion above, it should be clear that although liability rules create an adequate incentive for the airport operator to reduce noise and pollution, nevertheless, no action is allowed for a reasonable level of noise consequent on ordinary incidents of a flight. It should also be noted that pollution damage is characterised by a large amount of damage thinly spread over large numbers of residents, which makes tort liability an ineffective means for controlling pollution. As in the context of regulation of airline safety/security and product safety, we therefore examine standards regimes governing aircraft noise and pollution, their relationship with liability rules, and their distributional consequences. Particular attention is paid to the ability of performance standards to regulate aircraft movements at an aerodrome for optimal pollution.

2.5.1 Standards regimes in general: It is true that under a standards regime, the polluter may be constrained to develop the cheapest means of meeting that standard.

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138. See also decisions of the same court in 47 RFDA (1993) 227 & 333.
139. Juglart, I(2121).
140. Sec 2.4.4 above.
141. Sec 2.3.4 above.
Nevertheless, it tends to be static: once that standard has been attained he would have no incentive to abate pollution further. The agency is supposed to set the standard by reference to the 'latest scientific knowledge', 'available technology', the 'best practicable environmental option', 'best available techniques not entailing excessive cost', or 'best available demonstrated control technology'. But the agency's knowledge of what is latest or best may not necessarily induce firms to develop better technologies, insofar as the judgment and application of these terms are left to the regulator. Moreover, target standards adopted in statutory provisions and international agreements governing environmental protection are worded in vague language, as seen in 'preventing or minimising pollution of the environment', 'to protect the public health or welfare', or 'to enhance the quality of water'.

The general language of standards regimes is also found in the context of aircraft noise and pollution. The US FAA Administrator must, to relieve and protect the public health and welfare from aircraft noise and sonic boom, prescribe (i) standards to measure aircraft noise and sonic boom and (ii) regulations to control and abate aircraft noise and sonic boom. When prescribing such a standards or regulation, the Administrator is required to consider whether the standard or regulation is consistent with the highest degree of safety in air transportation in the public interest, whether the standard or regulation is economically reasonable, technologically practicable, and appropriate for the applicable aircraft, aircraft engine, appliance, or certificate.

2.5.2 Target and specification standards and their constraints: In product safety regulation, as we have seen, the target standard is worded in very general language,

144. Ibid, s 7408(b)(1).
149. Breyer, 265.
150. Ogus, 207.
152. Clean Air Act 1970 as amended, 42 USC s 7409(b)(1)-(2) & 7409(c) (1996).
154. 49 USC s 44715(a)(1) & (2) (1996); 49 USC Appd s 1431(b)(1) (1988), as inserted and made applicable by the Control and Abatement of Aircraft Noise and Sonic Boom Amendment to the Federal Aviation Act 1958.
155. Ibid, s 44715(b)(3)-(4); 49 USC Appd s 1431(b)(4) (1988); 14 CFR s 36.5 (1985). The Administrator must also consider "the extent to which the standard or regulation will carry out the purposes" of the relevant section. Ibid, s 44715(b)(5).
such as a prohibition of activities or conditions of a product generating an
unreasonable risk of injury or death. An equivalent approach can be found in the
pollution context, i.e. prohibiting "any source or other type of emissions activity" or
"air pollution which may reasonably be anticipated to endanger public health or
welfare". Operation of subsonic aircraft not complying with Stage III noise levels
will be prohibited after Dec. 31, 1999. Likewise, in English law the Secretary may,
after consultation with the CAA, give directions in order to prevent or deal with noise,
vibration, pollution or other disturbance attributable to aircraft used for civil
aviation. However, given the vast number of individual polluting sources and the
complex process of determining optimal pollution by calculating the benefits and costs
of pollution damage, these standards will incur high information costs and will
inevitably give rise to errors because of complex spillovers.

In order to get round these problems, there has been devised a specific, quantitative
target standard, often referred to as an ambient quality standard (AQS) and formulated
on the measurement of the quality of the receiving environment. Thus, in English
law the Secretary of State is required to take necessary steps to implement the air
quality limit values. The CAA is under duty, in exercising any aerodrome licensing
function, to have regard to the need to minimise so far as reasonably practicable any
adverse effects on the environment and any disturbance to the public from noise,
vibration, atmospheric pollution attributable to the use of aircraft for civil
aviation. A parallel provision has been made in relation to the discharge of the
CAA's air transport licensing functions. The US Clean Air Act 1970 as amended
also provides for the FAA Administrator to set national primary and secondary ambient
air quality standards for each air pollutant including nitrogen dioxide (NO2).

Formulation of an AQS, however, involves a difficult problem of obtaining adequate
and accurate information, most of which are in the hands of various polluting firms the

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156. Ch 3: 2.4.2 above; Ogus, 208.
158. Ibid, s 7408(a)(1)A).
159. 49 USC ss 47522(2) & 47528(a) (1996); 49 USC Appd s 2157-58 (1988); 14 CFR 36 (1990); J J
Jenkins, The Airport Noise and Capacity Act of 1990: Has Congress Finally Solved the Aircraft Noise
160. Civil Aviation Act 1982, s 6(2)(f).
162. Ogus, 208.
164. Civil Aviation Act 1982, s 5(1).
165. Ibid, s 68(3).
166. 42 USC s 7409 (1996); Breyer, 262.
The airport operator's liability

The airport operator's liability

agency purports to regulate. Since there usually exist a number of sources polluting an airshed, it is almost impossible to determine the abatement target required of each individual source to meet the standard without information on the emissions from other sources. Firms will not be sure precisely what they are supposed to do and will have little incentive to comply with general ambient standards to reduce pollution. An ambient quality standard then should not be used as a standard directly applicable to firms. Another problem with an AQS concerns the extent of variation between regions, a problem of whether to formulate uniform or differentiated AQSs. The preferences of citizens for a clean environment may well be different, not to speak of their willingness to pay for a cleaner air (free-rider problem). If the population in a region or country are broadly prepared to bear the additional costs, some regional or national variation regarding amenity may be considered. Differentiated standards, however, are difficult to formulate and enforce. The problem of variation becomes acute where there are spillovers into other regions or countries, in which case a strong case can be made for the adoption of uniform AQSs. But uniform standards tend to put small firms at a disadvantage.

Given the public interest goal of optimal pollution and constraints on target standards, the focus of standards regimes in the regulation of noise and pollution is placed on specification and performance standards. Specification standards have been adopted in the US federal regulation that restricts noise at the source (the airplane) by requiring airplanes to meet certain construction and equipment specifications that reduce the level of noise emissions. They are also seen in English law. Under the Civil Aviation Act 1982, the Secretary may by order require the aerodrome operator at his own expense to provide in an area and within a specified period, and to maintain and operate, specified equipment for measuring noise in the vicinity of the aerodrome, and to make to the Secretary reports with respect to the noise measured by the equipment. Specification standards, however, create little

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167. Ogus. 208; Breyer, 265-66.
168. Ogus, ibid.
169. See Breyer, 267.
170. Ogus, 208.
171. Ogus, ibid.
172. Ogus, 208-09.
174. Ogus, 208.
175. Breyer, 270.
176. See Ogus, 209.
177. 49 USC Appd ss 2121-25 (1988); 14 CFR pt 36, 36.5 & 150 (1985); Rockett, n.17 above, 501.
178. S 78(8).
incentives for firms to develop cheaper and better antipollution technology and are thus liable to cause anticompetitive effects.\textsuperscript{179}

2.5.3 Performance standards for regulating aircraft movements and their constraints: Performance standards usually take the form of prohibiting the discharge of certain pollutants or of imposing maximum emission limits.\textsuperscript{180} The principal legal technique used for performance standards is to require firms to obtain from the regulatory agency an authorisation for the emission of pollutants, and the agency to impose performance standards as a condition for the granting of authorisation.\textsuperscript{181} Thus, under the Airports Act 1986, the CAA must, when granting a permission to a designated airport, impose mandatory conditions as to its accounts and airport charges.\textsuperscript{182} The CAA may impose discretionary conditions relating to accounts on any airport which is not a designated airport.\textsuperscript{183} Performance standards adopted by the Civil Aviation Act 1982 authorise the Secretary to prohibit aircraft from taking off or landing, or to limit or specify the maximum number of occasions on which the aircraft may take off or land, at the aerodrome during certain periods, for the purpose of avoiding, limiting or mitigating the effect of noise and vibration connected with taking-off or landing.\textsuperscript{184} It is the duty of the aerodrome operator to comply with such prohibitions or restrictions.\textsuperscript{185}

The Airports Act 1986 also has a similar provision authorising the Secretary to make an order by imposing an overall limit on the number of occasions on which aircraft may take off or land at the airport and/or by imposing such other limit or limits applying to the taking off or landing of aircraft at the airport during any such specified period.\textsuperscript{186} It is the duty of the airport operator to secure that any limit imposed is complied with.\textsuperscript{187} The US Airport Noise and Capacity Act 1990\textsuperscript{188} seeks to establish a uniform procedure for use by all airport operators in the implementation of future restrictions on aircraft operations and in the establishment of noise limits.\textsuperscript{189} In France

\textsuperscript{179} Breyer, 269; Ogus, 209.
\textsuperscript{180} Ogus, 210.
\textsuperscript{181} Airports Act 1986, s 39(1); Environmental Protection Act 1990, ss 6-7; Ogus, 210.
\textsuperscript{182} S 40(1)(a).
\textsuperscript{183} Airports Act 1986, s 41 & 40(2).
\textsuperscript{184} S 78(3)(a)-(b). An annual limit of 275,000 movements at Heathrow airport had once been recommended for noise regulation purposes but was not adopted. See Shawcross, III(15.3), (15.4) n.7 & (38).
\textsuperscript{185} S 78(6). At Orly, jet aircraft may neither take off nor land between 11 o'clock at night and 6 in the morning. Juglart, l(2109). This practice or regulation is in the course of generalisation in Europe.
\textsuperscript{186} S 32(1)(a)-(b).
\textsuperscript{187} Airports Act 1986, s 32(3).
\textsuperscript{188} 49 USC Appd ss 2151-58 (1988).
\textsuperscript{189} Jenkins, n.159 above, 1037.
the government seeks to limit the level of nuisance to the maximum extent through the application of art D.133-7 of the Code.\textsuperscript{190}

Although performance standards prohibiting or limiting aircraft movements at an aerodrome have widely been adopted in controlling airport noise and pollution, they are also afflicted with constraints. First, performance standards are more costly to formulate than target standards and subject to errors, since regulators must relate different levels of pollution to the regulatory objectives.\textsuperscript{191} Secondly, as seen in English performance standards, since the maximum or an overall limit on the number of taking off and landing at an aerodrome will be formulated always in relation to \textit{any specified period}, the airport operator would have no incentive to reduce aircraft movements during the periods other than specified. Thirdly, there is a problem of difficult choice between differentiated and uniform standards. From the public interest rationale, differentiated performance standards have been advocated because there exist significant variations in the damage and abatement costs, depending on geographical and other conditions in the given area, on the number of polluting firms, and on the size of the firm.\textsuperscript{192} Uniform standards, on the other hand, are less costly to formulate and administer and encourage firms to develop cheaper means of abatement.\textsuperscript{193} As in the case of target standards, however, uniform performance standards may put smaller airports at a relative disadvantage.

2.5.4 Revocation and suspension of noise certificates: An aircraft is prohibited from landing or take-off in the United Kingdom unless there is in force in respect of that aircraft such certificate of compliance with noise standards\textsuperscript{195} and aircraft engine emissions certificate\textsuperscript{196} as issued or validated by the CAA or the competent authority of the country of registry of the aircraft. The CAA may, after sufficient ground being shown to its satisfaction after due inquiry, revoke, suspend, or vary any noise certificate, approval, exemption or other document.\textsuperscript{197} The threat of suspension and revocation of a certificate may, as explained in the air carrier's and manufacturer's

\textsuperscript{190} Jugfart, I(2058).
\textsuperscript{191} See ch 1: 7.3.2 above.
\textsuperscript{192} See Ogus, 210.
\textsuperscript{193} See Ogus, 211.
\textsuperscript{194} See the \textit{Convention on International Civil Aviation (Chicago) 1944}, arts 6 & 9(a) and Annex 16 (Environmental Protection, 2 vols: Aircraft Noise and Aircraft Engine Emissions). Aircraft noise and sonic boom are now considered in the context of affecting public safety. Shawcross, III(31)-(32).
\textsuperscript{195} \textit{Civil Aviation Act} 1982, s 60(3)(r) & (s); \textit{Air Navigation (Noise Certification) Order 1990}, SI 1990/1514, art 6; Shawcross, III(37).
\textsuperscript{196} \textit{Air Navigation (Aircraft and Aircraft Engine Emissions) Order 1986}, SI 1986/599, arts 3-5; Shawcross, V 16.1).
\textsuperscript{197} \textit{Air Navigation (Noise Certification) Order 1990}, art 9(1); Shawcross, V(15).
context,\textsuperscript{198} induce the airport operator to take optimal care to reduce aircraft noise and pollution. In America, an original type certificate may be issued for an aircraft for which substantial noise abatement can be achieved after the FAA Administrator prescribes standards and regulations that apply to that aircraft.\textsuperscript{199} Similarly, the FAA Administrator may issue an order amending, modifying, suspending, or revoking any part of a certificate if the holder of the certificate has violated an aircraft noise or sonic boom standard or regulation.\textsuperscript{200}

Again in France, no aircraft belonging to one of such categories as defined by the Minister charged with civil aviation may be used for air navigation unless it is provided with a noise certificate (certificat acoustique) or an individual certificate of limitation of nuisance (certificat individuel de limitation de nuisances) rendered valid to prove that it is in conformity with a type already certified.\textsuperscript{201} Certificate may be suspended when the aircraft is used under conditions not in conformity with such conditions as have been defined by the certificate, when one of the parts or components of an aircraft affecting the safety and security of the aircraft have suffered a big damage, or when an aircraft has not been maintained in conformity with the regulatory provisions setting out the technical conditions to be used, or when an aircraft has been subjected to a modification not approved.\textsuperscript{202}

2.5.5 Ban on airport operation: In English law the Secretary may, as already explained, prohibit an aircraft of specified description from taking off or landing, or limit the \textit{maximum number of occasions} for such an aircraft to take off or land, at an aerodrome during certain periods.\textsuperscript{203} If an operator of an aircraft has not complied with any requirement specified in relation to the aerodrome, the Secretary may also give an aerodrome operator a direction requiring him to secure that facilities for using the aerodrome are withheld to the extent specified in the direction from the aircraft.\textsuperscript{204} Thus, although English law authorises the Secretary to prohibit or limit the taking off or landing of aircraft of specified description at a specified aerodrome, it does not envisage the possibility of banning airport operation merely for its operator's failure to comply with such prohibitions or restrictions applicable to certain aircraft. This is the

\textsuperscript{198} Ch 2; 2.5.4 & ch 3; 2.4.4 above.

\textsuperscript{199} 49 USC s 44715(a)(3) & s 44704 (1996).

\textsuperscript{200} \textit{Ibid}, ss 44715(a)(2) & 44709.

\textsuperscript{201} Code, art R.133-2; Juglart, I(488), (2058) & (2106); ch 1: 8.1.5 above.

\textsuperscript{202} Juglart, I(504).


\textsuperscript{204} \textit{Ibid}, s 78(1)-(2).
result somewhat similar to one in which an absolute entitlement is rarely allowed under the injunctive remedy.

In a similar vein, the Second Circuit in *British Airways Board & Compagnie Nationale Air France v. The Port Authority of New York & New Jersey* held that an indefinite ban on Concorde flights imposed by the Authority in conformity with its own noise standards constituted an unreasonable, arbitrary and discriminatory impingement on commerce. In French law again, neither an administrative nor a civil court judge can enter a judgment banning the taking off and landing of aircraft causing noise or prescribe even the least modification of equipment of an airport which would undermine the functioning of a public service. Even if aerodromes are classed as annoying, harmful and dangerous, courts cannot prohibit an activity authorised by administrative regulation, insofar as no fault could be attributed. Thus, as long as reasonable and ordinary noise is caused, neither an injunctive remedy under liability rules nor total ban under regulation is allowed under the three legal systems, which is the efficient outcome.

2.5.6 Relationship between regulation and civil liability and their respective distributional consequences: Aircraft and airport operators are given an immunity from liability for a normal level of noise and inconvenience by statute or by judicial decisions including d'Orly and Nice cases. Although the US FAA is responsible for prescribing and amending minimum noise-vibration standards and regulations and thus preempts on this matter state or local government actions (federal pre-emption), the federal government assumes no liability for unacceptable airport noise. Again, judicial proceedings are not only costly but generally ineffective for small, diffuse environmental claims where the aggregate social harm may be great but the

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207. Juglart, I(2096).

208. Juglart, *ibid*.

209. *Civil Aviation Act 1982*, s 76(1) & 77(2); Shawcross, III(36) & V(137). The immunity, however, is conditioned upon compliance with the Air Navigation Order and regulations made thereunder.


212. Griggs, n.57 above, at 89-90 (1962) (federal government did not choose the airport site); Rockett, n.17 above, at 500-01; sec 2.0.1 above.
establishment of causal link in individual cases is difficult.\textsuperscript{213} Here, the public interest in environmental regulation may be great enough to override its possible inefficiency in inducing airport operators to cause optimal pollution.

From the distributional viewpoint, although both the court system and the regulatory agency are operated on taxpayers' money, regulations may distributionally be a more desirable approach to dealing with the noise and pollution problem. Under a regulatory regime, all citizens are placed on the same and equal footing, and victims of pollution do not have to institute a legal action which only the rich can afford.\textsuperscript{214} If consequently the victims give up their actions or fail in their claims, this would virtually make airport operators and airline passengers richer than they deserve to. Again, liability rules may produce an inequitable result, given the fact that victims will generally bring an action against only one of the parties, rather than all of them, that are responsible for causing noise and pollution, i.e. either against the airlines or an airport operator.\textsuperscript{215}

3. Causation

3.1 Causation and the Victims' Incentive to Fraud

3.1.1 Difficulty with establishing causal link under trespass: As we have seen above, English, American and French laws all allow the victim to bring an action against the aircraft operator under the trespass theory.\textsuperscript{216} In order to succeed in such an action, the victim must not only prove the fact of noise-vibration but establish causal link between the boom and the damage, although a presumption of direct damage from the boom has been admitted in some case law.\textsuperscript{217} It would, however, be difficult or costly under the trespass approach for every subjacent landowner affected to establish causal link between noise-vibration and the resulting injury or harm, since it will not be easy to monitor, trace and identify a particular trespassing aeroplane whenever it occurs. Thus, in cases involving bodily injury (\textit{dommage corporel}) allegedly sustained by the plaintiffs during a sonic explosion, the French Cour de cassation and the Court of Orléans refused to recognise the existence of causal link.\textsuperscript{218} Similarly, in \textit{Greenfield v. Law}\textsuperscript{219} which arose from injuries the lady plaintiff suffered when she fell from a horse

\textsuperscript{213} Juglart, I(2102); sec 2.3.4 above & sec 3.1 below.
\textsuperscript{214} Juglart, ibid.
\textsuperscript{215} Juglart, I(2103).
\textsuperscript{216} Sec 1.2.4 above.
\textsuperscript{217} 27 RFDA (1973) 314; Juglart, I(2066) n.210 & references.
\textsuperscript{218} \textit{Trésor Public c. Véceréau} (CA Orléans, ch civ, 18 Dec. 1967). 22 RFDA (1968) 207; Juglart, I(2067) n.211.
\textsuperscript{219} [1955] 2 Lloyd's Rep 696; Shawcross, V(140).
allegedly bolting because of fright at the sound of a low-flying aircraft, the plaintiff could not establish causal link and failed in the initial claim in negligence.

Even if a particular 'foreign' aircraft has been identified and found guilty of noise-vibration in a court of a state where the damage was claimed, there would arise the difficulty of enforcing a judgment against the airline who might have little assets within the forum state. Given the possibility that individual aircraft operators may easily escape liability taking advantage of the victim's difficulty with identifying the aircraft or airline responsible for noise-vibration and establishing causal link, liability on the aircraft operator for trespass may not adequately induce him to take noise- and pollution-reducing steps. It would thus be more efficient to attribute aircraft noise-vibration damage costs to the airport operator, while leaving the issue of setting minimum permissible noise-vibration levels to administrative regulation as discussed below (sec 4.3).

3.1.2 Victims' incentives to fraud: The imposition of liability on the aircraft operator for sonic boom under the trespass approach may also create incentives for the victims to fake claims or for an offender of other wrongdoing at the time of sonic boom (e.g. window breaker) to ascribe his act to sonic boom.220 Whenever a sonic boom was claimed in an area, those who had suffered damage from other causes (e.g. previously broken windows or personal injury) would be induced to impute their damage to the sonic boom.221 These incentives would be eliminated by requiring the airlines to pay an airport tax set to equal actual damages, rather than by entitling the victims to sue the airline. Although this may dilute victims' incentives to report a sonic boom damage and accordingly results in the lack of necessary data for taxation, the average noise-vibration damage can be computed by sampling the damage recorded over a certain period of time.222

3.1.3 Problems of joint and multiple polluters: In the case of air pollution, it would be more difficult than in noise-vibration to establish a positive correlation between air pollution from a particular aircraft and its respective contribution to the resulting harm. Establishment of causal connection will further be complicated because there usually are multiple and collateral causes of pollution in addition to aircraft emissions (e.g. factory smoke, automobile emissions etc.).223 And even scientific knowledge still finds it difficult to assess exactly the effects of air pollution in general and various noxious

220. Posner, 278.
221. France operates a detailed procedure for the reparation of sonic explosion. Juglart, I(2122).
222. Posner, 278.
223. Ibid. 46 n.6.
aircraft emissions in particular on human health and the environment.224 The usual time lag between aircraft engine emissions and resulting harm also aggravates the difficulty with, and increases costs of identifying, particular sources of pollution and their respective contribution to the consequence. This means that the courts will need additional expenditure for relevant information and experts' opinions225 in determining the merits of a case on an individual basis.

3.1.4 Trends in causal requirement in environmental law: Although the notion of pollution has yet to be more clearly identified and defined,226 it is used to refer to changes in the physical environment which have significantly adverse and deleterious effects on human health, on the productivity of natural or managed ecosystems or on materials amenable to human beings.227 More generally, pollution may be defined as damage having 'any impact on the living or non-living components' including harm to atmospheric, marine or terrestrial life, beyond the negligible level.228 The definition is thus increasingly heading towards a broader one in terms of environmental conservation or amelioration,229 independently of actual or intended human usage of the environment, to focus on the 'precautionary approach' to any potential harm and the interdependence of human activity in nature.230

4. Public Ownership, Monopoly, and Taxation of Noise and Pollution Costs

We have so far demonstrated that liability rules have their own limitations as a legal device to control airport noise and pollution and consequently that the prices of airport services may not fully reflect their true social costs. In so doing, we assumed that airport operators are private firms operating in the competitive market. But airports are often publicly owned and/or operated and subsidised by general tax revenues with their services being provided on a statutory monopoly basis. We therefore reconsider the problem of airport noise and pollution within the context of a public firm operating

224. See e.g. K Cameron & R Maynard, A New Look at the Health Effects of Air Pollution, 24 Health Trends (1992) 82; Posner, 44.
225. Sec 2.4.4 above on the Roissy case.
in a monopolistic environment. It can safely be assumed that important economic goals for any organisation, public or private, include *productive* and *allocative efficiency*, although the latter may not be regarded as an exclusive or overriding goal for a public corporation. We first examine economic regulation (notably price controls) of public ownership and natural monopolies and its constraints on achieving efficiency to argue for taxation of airlines passengers for noise and pollution damage from both efficiency and distributional grounds. We then discuss the relative efficiency of standards regimes and various economic instruments to give support to our previous analysis and arguments. It should be noted that although legal rules and principles governing noise and pollution damage are more or less similar, they nevertheless constitute separate risks and should thus be discussed separately.

4.1 Public Ownership, Economic Regulation of Monopoly, and Its Constraints

4.1.1 The notion of public ownership: The distinction between public and private enterprise cannot always be clearly, nor easily, drawn. A public enterprise may nevertheless be defined as a person or body, whether corporate or not, which performs public statutory duties and carries on a service or undertaking for the benefit of the public and not necessarily for profits. A public enterprise is thus an entity discharging its functions ostensibly in the public interest and is subject to financial control of government or a local council, whether it is owned by the state or by a local authority (made up of a council or councils). It can be placed under direct ministerial control or constituted by legislation as a statutory public corporation, both of which are now rarely used, or can be registered as a company. In contrast to

231. Ch 1: 2.2.1 & 7.2.1.
232. Ogus, 22, 272 & 281. For the notion of allocative efficiency, see ch 1: 2.2.1 above.
233. See ch 1: 7.2.4 above.
234. Thus, secs 4.2 and 4.3 below may be applicable to both noise and pollution damage, whereas sec 4.4 below applies solely to pollution damage.
237. BAA plc. a successor company to the former British Airports Authority, is under firm governmental financial control. See Airports Act 1986, ss 4-7; Shawcross, III(3.3).
239. See the Civil Aviation Act 1982, s 25.
240. See ibid. ss 30 & 26; Airports Act 1986, ss 12(1) & 16.
242. See the Airports Act 1986, s 13(2); Shawcross. III(7) & (9). BAA plc is a company limited by shares, wholly owned by the Crown and registered under the Companies Act 1985. See Airports Act...
private ownership, a public enterprise is characterised by the facts that: a) its owners do not typically seek to maximise profits; b) there are no marketable ordinary shares in the enterprise, hence no market for corporate control; and c) there is no direct equivalent to the bankruptcy constraint on its financial performance. The distinction between a public and private firm should thus be made by reference to who controls its managerial performance or by whether its operation is financed or subsidised from general tax revenues and the market is thus bypassed in the pricing of services.

4.1.2 Public ownership, monopoly and economic regulation: Although it is far from clear whether public ownership represents regulation or not, it nevertheless cannot be denied that changes in property rights will affect allocative efficiency, incentive structures and behaviour of the management. This is because ownership or allocation of property rights determines the objectives of an enterprise and the system of monitoring its managerial performance. It is true that market competition and effective regulation have more important effects on the firm's performance than ownership per se. And public ownership is not, at least in theory, incompatible with competition, nor does private ownership necessarily guarantee competition. A private firm may be granted monopoly and the undesirable consequences may be checked by regulation. Nevertheless, given the regulatory and legal difficulties as well as technical conditions involved in airport operation, a private monopoly is not considered a good alternative. The undesirable consequences of monopoly, natural or otherwise, under public ownership would rather be tackled more effectively through economic regulation than by legal controls of private monopoly firms, given the limited information and competence of judges to assess efficiency.

In the absence of as fierce and effective competition between existing airports as in the airline or insurance industry, regulatory intervention may create an incentive system to influence, guide or constrain the airport operator's (or his managers')

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1986, s 2(2); Shawcross, III(3.2). For examples of public enterprises in the United Kingdom including the CAA, see Vickers & Yarrow, 141.
244. 49 USC Appd s 2202(a)(16)-(17) (1988).
245. Ogus, 265.
248. Vickers & Yarrow, 45.
249. Ogus, 265-66; M Friedman, Capitalism and Freedom, 29.
251. White Paper on Airports Policy (Dept of Transport 1985); Vickers and Yarrow, 355 & 363. This is not to say there is no competition between existing airports, but simply to point out the existence of such barriers for a private corporation to build a new airport as technical and investment requirements and the opposition from the residents and environmental groups.
decisions.\footnote{This is not to say that economic regulation is without constraints. See sec 4.1.4 & 4.1.5 below. One of such constraints concerns the principal-agent problem within a public firm which may constrain efficient management. J Kay \\& J Vickers, Regulatory Reform: An Appraisal, in G Majone (ed). Deregulation or Re-regulation, 223, 231; ch 1: 7.4.2 above.} Even for privately-owned enterprises like BAA,\footnote{Vickers \\& Yarrow, 141.} the British government is entrusted with the task of monitoring its managerial performance and conducting economic regulation.\footnote{Ogus. 32. 267, 272-74 \\& 112.} Economic regulation is usually conducted in the form of conditions attached to granting permission which airport operators must obtain from the CAA to levy airport charges.\footnote{\textit{Airports Act 1986}, ss 37-39; Vickers \\& Yarrow, 361.} For example, the UK's \textit{Airports Act 1986} stipulates that in performing its functions as economic regulator, the CAA must act in the manner which it considers best calculated to further the reasonable interests of users of airports; to promote the efficient, economic and profitable operation of such airports; to encourage investment in new facilities at airports in time; and to impose the minimum restrictions.\footnote{\textit{Ibid.} s 39(2)(a)-(d); Vickers \\& Yarrow. 361.} 

4.1.3 Economic regulation of monopolistic pricing at domestic and international level: From the public interest objective of price controls on a monopolist firm, regulators must set the prices aimed at inducing allocative and productive efficiency of such a firm.\footnote{Ogus. 267-68. 281-82 \\& 284; ch 1: 7.1 \\& 7.2.4 above.} In this connection, the \textit{Airports Act 1986} identifies three different courses of conduct to be taken by an airport operator which may be subject to discretionary control exercised by the CAA in this connection: unreasonable discrimination against or unfair exploitation of airport users in pricing, unreasonable restriction on the rights of a person to carry on activities and offer services or facilities at the airport, or fixing of airport charges at such 'artificially low' levels that they are insufficient to cover the costs of providing the services or facilities and may materially harm any of the operator's competitors.\footnote{\textit{Airports Act 1986}, s 41(3)(a)-(c).} 'Artificially low' means economically and financially unsound levels of charges significantly lower than they would otherwise have been by reason of any subsidy or any conduct which will not bring about a reasonable return on the capital in carrying out operational activities.\footnote{\textit{Ibid.} s 41(4)(a)-(b).}

At the international level, pricing of user charges at most airports serving international flights is subject to control under bilateral agreements. The \textit{UK-US Air Services Agreement} of 1977 (Bermuda II),\footnote{Agreement between the United Kingdom and the United States Concerning Air Services, 23 July 1977. 28 USTS 5367. as amended. For the text, see Shawcross, vol 2, Appd.} for example, contains a provision...
requiring each government to use its best efforts to ensure that traffic charges imposed on the designated airlines of the other contracting party are "just and reasonable". User charges are considered just and reasonable if they do not discriminate on the basis of nationality and if they reflect, and do not exceed, the full cost to the competent charging authorities of providing appropriate airport and air navigation facilities and services and demonstrate a "reasonable rate of return on assets".

4.1.4 Constraints of price controls in achieving allocative and productive efficiency:

The stipulation of a 'just and reasonable return on assets' appearing in the aforementioned Bermuda II Agreement or the Airports Act 1986 is a form of price (rate level) controls in monopolistic markets and is referred to as the 'fair rate of return' approach. The approach is to allow a regulated airport operator to obtain, as total revenue, an appropriate sum which will cover both his annual expenditure (including operating costs, depreciation and taxes) and a reasonable profit on his capital investment. The obvious difficulty, however, is on what criterion one can measure the expenditure, the rate base (the attributed value of assets or capital investment) and the fair rate of return. Even if the operator were allowed to raise total profits through the expansion of the assets (rate base) on which a proportionate rate is granted, he would have an incentive to over-invest or under-invest in capital.

Specifying a target rate of return on assets would result in similar inefficiencies. If on the other hand the airport operator were allowed to shift current costs to its consumers (airlines and passengers), he will have no incentive to constrain expenditure. Nor will administrative costs be trivial for the regulatory agency to monitor and scrutinise the operator's behaviour and history closely. As to the retail

262. Ibid, art 10(2) & (3).
263. A Kleverick, The "Optimal" Fair Rate of Return, 2 Bell J Econ (1971) 122; Breyer, 41; Kahn, I, 40-41; Posner, 255; Ogus, 306. The approach has been developed by US Regulatory Commissions and courts in the context of setting utilities rates in an attempt to devise a regulatory equivalent to the price mechanism in unregulated competitive markets. See Ogus, 307 & n.71 for references.
264. See Ogus, 308.
265. E.g. by the depreciated original cost of the firm's capital assets or by their replacement cost. Kahn, I, 70-73 & 111; Posner, 255; Ogus, 306 & 308.
268. D Starkie & D Thompson, 266 above.
269. See Ogus, 309.
270. Ogus, ibid.
price index minus a variable factor (RPI-X) method, also known as the price cap method, it is doubted if the method can really achieve allocative or productive efficiency, given regulatory lag, regulators' information deficits and inflation, etc. In addition to the problem of rate level controls aimed at ensuring appropriate total earnings of the regulated airport operator in light of its costs, there is also rate structure problem affecting allocative efficiency and involving distributional implications. The regulatory agency may have to determine how the total revenue of the operator will be structured as between different services and as between different groups of airlines he serves.

4.1.5 Justification for taxation to raise the necessary revenue: As shown above, problems inherent in public ownership and natural monopolies are hard to overcome through economic regulation relying on price controls. Both the fair rate of return approach or the price cap method may not be conducive to allocative and productive efficiency. The goal of productive efficiency is further defeated by the operator's explicit statutory and international obligations, as already explained, and the government's regulatory policies. Again, because of declining long-run marginal costs up to a certain point under natural monopolies, the airport operator cannot charge a price on the basis of the marginal cost principle. Possible alternatives to the marginal cost principle such as price discrimination and a dual tariff system have their own limitations and will not resolve entirely the problems associated with monopolistic pricing of airport services. Nor is the regulatory control by cross subsidisation conducive to allocative efficiency and the distributional goal. To meet the losses from marginal cost pricing and to raise the necessary revenue, therefore, the airport operator would rather have recourse to a subsidy funded through a lump sum tax not on general taxpayers but on airline passengers.

271. S Littlechild, Regulation of British Telecommunications' Profitability (1983); D Starkie & D Thompson, n.266 above; Ogus, 310; Vickers & Yarrow, 86-87 & 361-62.
274. E.g. differential landing fees such as peak and off-peak load pricing according to the congestion level which is more complicated in practice than in theory. Breyer, 57.
275. See Ogus, 307 & 248 n.18; Kahn, I, 100-02. There is also the quality issue which may cause inefficiencies arising from monopolies. See Ogus, 285, 307 & 315-16.
276. Ogus, 309 & 313.
277. Ogus, 274.
278. Vickers & Yarrow, 361.
279. See Ogus, 281.
280. Ogus, 282.
281. Ogus, 283.
283. See Ogus. 283. See sec 4.2.1 below for the justification of this argument from the distributional goal.
The problem is that a public firm, unlike a private firm, has no private shareholders holding financial interest in its profitability other than general taxpayers who as individuals will have little incentives to spend their own resources to co-ordinate and initiate costly actions, legal or political. The lack of an appropriate mechanism to control a public firm's performance may dilute incentives of its managers to reduce production costs. Nevertheless, growing pressure is now brought to bear on governments, as more civic consumer and environmental groups are now acting vigorously to provide the general public with information and to organise various actions on the basis of their monitoring of government's performance. Again, although consumers and taxpayers may lack standing to apply for judicial review, it does not necessarily follow that they are automatically excluded. Moreover, the court now takes a more liberal approach to exercise its discretion in determining "a sufficient interest in the matter to which the application [for judicial review] relates". Again, although judges have limited competence to appraise productive efficiency, government intervention through price controls is also afflicted with information problems and conflicting goals. This is why tax subsidies were often used to make up for the loss resulting from sub-optimal prices.

4.1.6 Legal status of airport authorities and public funding of services under domestic laws: Most of European airports are publicly owned, and their legal status can be grouped into three categories: state corporations, those under local or regional government's ownership and those under mixed private-public ownership. As of 1990, there are 142 aerodromes for public use in the United Kingdom, where aerodromes may be established, owned and managed by the Secretary of State, the CAA, a local authority or a private person or firm. Aerodromes may be financed by loans or grants from the Secretary of State and local authorities, investments by local authorities and charges levied by the airport operator on users of the

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284 See Ogus, 189 & 273.
285 Ogus, 283.
286 E.g. the UK National Consumer Council and Consumer Association and the US Consumer's Union.
287 Ogus, 275-76.
288 Supreme Court Act 1981, s 31(3); Ogus, 276.
289 See Bronley v. GLC, [1983] 1 AC 768; Ogus, 274-75 & 280.
290 Ogus, 280.
291 Ogus, 284.
294 Civil Aviation Act 1982, ss 25, 30 & 45; Shawcross, III(2)-(3).
296 Airports Act 1986, s 20(1) & (3).
The former British Airports Authority (BAA) and now BAA plc, is a body corporate independent of the Crown and has a statutory duty to operate Heathrow, Gatwick and other major international airports in the United Kingdom.

France has 418 public aerodromes as of 1990 and 73 commercial airport authorities (aéroports) which receive at least 5,000 passengers annually, in addition to the 'Aéroport de Paris' and the 'Aéroport binational de Bâle-Mulhouse', both of them public bodies. Of the 73, 52 authorities are owned by the state, 17 by government departments (département) and local authorities (villes) and 4 by mixed associations (syndicats mixtes). Actions against them for delictual liability are entertained by administrative tribunals only. As the airport is considered a public building (ouvrage public), stricter liability is imposed on the operator than on the ATC agency. Basically, the operator is liable towards third-party users of airport terminals unless he proves force majeure, sufficient maintenance or negligence of the victim.

In America there are 5,584 aerodromes open to public use, among them JFK airport operated by the Port Authority of New York and New Jersey and Washington National airport in Washington DC operated by the FAA. As part of airport improvement programme, federal funds may be apportioned for the acquisition, establishment, construction, alteration, repair, maintenance or operation of certain airports or of air navigation facility thereon, upon written recommendation and certification of the Secretary that such landing area or facility is reasonably necessary for air commerce. Again, as part of airway facility and equipment improvement programme including research, engineering and development and airport capacity enhancement, a certain predetermined amount of money may be appropriated and transferred from the Trust Fund to each project and activity.

4.2 Distributional Considerations

297. Ibid, s 37 & Shawcross, III(14.3).
298. Shawcross, III(3.3)-(3.4) & III(3.11)-(3.14); Airports Authority Act 1975, s 1(1)(7).
299. ICAO, n.293 above.
300. Juglart, I(751)-(757).
301. Juglart, I(341).
302. See G Guillaume, La responsabilité des services de la circulation aérienne en France, 3 AASL (1978) 133.
303. ICAO, n.293 above; Juglart, I(807).
304. 49 USC Appd s 2401ff (1988).
305. Ibid, s 2204.
306. Ibid, ss 1349(a) & 2206.
307. Ibid, s 2205(a), (b)(1)-(4).
Public ownership may be considered the most suitable form of legal control to achieve distributional goals in the provision of public services, and one of such distributional goals of a public enterprise is construed as providing its products or services at a price lower than their production costs to consumers. And to recover any losses from the lower-than-cost (monopolistic) pricing in the provision of airport services, we argued for a subsidy through a lump sum tax despite its constraints on allocative efficiency. Assuming that the public airport operator should be held responsible for noise and pollution damage to help remove externalities, this will have the effect of making taxpayers bear the noise and pollution damage costs. This is neither an efficient nor a distributionally desirable solution to the problem for the following reasons.

4.2.1 Rationale for distributional consideration: Efficient control of environmental harm will make international society better off by inducing airport operators to allocate the optimal amount of resources to its avoidance. And efficiency will certainly make airport operators shift noise and pollution costs onto either taxpayers or airlines (in the form of a hike in airport charges). Since airline passengers derive direct benefits from international carriage by air, it will be both efficient and distributionally desirable for airline passengers to pay increased fares to compensate airport residents for the noise and pollution damage. On the other hand, taxpayers, if they were made to bear noise and pollution damage costs, will be unduly discriminated against, since they do not get any direct benefits from airport services and since they already bear the productive inefficiency loss resulting from the monopolistic pricing of airport services. Taxation of airline passengers will thus rectify inequitable wealth distribution in favour of the less advantaged taxpayers and will enable international community to achieve the spreading of environmental costs among airline passengers.

4.2.2 Basic distributive goals posited: As we have tried to demonstrate so far, the resolution of a pollution dispute depends not only on efficiency (and social wealth maximisation) consideration, but on parties' relative wealth (wealth effects). For example, if the polluter is given an entitlement to pollute, he would get richer than he deserves to. Thus, the placement of initial entitlement to clean air or pollution is closely bound up with society's distributive goals and will have effect on wealth distribution in society. And since each society may well have a different system of entitlements and

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308. Ogus. 284.
309. See Ogus. 284; sec 4 1.5 above.
310. It is thus not necessarily correct that a Nigerian delegate to the 1966 special Montreal meeting, expressing his objection to the US government's move to upgrade the carrier's liability limits for passenger damage, remarked, "Why ever should the peasant be made to pay for the comfort of the king?" See Symposium on the Warsaw Convention, 33 JALC (1967) 576.
311. Milgrom & Roberts. 35.
distributional preferences, we may not be sure what sort of wealth distribution system will be in the best interest of international society. Nor is the issue of distributional goals easily lending itself to analysis. Nevertheless, if most societies were assumed to share a broadly defined order of preferences, an agreement may be possible on certain basic principles of distribution as between a majority, if not all, members of international community. Although unanimity between all members is highly desirable, each constituent society acting on rational self-interest will prefer a simple majority to unanimity, given transaction costs incurred to arrive at multilateral unanimity. And agreement on what is essential is considered a necessary precondition to its minimum validity in the realm of values such as distributional justice.

4.2.3 Basic distributive principles agreed: From the considerations above, the following propositions may be put forward for agreement. First, in order to avoid externalities to the maximum extent possible, risk creators need to be made to bear the environmental costs they engender in the course of their activities (cost internalisation). Thus, from the viewpoint of equitable risk allocation, the entitlement to make noise and pollute will not make sense, for this would make the polluter better off than he deserves to be and at the expense of airport residents. Indeed, the residents around airports would probably not agree to accept such pollution without due compensation, nor would they have correct information about the harm. In many cases, these sections of life simply happened to live in the vicinity of an airport without being fully informed of the level of noise and pollution, or a new airport happened to be built around their residence to subject them to the environmental harm.

Secondly, in order to achieve a maximum of distributive goals in resolving the disputes, we will posit as the socially desirable goal that each victim deserves to get prompt, equitable and adequate compensation. Such a compensation scheme will not necessarily dilute the injurer' incentives to take care or to engage in a socially useful activity, nor should it incur high administrative costs. Thirdly, it would be desirable for international society to set a uniformly acceptable noise and pollution level in order to control the risk and achieve an equitable, although not a perfectly egalitarian, society. Collective, uniform and thus predictable implementation of

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312 Ogus, 204 & 208.
314 Abraham, Distributing Risk. 10.
315 Calabresi & Melamed, at 1098-99.
316 E.g. Delta Air Corporation v. Kersey, Kersey v. City of Atlanta, n.117 above.
318 See Polinsky. Resolving Nuisance Disputes. at 1084-85.
pollution control will ensure efficient resource allocation, facilitate mutually beneficial transactions between the parties and also promote equitable wealth distribution among members of international society.

4.2.4 Efficiency and equity via social insurance for environmental damage: Since wealth distribution by liability rules is likely to be less precise and more costly than taxation, it is unlikely to remove externalities entirely. Thus if, as assumed, the desirable goal in these categories of risk were closely bound up with wealth distribution in society, it would better be achieved through direct taxation and social security benefits rather than through indirect and sporadic application of liability rules. For as long as such wealth distribution does not involve substantial administrative costs, the desirable objective of distributional justice will override the efficiency criterion in the case of the risks arising from stranger relationships. By adopting a social insurance scheme, these risks will be shared, distributed and ultimately spread into the entire spectrum of international society.

4.3 Economic Instruments For Noise and Pollution Control

We saw that target and performance standards have their own constraints, especially in relation to their ability to relate aircraft movements to the economic goal of optimal noise and pollution by airport operators. As an alternative to standards regimes, therefore, we now examine economic instruments.

4.3.1 Economic instruments for noise and pollution control: General dissatisfaction with the traditional regulatory approach based on standards regimes has led to an introduction of other regulatory tools relying on financial incentives (economic instruments: EIs). Economic instruments have been developed in the context of dealing with externalities arising from environmental pollution and are considered a technique having advantage in pollution control over the traditional CAC approach in several respects. First, whereas the CAC approach involves a complex and detailed set of centrally formulated standards, EIs can function within broad target goals and can reduce information and administrative costs for the regulatory agency. Provided that the regulatory agency can reasonably make an estimate of noise and pollution

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319. Friedman, Capitalism and Freedom. 190-92; Harris, Remedies. 341.
320. Ogus & Veljanovski. 23.
321. Ch 1: 2.2.2 above.
322. Sec 2.5.3 above.
323. Ogus. 245 & n.2.
324. Ogus. 245 & n.3.
325. Ogus. 246.
damage costs, it need not have information on noise and pollution abatement costs.\(^{326}\) Secondly, since EIs confer greater freedom on firms, they create incentives for firms to develop technological innovation. Thirdly, whereas there is uncertainty over the agency's enforcement discretion (sanctions) in case of violation of a CAC standard, EIs require firms to pay a specified sum which will provide firms with better prior information on the costs to be incurred from pollution.\(^{327}\) Fourthly, use of criminal law and its institutions stigmatises pollution (mandatory), while EIs merely entail administrative intervention (voluntary) and can promote persuasive and co-operative, as opposed to confrontational, enforcement.\(^{328}\) As such, the strategy under EIs is directed towards not confrontation but voluntary and 'negotiated compliance' based on persuasion and co-operation, which will ensure maximum effectiveness.\(^{329}\)

4.3.2 Subsidies, marketable emission rights, and charges or taxes: A subsidy scheme can have the same economic effect as charges or taxes, but at the same time will induce additional firms to enter the industry and existing firms to increase pollution to attract more subsidies.\(^{330}\) Another objection to a subsidy scheme from distributional considerations is why taxpayers should ever be made to support polluters.\(^{331}\) Under the tradable emission rights system, the rights will ultimately end up in the hands of those willing to pay the highest price for polluting and those to whom the costs of abating pollution would be the greatest.\(^{332}\) Also under the system, one can predict the amount of pollution to be produced (equalling the sum of rights issued), but cannot know in advance the price of continuing to use the existing process emitting pollutants.\(^{333}\) The converse problem occurs to a tax approach.\(^{334}\) Objections to marketable emission rights are that they have not yet been adopted in any jurisdiction\(^{335}\) and that they will not, unlike taxes or charges, generate any funds to be used to compensate pollution victims.\(^{336}\) Regulators should also ensure that a firm or group of firms will not hold a monopoly of the marketable rights for anticompetitive purposes such as the prevention of new firms from entering into the industry.\(^{337}\)

\(^{326}\) D N Dewees, G F Mathewson & M J Trebilcock, Policy Alternatives in Quality Regulation, in D N Dewees (ed), The Regulation of Safety, 27, 37; Ogus, 251.

\(^{327}\) Ogus, 251.

\(^{328}\) Ogus, 94-97, 255 & 206.

\(^{329}\) Fifth Report of the Royal Commission on Environmental Pollution, Cmnd 6371 (1976), para 227; Ogus, 97 & 206.

\(^{330}\) Dewees et al. n.326 above, 37; Ogus, 249.

\(^{331}\) Ogus, 255.

\(^{332}\) Breyer, 171.

\(^{333}\) S Breyer, Regulation and Deregulation in the US: Airlines, Telecommunications and Antitrust, in G Majone (ed), Deregulation or Re-regulation?, 7, 18; Breyer, 171-72; Dewees et al, n.326 above, 37.

\(^{334}\) Breyer, 273.

\(^{335}\) Ogus, 250.

\(^{336}\) Ogus, 250.

\(^{337}\) Breyer, 274.
The most typical of Els is a charge or tax which will have the polluter bear the external costs incurred by his activity. Taxation may supplement or substitute the traditional standard-setting and creates funds to compensate victims (income transfer). A tax scheme is basically impersonal with a market characteristic, and will induce polluters to shift to a more noise- and pollution-free production process without, at the same time, prohibiting continued use of polluting processes where such a shift incurs high costs. A tax system is ideal for creating incentives leading to long-run technological progress and also provides a fairly simple rule to apply and enforce, and yet can produce flexibility in results. The amount of a tax should, if it is to correct externalities and to ensure allocative efficiency, be set to equal the marginal damage caused. Each aerodrome operator will then have an incentive to develop cheaper means of its abatement and to abate noise and pollution levels up to the point beyond which it would be more expensive for him to spend on noise and pollution abatement than to pay the tax. If the abatement costs were more expensive than the tax reflecting pollution damage costs of particular pollutants, the operator is free to continue to pollute and to pay the tax. Once the tax level is fixed, regulators need not determine the precise pollution control level for each individual source.

A possible objection to the tax approach (and to a marketable rights system) is that it appears to require polluting firms to pay twice: not only for the abatement equipment or technology but also for emissions. But aircraft manufacturers, for example, do the same: they should pay for safety equipment and for the injury and death of passengers caused by a defect in their aircraft. And the airport operator is free, if he finds it more expensive to abate pollution, to continue to pollute and to pay the tax which reflects the damage costs imposed by the airport operator upon third parties. It is true that

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338. Ogus, 246. The difference between a pecuniary penalty (e.g. fine) imposed as a penal sanction and a tax or charge is that the former is a sum required of an unlawful act, whereas the latter is a sum imposed on a lawful act. R v. Bargery, 6 Criminal LR (1908) 41, 54, per Issacs, J; Ogus, 255 n.63; Breyer, 283.
339. Breyer, 164; id. n.333 above, 18.
344. Breyer, 272.
345. Ogus, 246; Dewees et al. n.326 above, 36.
346. I.e. where the marginal cost of pollution abatement equals the marginal reduction in harm.
347. Ogus, 252.
348. Posner, 280; S Breyer, n.333 above, 18; Ogus, 251.
349. S Breyer, n.333 above, 18; Breyer, 165.
350. Ogus, 255-56; Breyer, 281.
there is difficulty with estimating pollution damage costs and putting an appropriate price on emissions under the tax approach.\textsuperscript{352} To avoid this difficulty, regulators will take a trial-and-error approach to learn from experience,\textsuperscript{353} causing instability and unpredictability of the costs imposed on firms.\textsuperscript{354} However, even these qualifications compare favourably with the traditional CAC techniques under which the agency should, to set an optimal standard, have accurate information on both pollution abatement costs and pollution damage costs, which may cause the \textit{capture} of regulators by the industry.\textsuperscript{355} The information on emission levels required for taxation may be prepared and submitted on a voluntary basis by the airport operators themselves without incurring monitoring costs.\textsuperscript{356}

4.3.3 Level of airport charges related to noise: At the outset of this Chapter, it is to be recalled, we have identified aircraft movements as the primary factor affecting airport noise and pollution damage,\textsuperscript{357} and tried to demonstrate that a tax system is superior and thus preferable to standards regimes and other economic instruments both for efficiency and distributional grounds. But even if that is the case, an important question still remains as to how to relate the level of airport charges to the different levels of aircraft movements at an aerodrome and the noise levels. 'Airport charges' mean charges levied by an aerodrome operator on user airlines for the use of, or for services provided at, an aerodrome in connection with landing, parking and taking-off of aircraft.\textsuperscript{358} In order to produce a maximum amount of deterrence, it is therefore necessary to match the level of airport charges payable by aircraft operators not just to the arithmetic number of their aircraft landing and taking off but to aircraft weight and noise factors.\textsuperscript{359} This is because new and quieter aircraft should be given due consideration.

4.3.4 Taxation of noise damage costs under domestic laws:\textsuperscript{360} In English law the operator of an aerodrome licensed for public use and subject to economic regulation is

\textsuperscript{352} Posner, 280.
\textsuperscript{353} T Prosser, Regulation of Privatised Enterprises: Institutions and Procedures, in L Hancher & M Moran (eds). Capitalism, Culture, and Economic Regulation, 135, 144.
\textsuperscript{354} Ogus, 251-52.
\textsuperscript{355} Ogus, 251; Breyer, 273; Dewees et al. n.326 above, 37; ch 1: 7.4.1 above.
\textsuperscript{356} Sec 4.3.4 below.
\textsuperscript{357} Sec 2.1.1 above.
\textsuperscript{358} Compare the \textit{Airport Acts} 1986, s 36(1) with the \textit{Civil Aviation Act} 1982, ss 73(1)(a) & 88(10). See Shawcross, III(14.3), (14.4) n.4, III(19) n.1. There is another type of airport charges, i.e. those collected from passengers on their use of airport services and facilities. \textit{Evansville-Vanderburgh Airport Authority v Delta Airlines, Inc.}, 405 US 407 (1972).
\textsuperscript{359} Doganis, Flying Off Course, 140-41 & Table 6.4; sec 4.4.4 below.
\textsuperscript{360} States are empowered to regulate entry, departure, operation and navigation of aircraft by adopting noise- and pollution-reducing measures aimed at controlling aircraft speed, height or noise index levels. \textit{Convention on International Civil Aviation}, Chicago, 7 Dec. 1944, (ICAO Doc 2187).
entitled to fix and levy, upon permission from the CAA\(^\text{361}\) or the Secretary,\(^\text{362}\) airport charges on user-airlines by reference to noise\(^\text{363}\) and load factors.\(^\text{364}\) The Secretary may require an airport operator to report to him on the noise levels of aircraft on the aerodrome.\(^\text{365}\) These provisions are generally considered efficiency-oriented, since aircraft noise levels are dependent on aircraft type, age and weight. For the grant of such permission, the operator must produce financial (accounts, estimates and returns) and other required information.\(^\text{366}\) The CAA may attach to the grant of permission mandatory\(^\text{367}\) or discretionary\(^\text{368}\) conditions which will further the reasonable interests of airport users, promote the efficient, economic and profitable operation of such airports, and encourage investment in airport facilities and impose as little restriction as possible.\(^\text{369}\)

In America airport taxes and charges are imposed at three different levels (federal and state governments and airport authorities) which are generally linked to federal noise policies, although recent federal legislation greatly restricts such powers of each state.\(^\text{370}\) In the case of charges imposed by airport proprietors, fees that do not accurately reflect costs incurred by the proprietor or those that are not fairly allocated among airport users are considered unreasonable and discriminatory, and they are thus federally preempted.\(^\text{371}\)

In France aerodrome operators are entitled to impose on user-airlines two types of charges in connection with their services: airport and noise abatement charges.\(^\text{372}\)

**Airport charges (redevances aéroportuaires)** may be collected in connection with provision of facilities for landing, assisting in air navigation, parking and sheltering of

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\(^{361}\) Airports Act 1986, ss 38 & 33(1); Shawcross, III(14.5).

\(^{362}\) Ibid, s 33(1); Air Canada v. Secretary of State for Trade, [1981] 3 All ER 336 (charges established by the British Airports Authority are the charges authorised by the Secretary to levy).

\(^{363}\) Civil Aviation Act 1982, ss 38(1), 27(1)(b), 29(1), 29(2), 32 & 33; Shawcross, III(14.3). Differentiated landing charges may be imposed depending on the level of aircraft noise. See the White Paper, The Common Inheritance, Cm 1200 (1989), para 14.31; Ogus, 248 n.18.

\(^{364}\) Airports Act 1986, s 36(1); Shawcross, III(14.3), (14.5) & (16).

\(^{365}\) Ibid, s 78(8)(b) & s 78(9) for sanctions for failure to perform this obligation.

\(^{366}\) Ibid, s 38(1)-(4); Shawcross, III(14.5).

\(^{367}\) Ibid, s 40(3) & (9) (e.g. regulation of the maximum amount of airport charges); Shawcross, III(14.8)-(14.9) & IX(2).

\(^{368}\) Ibid, s 41(2). Shawcross, III(14.11).

\(^{369}\) Ibid, ss 39(1)-(2), 82(1) & 36(1); Shawcross, III(14.6).


\(^{371}\) Indianapolis Airport Authority v. American Airlines, Inc., 733 F 2d 1262 (7th Cir 1984); Pennington, n.105 above, at 835-36.

\(^{372}\) Code, art R. 224-1.
aircraft or provision of installations and equipment related to such operations or dedicated to reception of passengers or goods, or in connection with the setting up and operation of devices intended to ensure safety of passengers. Since 1984 the landing charge (redevance d'atterrissage) has been linked to a coefficient of modulation of noise characteristic of a certain type of aircraft, with the possibility of frequent adjustment of the coefficient within the margin. For these purposes, aircraft are grouped into five categories.

'Noise abatement charges' (redevances pour atténuation des nuisances phoniques) had originally been instituted by two decrees as a parafiscal tax (la taxe parafiscale) with a view to reducing nuisance damage suffered by the residents around Orly and Charles-de-Gaulle airports. The charges, rated according to the number of passengers, were collected from airlines upon departure from the two airports. The revenue was to provide a financial aid covering up to 66 percent (80 percent since 1983) of the costs of soundproofing educational, medico-social and residential buildings situated adjacent to the two airports. The airlines had protested that the airport charges did not correspond to the service rendered to its users and that the financial aid given to adjoining residents did not at all protect airlines against noise damage claims. Responding to these complaints, the Conseil d'Etat ruled that the noise tax did not have, as its object or as its effect, the indemnification of the residents nor would it substitute airlines' liability for noise damage.

The original scheme has been modified by a 1984 decree which envisaged a noise abatement charge supplementary to landing charges to be collected at certain public aerodromes designated by order in Conseil d'Etat. The new noise abatement charge is more incentive-oriented than the previous parafiscal tax, since it is rated as a percentage of the base tariff of the landing charge which itself is linked to the noise
level and weight of a particular aircraft rather than passenger numbers. Another decree has authorised the imposition of a noise abatement charge around Orly and Charles-de-Gaulle aerodromes upon landing of aircraft where applicable. Principal provisions of the decree affecting the residents around the two airports recapture on the whole the measures formerly provided for in their favour by the original scheme, and a 1984 order has determined the zones for which noise abatement expenses may be executed, as well as their limits and conditions. A commission has been set up under a 1985 order to give advice on noise damage reduction around the two aerodromes.

4.3.4 Provision of soundproofing grants under domestic laws: In English law, the Secretary may prepare a scheme requiring the operator to pay the residents a specified sum of grants towards the cost of insulating affected buildings against noise in the specified area(s). In France, noise abatement measures, effected through corrective administrative orders, are divided into two categories: 1) measures concerning noise abatement around aerodromes, e.g. financial aid schemes for soundproofing and aid plans for the residents around other aerodromes and 2) measures dealing with low-flying and sonic explosion. In America, the Secretary of Transportation is mandated to provide, from federal funds, noise abatement grants to airport proprietors who have prepared a noise exposure map and developed noise compatibility programs.

4.4 Economic Valuation and Attribution of Pollution Cost for Taxation

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382. Juglart, I(769) & (2113); Code, art R. 224-2.
388. E.g. décret No.29 du 11 jan. 1984 & arrêté interministériel du 27 jan. 1984 (JO du 12 fév. 1984), 38 RFDA (1984) 137; Juglart, I(2117)-(2118). This scheme on the whole reproduces the principles enunciated in the cases involving the two airports.
390. Ibid. I(2120) ff.
Airports cause not only noise but also air pollution. Although we have argued that it would be efficient and equitable to tax airport operators for pollution, the question remains as to how to set the optimal level of pollution charges.

Example 5.3 Suppose that there is only one international aerodrome operator in a country and that a pollution tax is imposed by reference to the amount of pollution as measured by aircraft movements at the aerodrome related to load and pollution factors. The more pollution he produces, the higher tax there will be imposed. Faced with a tax reflecting a reasonable estimate of pollution damage costs (no externalities), the operator will weigh the tax costs against the abatement costs. If he can reduce pollution at a cost cheaper than the tax, he will abate the emissions below the permissible level (recall that an absolute entitlement or no pollution is not feasible or desirable). If on the other hand he finds it more costly to reduce pollution below the permissible level, he will choose to continue to pollute, pay the tax and reflect the tax cost into the price of his service as the true social cost of his activity. This is the same result as the price mechanism achieves in the market, i.e. obtaining any given output at the lowest cost and allocation of resources to their most valuable use (productive and allocative efficiency). This will also create a dynamic incentive for aircraft manufacturers and airlines to develop the cheapest pollution reduction device to avoid the tax cost and will help to bring about a long-term technological progress.

4.4.1 Single polluter and valuation of estimated costs for setting the level of charges equal to it: If, as believed, society cannot eliminate airport pollution once and for all, it must weigh up the costs and benefits of airport activities to work out an appropriate trade-off between the desirable environmental protection and industrial activities. Supposing in Example 5.3 above that there is only one international aerodrome operator in a society, the pollution tax rate should be set to correspond to the estimated costs of pollution damage inflicted through the activity of its aerodrome operator. Upon the expert's report, the estimated costs can be calculated by reference to the estimated annual average costs of pollution damage a society causes over a certain period of time, say three years. The estimated annual average costs can in turn be measured on the basis of the activity level as represented by the volume of aircraft movements at the airport.

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392 Sec 2.4 above.
393 Ogus, 204; Juglart, I(2032).
394 Posner, 280. If the levy is less than the estimated pollution damage costs, the aerodrome operator will not be adequately induced to reduce pollution. If on the other hand the levy exceeds the estimated costs, he will be induced to overspend on abatement.
395 Juglart, I(2052) & (2054); the Roissy case in sec 2.4.4 above.
4.4.2 Joint-multiple polluters and attribution of estimated pollution damage costs in proportion to their relative pollution production: Obviously, it can safely be assumed that almost every society has more than one international airport operators responsible for causing pollution. In this case of joint and multiple polluters, valuation of aggregate estimated cost should be based on agreement between members of international society for collective determination of the estimated pollution costs. This is just as societal valuation of damages (usually by the court) is justified under liability rules. International society can then apply mutatis mutandis the rule analogous to the liability of joint and multiple injurers for passenger damage caused in collision. This can be done in two steps.

First, international society should commission an inquiry by experts to conduct collective valuation of world total airport pollution harm and to come up with aggregate total expenditure to be borne by it for compensating the victims of airport pollution. The world total airport pollution harm is the sum of the pollution harm each country produces through the activities of its international airport operators. Secondly, international society should allocate total environmental costs to individual societies in proportion to the relative magnitude of environmental harm each country generates through the activities of its international airports. Thus in the 1987 Protocol on Substances That Deplete the Ozone Layer, the notion of "annual production of each controlled substance" is employed in Art 3(a). 'Production' is defined as meaning "the amount of controlled substances produced, minus the amount destroyed by technologies... and minus the amount entirely used as feedstock in the manufacture of other chemicals". When this formula is applied, pollution caused at each airport can be calculated by reference to its annual production of noxious aircraft emissions from fuel burning such as carbon monoxide, hydrocarbon and nitrogen oxide.

Taxing each society according to its relative pollution production is similar to relative probabilistic liability allocation in passenger damage cases. This will produce the same allocative effect as imposing strict liability on the polluters in proportion to

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396. Sec 4.2.2 above.
397. Ch 2: 6.2 above. The difference between multiple injurer and polluter cases, for the purpose of liability allocation, is that in the former case the actuarial risk depends on the frequency of its occurrence, whereas in the latter it has much more to do with its magnitude.
400. Sec 1.1.2 above.
401. Ch 1: 5.2.6 & ch 2: 6.2.3 above.
their relative market share in the world total airport pollution production. From the viewpoint of international society, pollution damage each society's international airport operators cause can be viewed as its output share in the world market of airport pollution production.\textsuperscript{402} The tax amount payable by each society should be reviewed and adjusted periodically (e.g. every 1-3 years) in order to reflect the change in the volume of activities of each society's international airports and inflationary effects.\textsuperscript{403} Eventually, the levies collected will make up a fund to be managed by an international body.

4.4.3 Provision of necessary information for taxation: In order to levy charges on international airport operators in different countries, some objective data relating to aircraft movements at each airport serving international flights will be necessary. International society can obtain this information by requiring each society to file a regular report on the activities of its international airport operators. It is noteworthy in this context that the 1979 Geneva Convention on Long-Range Transboundary Air Pollution\textsuperscript{404} has established an international framework for the exchange of available information between contracting states parties on: data on emissions at periods of agreed air pollutants, major changes in national policies and industrial development and their potential impact, control technologies and the project cost of the emission control, and physico-chemical and biological data relating to the effects of long-range transboundary air pollution and the extent of damage.\textsuperscript{405}

At the domestic level, English law requires the CAA to provide the Secretary of State with information on matters affecting civil aviation including noise, vibration, pollution or other nuisance related to aircraft operation.\textsuperscript{406} In order to fulfil this duty, the CAA may require any aerodrome licence holder to furnish it with descriptions of information relating to the numbers of aircraft and passengers\textsuperscript{407} or enjoin, by notice in writing, any person to produce to it such information as it may need.\textsuperscript{408} The Secretary may require the operator of an aerodrome licensed for public use to make available to him all the particulars relating to the charges the operator may have established in

\textsuperscript{402} See Coase, The Problem of Social Cost, at 41.
\textsuperscript{403} A flat-rate tax applicable to all societies will not make any economic sense, since it will not properly encourage them to minimise environmental damage and internalise the costs.
\textsuperscript{404} N.229 above; P Sands, n.398 above, 248; A Kiss & D Shelton, n.398 above, 342.
\textsuperscript{405} Arts 3 & 8.
\textsuperscript{406} Civil Aviation Act 1982, ss 17(1)(a) & (b), 17(1)(d)(ii) & 6(2)(f); Shawcross, II(55).
\textsuperscript{407} Ibid, s 84(1)(iii) & 84(4).
\textsuperscript{408} Airports Act 1986, s 73(1) & 73(3); Civil Aviation Act 1982, s 35 (airport operator's obligation to make available to its users information relating to its management).
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respect of the services or facilities provided\(^{409}\) and to keep adequate records of aircraft movements "for the purpose of facilitating the assessment and collection of charges" imposed for the use of navigation services.\(^{410}\)

5. Passenger Damage

In addition to environmental damage, the airport operator's activity also creates passenger damage risk. Typical examples include damage sustained by passengers within airport premises for lack of safety or security (e.g. fire\(^{411}\) or terrorist attack at airport terminals) or damage caused by inadequate facilities (e.g. inappropriate ground marking on the runways or taxiways,\(^{412}\) presence of obstacles around approach areas, or improper provision or maintenance of runway surface, instrument landing guidance apparatus, approach lights or marker beacons). Passenger damage from bird strike may also be included in this category of risk.

5.1 Passenger Damage Caused at Airport Premises

Example 5.4 Imagine an international airport where, for lack of sufficient embarkation or disembarkation gates, passenger bridges have not been installed and instead shuttle coaches are operated within the premises between aircraft and the airport terminal. Suppose that a shuttle coach taking on incoming passengers turned upside down on its way to the airport terminal following a sudden landslide on the road within the airport's premises, causing injuries to some passengers (Or suppose passenger damage occurred as a result of a taxiway cave-in while the aircraft was en route to the airport terminal for disembarkation or to the runway for take-off).\(^{413}\) It is assumed that passengers already disembarked from the aircraft. In this case, the efficient solution is to hold the airport operator as the cheapest cost avoider liable for such losses. It is indeed inconceivable that individual airlines can take risk-reducing precautions against such risk at a cost cheaper than the airport operator.


\(^{410}\) Civil Aviation Act 1982, s 73(7) & 73(10), Shawcross, III(16); see also ibid, s 74(1).

\(^{411}\) See TT, 12 April 1996, p. 11 for a fire at Düsseldorf international airport which claimed 16 lives.

\(^{412}\) See the Civil Aviation Act 1982, ss 27(1) & 29(1), 32(1) & 33(1); Air Navigation Order 1989, SI 1989/2004, arts 69(2)-(4) & 80; Rules of the Air Regulations 1991, SI 1991/2437, sch, rr 42-51; Shawcross, VI(15) & VIII(47)-(50). We are not concerned here so much with damage to spectators or unauthorised trespassers.

\(^{413}\) A small landslide accompanied by cracks occurred at Heathrow airport, which appeared to be caused by the construction of the main terminal station for the new £300 million Heathrow-Paddington express underground link. No one was hurt. See TT, 22 Oct. 1994, p.8.
5.1.1 Cheapest cost avoider of passenger damage caused at airport premises: In the first case in the Example above, the accident happened outside the scope of the operations of embarkation or disembarkation and the airline was not in control of the passengers. As such, there is little justification for the carrier's liability for such damage under the terms of the Warsaw Convention 1929. Although in the second case of the taxiway cave-in, the accident occurred after embarkation and before disembarkation and may thus be construed as having occurred 'in the course of any of the operations of embarkation or disembarkation', this nonetheless does not justify the carrier's liability. For the carrier could not possibly have avoided such accident even if he had taken all necessary measures. The imposition of liability on the carrier in this situation would neither create incentives for him to take care (incentive gains) nor induce him to allocate the efficient amount of resources to loss avoidance (allocative benefits). It would only vitiate the airport operator's incentive to take risk-reducing precautions in the conduct of his business.

As the two examples demonstrate, in determining the liability or nonliability of the aircraft operator, the important question is not so much about whether it occurred in the course of or outside the operations of embarkation and disembarkation or whether the carrier assumed control of passengers. The more relevant enquiry should be about the location of the injuries sustained, i.e. inside or outside airport premises, or about the cheapest cost avoider of such damage. In this regard, no distinction is justified between embarking and disembarking passengers. This also applies to passenger damage caused by terrorist attacks at airport terminals. For the airport operator can avoid or minimise such risk better and cheaper than any other party by posting an optimum number of security guards within the terminal area, by setting up a security identification system designed to ferret out suspects or by installing high-performance baggage-screening equipment.

5.1.2 Strict liability and taxation: In view of relatively infrequent incidence of passenger damage cases at airport premises, victims will also find it difficult to establish causal link under liability rules. This is especially so where, as we have already seen, there exists uncertainty over liability division between the carrier and the airport operator for passenger damage sustained at airport premises. For in this case the airport operator will not be induced to take proper precautions or take out

414. See art 17, Warsaw Convention; ch 2: 3.1 above.
415. Ch 2: 3.2 above.
417. For procedural issues in French law on this point, see Juglart. I(773) & (774).
418. See the Economist. 14 Jan 1989, p.66.
adequate insurance even under strict liability, an inefficient outcome. In extreme cases, the airport operator will not be held liable at all for damage he actually caused, causing externality. Insurers will then be unable to assess accurately passenger damage risk caused at airports and to set the premiums that will correspond to insured airport operators' damage record and induce them to take risk-reducing measures. These problems under liability rules can be removed by taxing airport operators according to the relative magnitude of harm as measured by their relative activity levels.

5.1.3 The airport operator's activity level as the measure of taxation: Since the passenger damage risk caused by airport operators is more remote in frequency than the risk caused by carriers and manufacturers, accident probability would have less of relevance than its magnitude as the measure of assessing the risk each society creates through its international airport operators' activities. It is true that an airport operator's activity level may not necessarily be closely linked to his passenger damage record (e.g. busy airports do not necessarily mean lax security). Nevertheless, given the infrequent incidence of passenger damage caused at airports, it is equally questionable whether accident probability of airport operators is as accurate a pointer for assessing the risk and imposing a tax as is accident probability recorded by carriers and manufacturers. Thus, in this type of risk again as in environmental risk, the airport operator's activity level would be more appropriate as the measure of fixing the level of charges to be imposed on each society.

5.1.4 Domestic laws: Both English and French law generally appear to accord with efficient risk apportionment between the airport operator and the carrier in tune with the Warsaw Convention 1929 which holds airlines liable for personal damage caused by the perils unique to or inherent in air navigation. Obviously, the risk of personal injuries sustained within airport premises is not considered the type of risk unique to or inherent in carriage by air. In English law, the airport operator may be required to secure "the safety of aircraft, vehicles and persons using the aerodrome and preventing danger to the public arising from the use and operation of the aerodrome". Thus, an airport operator as the occupier of premises owes a duty of care to visitors entering his premises. Since tortious duties exist by virtue of statutory provisions, the operator

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419 Private insurance for airport premises liability is available on the market. Margo, 195-96.
421 Ch 2: 1.3 above.
422 Civil Aviation Act 1982. ss 27(1)(a), 28(3), 32(1) & 33(1); Shawcross, III(16).
may not exclude or restrict his duty imposed for the safety of visitors during their use of the airport except by agreement (e.g. visitors or well-wishers admitted by ticket).424

In *British Airports Authority v. British Airways Board,*425 the court was asked to judge on the validity of a BAA-imposed condition for the use of Heathrow airport requiring that user-airlines would indemnify the BAA for any claim against it for third-party personal injury caused by aircraft personnel or passengers. The court held that although a licensed aerodrome operator may impose on user airlines certain conditions, the BAA's indemnity condition was *ultra vires* and had no effect on the grounds that the *Airports Authority Act 1975* could not be construed as giving a power for the BAA to impose such an obligation on airlines; and that such a condition would hold airlines also liable for such losses as the Act did not intend to attribute to them.426 The court rejected as unreal and without foundation the BAA's argument that the avoidance of such a condition would increase its liability insurance premium by £88,000 annually.427

French jurisprudence, like English statutory and case law just mentioned, also seems to favour the location test, viz. the Warsaw Convention will not apply to damage sustained in a safe point within the airport building. In *Maché c. Air France,*428 the Cour de cassation rejected the plaintiff's claim against the airline for compensation of the injury he sustained while being escorted on a ground route to the airport terminal building after disembarkation. In order to hold the carrier liable under article 17 of the Warsaw Convention 1929, the French Supreme Court pointed out, it was required of the plaintiff to establish that the location where the damage occurred was exposed to 'risks inherent to air navigation and exploitation'.429

In *Air Inter c. Sage,*430 the French Court of Appeal of Lyon correctly ruled that the airline could not be held liable for the fall of a passenger in the airport hall when he was in front of the boarding ticket issue desk and thus 'not within the category of passengers due to leave' (*non dans l'enceinte de passagers en partance*).431 The court reasoned that the airport hall is open to the public and subject to the control and management of the airport operator and that at such a preparatory stage carriage by air

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429. *Ibid,* 29 RGAE (1966) 32, 34; Miller, 138-39. For art 17, see ch 2; 3 above.
430. (CA Lyon, 1º ch, 10 Feb. 1976), 30 RFDA (1976) 266.
431. Juglart, I(775).
could not be considered to have commenced. In a case involving a sabotage attempt against an aircraft at Quimper airport, the state and not the airport operator, was held liable for damage caused on the grounds that administrative authorities were grossly negligent in not having taken necessary preventive measures. This is because in France most airport authorities are owned by the state which as such is responsible for maintaining security at aerodromes (e.g. by posting sufficient police force). The reasoning in these cases is thus premised on the supposition that the airport operator is the cheapest cost avoider of passenger damage caused within airport premises before embarkation or after disembarkation.

American courts have applied two different tests to determining the applicability of the Warsaw Convention system and thus to establishing the carrier's liability. For damage to disembarking passengers, the test is still the location of the victim at the time of damage, and for this purpose the operation of disembarking terminates when 'the passenger has descended from the plane' and 'has reached a safe point inside the terminal'. For damage to embarking passengers, however, this location test was dismissed as inapplicable and a tripartite test was formulated in Day v. TWA, Inc. and Evangelinos v. TWA, Inc.: the location of the accident, the activity in which the injured passenger was engaged, and the defendant airline's control of such person at the time of the accident. The factual situation involving the two cases satisfied the tripartite test and the defendant airline was thus held liable. But the grounds of these decisions may be criticised on many accounts.

First, the tripartite test has led not only to discrimination between embarking and disembarking passengers but to inconsistency in that embarking passengers will not be at a safe point by entering the airport building for departure, whereas disembarking passengers will be after alighting from aircraft. Even if it is conceded that embarking

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433. Sec 4.1.5 above.
434. Miller, 135.
436. 13 Avi 17,647 (SDNY 1975), aff'd, [13 Avi 18,144 (2d Cir 1975)] 528 F 2d 31, 34 (2d Cir 1975), cert den 429 US 890, 45 USLW 3280 (S Ct 1976).
437. 14 Avi 17,101 (3d Cir 1976), on rehearing, [14 Avi 17,612] 550 F 2d 152 (3d Cir 1977). Both cases arose from the same terrorist attack committed when the victims were queuing at the airport lounge near the departure gate to undergo hand baggage checks and physical inspection by the Greek police prior to embarkation.
438. At 13 Avi 18,146 & 14 Avi 17,613. The rationale of the new test was explained as based on the facts that disembarking passengers, unlike embarking ones, are neither required to queue up nor under the airline's control. 13 Avi 17,647, 17,651; Martinez Hernandez v. Air France, [14 Avi 17,421] 543 F 2d 279 (1st Cir 1976), 31 RFDA (1977) 421; Legier, L'application de la convention de Varsovie par les juridictions américaines, at 260, Juglart, II(3239).
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passengers are required to perform relatively more activities (e.g. queuing up for hand baggage and security checks) than disembarking passengers, do these activities expose them to a substantially higher risk to justify such a distinction between the two for the purpose of determining the liability of the airline? Second, although it may be said that the airline began to perform his obligation as carrier under the contract of carriage, it is open to doubt even by the courts' own tests whether the carrier assumed 'responsibility for the plaintiffs' protection' at the time of attack. For the control and thus protection of passengers were in fact being exercised by the Greek police at that time. Third, it is difficult to argue that the risk unique to or inherent in carriage by air also includes the danger of violence at airports, since the risk of terrorist attacks is also present in other means of transport, like carriage by sea or by rail. Such risk would rather be characterised as related more to contemporary morals.

The *Day* and *Evangelinos* decisions can therefore be explained only against the background of the Montreal Agreement 1966 which imposes absolute liability on the carrier for passenger damage it causes during the operations of embarking and disembarking in respect of any international carriage touching the US territory. Or these decisions may be defended if the airport operator is exempted from liability for passenger damage caused at airport premises and victims are thus not assured of compensation from him. For only in this case imposition of liability on the carrier will induce him to take all justified measures and spread the costs among passengers. But this would no longer be the case if the airport operator will be liable for damage by terrorist attacks within the airport. Again an arbitrary distinction between embarking and disembarking passengers for determining the carrier's liability is not logically well founded. The efficient solution is to hold the airport operator liable for passenger damage sustained at his premises both after disembarkation and before embarkation.

5.2 Bird Strike
There have been reported a growing number of bird strike damage caused to aircraft around airports.\textsuperscript{444} Two-engined aircraft are particularly vulnerable to the bird strike risk, since bird collision with aircraft is done mostly to jet engines (ingestion) or aircraft nose. Although damage from bird strike has so far been confined mainly to aircraft engines or hull, the risk of passenger damage cannot be underestimated. Again, inappropriate airport facilities create actual risk to safe air navigation and to passengers and aircraft. Examples include the existence of electric power lines or other obstructions\textsuperscript{445} around the aerodrome and inadequate marking or lighting of the runways, taxiways or the approach areas. The question raised here is who, the airport operator, the air traffic controller or the carrier,\textsuperscript{446} should be held liable for such passenger damage and on what grounds.

5.2.1 The cheapest cost avoider of bird strike and other risk: Since bird strikes occur mostly around airports during the operations of take-off, landing, climb or approach, it is the aerodrome operator that can better avoid the loss or can better be induced to take appropriate risk-reducing measures. Or the operator may on balance choose to bear the risk. So he should be made to reduce or avoid the presence of birds around the aerodrome or on the runways. Precautions may start with installing an effective bird detection, warning and dispersal system. The operator may post around the aerodrome predatory birds like falcons or hawks which will effectively frighten away seagulls or pigeons responsible for most of bird strike damage.\textsuperscript{447} Upon expert ornithological advice, he may also weed out certain grass or grow long grass around the aerodrome to ward off some species from nesting or flocking around the aerodrome. As regards passenger damage caused by collision with electric power lines or other obstacles upon take-off or landing, air traffic controllers' warning of danger to the pilot will not be enough, since only the airport operator can avoid such hazard by removing or relocating them.\textsuperscript{448}

5.2.2 Liability rules v. taxation: Under the negligence rule, if the courts fail to establish the negligence standard correctly, the operator will not adequately be induced

\textsuperscript{444} In 1981, bird strike caused destruction of two aircraft and 105 major and 306 minor damage. In the United States, bird strike causes an annual average of $20 million worth of damage. See Perron, Liability of ATC Agencies and Airport Operators, at 213 n.25; Juglart, I(2208).

\textsuperscript{445} Fifty-five persons were killed when an Indian Airlines plane carrying 112 passengers crashed on take-off after hitting a lorry carrying cotton bales near the runway. The plane crashed five miles away from the airport. See TT, 27 April 1993, p.14.

\textsuperscript{446} See the proceedings involving Schiphol airport for a bird strike damage to the engines of a DC-10 sustained at the airport in 1974. Perron, n.444 above, at 214.

\textsuperscript{447} Juglart, I(2208), in fine.

\textsuperscript{448} See Harris v. US, [12 Avi 17,282] 333 F Supp 870 (ND Tex 1970). This decision attributing the loss to the controller for failure to warn of power lines must therefore be criticised.
to take appropriate risk-reducing measures, not to speak of administrative costs incurred to determine negligence. The courts may also have to investigate who, the operator, the pilot or the controller, was negligent, incurring administrative costs and causing the risk of error. Under strict liability, if an individual bird strike damage is not big enough, no action will be brought, causing externality. Even if such small actions were brought, no allocative benefits can be obtained, given high administrative costs. Again, if under strict liability the airport operator is risk-averse, the question would be whether sufficient third-party insurance cover for bird strike risk is available on the market for the airport operator. If this were not the case, as it really is,\(^4\) the operator should bear the risk under strict liability, which is not the efficient outcome. Therefore, bird strike hazard would better be taxed.

5.2.3 Data for and assessment of risk for taxation: Pursuant to Annex 14 ("Aerodromes") to the Chicago Convention 1944, ICAO has published an Airport Services Manual, one separate volume of which (pt III) is dedicated to bird control and reduction. ICAO has also established a computerised reporting system to compile statistical data\(^4\) which can usefully be employed as the basis for assessing the magnitude of the bird strike risk each society creates through the activities of its airport operators. Once the total annual losses are computed by reference to the total reported damage, the levies payable can be distributed to each society in proportion to its relative magnitude of losses each society reported.

5.2.4 Case law on bird strike and other incidents: In A/S Fred Olsens Flyselskap v. Norwich City Council and Norfolk County Council,\(^4\) the High Court held the airport operator liable for damage to the aircraft caused as a result of the ingestion of gulls into the engines upon take-off. In the view of the court, the airport proprietor failed to install an effective system of detecting and dispersing the gulls to reduce the hazard. The court also held that any responsible controller must be guarded against the reasonably foreseeable risk of bird strike and issue warnings to the pilot of aircraft taking off or landing and that in the case of take-off, his duty to keep a lookout continues beyond the time of clearance and until the aircraft starts its take-off roll. Nevertheless, the controller's duty to issue warnings should not be equated with a duty of such a kind as its breach would invite liability. For the controller's warnings are almost irrelevant to reducing or avoiding the actual risk, especially once the aircraft has already begun landing or take-off operations.

\(^4\) The fact that such insurance cover is not available may mean that there is not sufficient demand for the cover or that the insurer cannot load competitive premiums for such risk.
\(^4\) Perron, n.444 above, at 213.
\(^4\) (27 July 1979, High Ct, unreported); 5 Air L (1980) 35.
Indeed, in most of US cases involving bird strike, the airport operator and not the air traffic controller (in connection with the breach of his duty to give adequate warnings) was held liable for the damage caused.\footnote{452} Again, in a US case involving the presence of a dog on the runway, the aerodrome operator was correctly held liable for the damage caused to the aircraft.\footnote{453} But in a similar case involving a motor-cyclist trespassing on the runway,\footnote{454} the ATCA was held liable for failure to warn the pilot of a landing aircraft of the danger. This decision must be criticised, since the controller’s warning itself will not be sufficient to avoid such a damage and since it will not adequately induce the airport operator to take all the steps required for the avoidance of damage.

French jurisprudence generally appears to take a narrow view of the airport operator’s responsibility for clearing the air corridors from the risk of bird strike around the aerodrome. The Conseil d’Eat in \textit{Cie Air-Inter}\footnote{455} held the airport proprietor not liable for a damage caused to aircraft by the presence of birds in the air corridors. In so ruling, the court observed that no damage had resulted from public service and that no fault in navigation service (\textit{absence de faute de service de la navigation aérienne}) had been committed by the airport proprietor, since he had taken all appropriate measures to destroy the natural habitat of gulls and had installed proper dispersal devices around the aerodrome.\footnote{456} Similarly, in \textit{Société d’assurances <<La Réunion Aérienne>>},\footnote{457} which involved a situation similar to the two previous cases, the Administrative Court of Appeal of Nancy reached a similar decision relieving the operator of any liability for bird strike damage to aircraft. These decisions must be criticised for reasons already given in the previous paragraph.

\textbf{Conclusion}

In resolving disputes over aircraft noise-pollution damage, the trespass (or inverse condemnation) approach will produce a less efficient result than the nuisance approach. Since trespass involves direct, and not consequential, encroachment upon the use and enjoyment of property, the courts need not to compare relative values of conflicting land uses by the aircraft operator and the landowner. They have only to award

\footnote{452} See Shawcross, VI(36) n.9; R A Michael, Keep Your Eye on the Birdie: Aircraft Engine Bird Ingestion, 51 JALC (1986) 1007.
\footnote{456} See Shawcross, III(17) n.2.
The airport operator's liability

Damages corresponding only to diminution in the market value of the property affected as such (taking of a property) and other physical damage. The trespass approach thus tends to ignore nonmarket costs of intrusion (e.g., discomfort and annoyance) and fails to take into account true opportunity cost of the land. This is not to speak of the difficulty involved in identifying the particular aircraft causing noise and pollution and establishing causal link. Further, the trespass approach does not cover damage from ordinary or indirect overflights. The nuisance approach can avoid most of the inefficiency of the trespass remedy and enables victims to identify easily the airport operator against whom to bring an action. English and French courts have been found more reliant on the nuisance approach than their American counterparts.

Under the nuisance-injunctive remedy, strategic behavior can be avoided if the courts have adequate information on both the airport operator's profits and the residents' damages schedules and award the entitlement equivalent to the efficient activity level (intermediate entitlement). Under the nuisance-damages approach, the hold-out problem can be defeated if the courts have sufficient information only on the residents' damages schedule and award an entitlement matching the lowest possible output and set liability equal to actual damage. At this level of activity, the residents will have little incentives to sue the airport operator. Thus, to the extent that courts have imperfect information about the airport operator's profit schedule, the damages remedy is more desirable. National laws have been found to allow airport operators reasonable, ordinary use of airspace and favor the damages approach, except perhaps for American law which is more reliant on inverse condemnation than nuisance.

Imposition of liability on airport operators for environmental damage will make international society better off by inducing them to allocate an optimal amount of resources for noise and pollution avoidance. Nevertheless, we have seen that liability rules cause difficulties for victims to establish causal connection and may create incentives for victims to make fraudulent claims. More importantly, liability rules are not considered an appropriate means of reducing noise and pollution, since under liability rules not all victims are reasonably expected to bring an action for recovery of their diffuse, scattered claims, given the costs involved (free-rider and externality problems). Furthermore, distributive consideration also discredits the liability approach to resolving a dispute involving pollution harm.

Although public ownership of airports is not necessarily incompatible with competition, it does have a tendency to limit competition. Thus, when the division of

458. Sec 2.3.4 above & ch 1: 7.2.2 above.
the ownership of BAA-owned airports was proposed to promote competition, BAA's management vehemently opposed the idea of separate ownership which was finally rejected. Economic regulation of natural monopolies has its own limitations in achieving productive and allocative efficiency in the provision of airport services. The traditional regulatory approach relying on standard-setting is largely ineffective in controlling noise and air pollution, and incentive-based, less restrictive regimes such as economic instruments are likely to prove more effective. In accordance with this observation, all three domestic legal systems surveyed allow airport operators to impose noise charges on airlines, which is efficient. However, since no pollution charges are now being imposed, it is necessary to allow airport operators to tax airlines for causing pollution. Alternatively, international airport operators may be taxed by international society for causing pollution. In setting the level of pollution charges, each society should be held liable in proportion to its relative production of pollution through the activities of its international airport operators, as measured by aircraft movements and other pollution factors.

Finally, in the case of passenger damage caused at airport premises or by bird strike or other incidents, we have found that such losses should fall not on airlines or ATCAs but on airport operators, since the latter is in a superior position to avoid the risk at a cost cheaper than the former. And as case law demonstrated, courts may make errors under liability rules in identifying correctly the responsible party. Thus, passenger damage risk caused at airports, whether by bird strike or by other incidents, would rather be controlled by taxation of each society for its international airport operators' activities. Given the infrequent incidence of these two risks, the levies payable by each society need to be determined by reference to the relative total activity level of international airport operators of each society.

459 Vickers & Yarrow. 363-64 & 366. 460 Breyer. 261 & 271. 461 Sec 4.4 above.
CHAPTER 6

LIABILITY OF THE ATC AGENCY
FOR PASSENGER DAMAGE

If a state is to be happy, the authority of the rulers and the liberty of the subject must be combined in judicious proportions.

-------- Plato

He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it...he intends only his own gain, and he is...led by an invisible hand to promote an end which was no part of his intention.

-------- Adam Smith

Introduction

In the previous chapter, while discussing the airport operator’s liability, we argued for taxation of airport operators as the most efficient solution to minimising the combined costs of environmental and passenger damage and their avoidance. Clearly, provision of airport facilities and air navigation services is an indispensable condition to safe conduct of carriage by air, but it is not sufficient. Without ATC service, safe and efficient conduct of carriage by air will not be possible or at least must be compromised. Safe and efficient provision of ATC service is all the more necessary in view of growing traffic demand and congestion around hub airports. In this Chapter we therefore consider the economic consequence of the provision of ATC service to examine how international society can minimise passenger damage risk caused by the accident-prone or accident-avoiding behaviour of ATC agency.

In this type of risk arising from the parties in stranger relationships, it would be infeasible and inconceivable for the victims and ATCA to negotiate an agreement. This is not only because of their unequal bargaining power and illegality of bargaining (e.g. bargaining through bribing) but because of the sheer number of potential victims

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1. The Laws, Bk III, para 697.
2. Inquiry, IV, ii, 9.
3. Drion, 201.
5. Sasseville. ATC Agencies, 247.
involved and ensuing transaction cost. The asymmetry in the bargaining position may equally apply to the ATCA-carrier relationship in the case of damage caused jointly by both, given the fact that in most jurisdictions the ATCA also exercises regulatory functions of certification and licensing. Since ATC service is provided ostensibly in the public interest, the goal of the law governing the liability of the ATCA agency is assumed to be not profit maximisation but minimisation of the combined cost of passenger damage and its avoidance and of administrative costs. This goal, as stated at the outset, can be achieved by inducing the parties involved in carriage by air to generate the socially optimal level of safety.

We start with an overview of the relative position of the controller and pilot in avoiding accidents under two different meteorological conditions of flight (VFR and IFR). On the basis of these preliminary observations, we will evaluate the efficiency of the rules of negligence and strict liability. This will be followed by an analysis of whether the public ATC agency, often given a privileged status of immunity, should be held liable for the consequence of negligent provision of service. After discussing briefly issues in causation and choice of law, we will take into account economic implications of public provision of ATC service and argue in favour of taxation of ATC risk. We will finally consider the efficient control of wake turbulence damage and of damage caused jointly by two or more injurers of different classes (involving e.g. ATCA, carriers and manufacturers).

1. Public Ownership, Natural Monopolies and Liability Rules

The legal and economic consequences of public ownership and natural monopolies have already been examined in the context of airport services and they may largely be applicable mutatis mutandis to the provision of air traffic control service. Air traffic control service is provided by the publicly-owned agency and affects the safety of not only airline passengers but also, albeit indirectly, a broad spectrum of life in society (imagine a surface damage resulting from a mid-air collision or crash landing which was caused by negligent ATC service). Once again, as in the provision of airport services, competition in the ATC service market is very limited because of the public

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6. The Tenerife collision between two jumbo jets caused more than 600 deaths. Sec 5.3 below.
7. Ch 1: 8.1 above. Although the functions of both air traffic control service and regulatory activities are usually discharged by one public body in most countries, we will here, for analytical purposes, divide them into two categories for separate discussion.
8. See Ogus, 111, 272 & 281; Ch 5: 4.1.2 above.
9. See ch 1: 1.2 above.
10. Ch 5: 4.1.2 above & ch 1: 7.2.4 above.
safety involved, high costs of capital investment and high level of expertise required (natural monopolies).

1.1 Air Traffic Control as Public Service

1.1.1 The notion of public service as a mechanism ensuring safety and efficiency: The term public service refers to an activity undertaken usually by a public corporation to satisfy the needs of the general public (public interest). Since public service is intended to serve the public interest, it needs to be provided at reasonable costs (productive efficiency), while ensuring a maximum possible degree of safety. The public interest may thus be best served by the maintenance of the highest possible degree of safety in civil aviation, by the availability of adequate, efficient and economic services without any unjust discriminations on the basis of market competition, and by the development of a sound regulatory regime responsive to the public needs. Provision of ATC service has thus been entrusted not to a private entity which takes profit maximisation as the goal of its activities or as the measure of its success, but to a public corporation, subject to governmental controls over entry, profits and pricing (economic regulation).

1.1.2 The notion of ATC service as a form of public service: 'Air traffic control service' (service du contrôle de la circulation aérienne), as distinguished from air navigation service, is defined as instructions and advice provided to aircraft by means of radio signals for the purpose of: 1) preventing collisions: a) between aircraft and b) on the manoeuvring area between aircraft and obstructions; and 2) expediting and maintaining an orderly flow of air traffic. ATC service is divided into area control, approach control and aerodrome control services and is in practice provided around aerodromes (terminal ATC within terminal control area) and beyond aerodromes (en route ATC). In order to provide the service, an ATC unit must be equipped with

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14. See Ch 5: 4.1.1 & 4.1.2 above for the notion and economic implications of public ownership.
15. Ch 5: 4.1.3-4.1.5 above; Posner, 254; Shawcross, IV(48) n.10 and accompanying text for English licensing policies.
16. Air navigation service may include the provision of navigation facilities, airports, radio services, meteorological services. Civil Aviation Act 1982, ss 105(1) & 60(3)(i); Shawcross, VI(16) n.1; Chicago Convention 1944, arts 15 & 28.
17. ICAO, Definitions, ibid; Shawcross, VI(20) & (24) n.1; Juglart, I(823).
18. A terminal control area means "a control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes". ICAO, Definitions; Shawcross, VI(20).
various facilities (e.g. communications, radio and meteorology services, beacons, loran stations, computers and electronic clocks) so that it is capable of communicating to, and receiving information from, aircraft (e.g. flight plans, position reports and hazardous conditions reports). 21

1.1.3 Public provision of ATC service under domestic laws: In the United Kingdom it is the duty and function of the CAA to provide air navigation and ATC services within its airspace and any area outside for which it has undertaken to do so. 22 The CAA, a body corporate, is neither a servant or agent of the Crown, 23 nor does it enjoy any status, privilege or immunity of the Crown, nor is it exempt from any tax, duty, rate, levy or other charge of any kind, whether general or local. 24 The CAA is a joint operator with the Secretary of State for Defence of the National Air Traffic Services (NATS) which, like the CAA, is responsible for providing services in respect of not only civil but military aircraft. 25 The CAA conducts ATC service intended to expedite an orderly flow of air traffic, provides flight information and alerting services, and assists in the provision of navigational approach, landing aids and meteorological information. 26

For the purpose of ATC service, British airspace is divided into two at flight level 245 (7,500 meters). 27 The area below flight level 245 is divided into two Flight Information Regions (FIRs), 28 London and Scottish, respectively, while the airspace above this level is classified as the Upper FIR. 29 Certain parts of these two regions may

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20. Meaning either an area control centre or an approach control office or an aerodrome control tower. ICAO, Definitions, ibid.
22. Civil Aviation Act 1982, ss 3(b)-(c) & 72(1); Shawcross, II(51) & VI(7).
23. The CAA, however, acts on behalf of the Crown in order to perform international obligations falling on the Crown by virtue of the Chicago Convention 1944. Civil Aviation Act 1982, ss 20(2) & 60; Shawcross, II(52) & I(41).
26. Civil Aviation Act 1982, ss 3(b); Shawcross, VI(7). It is the duty of the CAA to provide services and facilities available for use to all persons on equal terms at aerodromes owned or operated by it. Ibid., s 28(3)-(4).
28. A flight information region is an "airspace of defined dimensions within which flight information service and alerting service are provided". ICAO, Definitions.
29. Hughes, n.27 above, 211.
be partitioned as controlled airspace\(^{30}\) to be provided with flight information and alerting services throughout. No one may provide any type of ATC service within any part of the United Kingdom unless he is granted by the CAA a valid licence with ratings specifying e.g. the type of ATC service that the holder is qualified to provide and the type of radar equipment that he is qualified to operate.\(^{31}\)

In France the Air Navigation Service (Direction de la navigation aérienne) is responsible for the general organisation and operation of ATC services, while its regional offices (les directions régionales de l’aviation civile) are carrying out these duties at aerodromes. The Air Traffic Control Service (un service du contrôle du trafic aérien: SCTA) was created in 1975 to supervise regional control centres and co-ordinate technical programmes for aerodrome approach control.\(^{32}\) ATC service has the objective of regulating air traffic in the interest of safety and speedy traffic flow.\(^{33}\) These two main objectives of air traffic control are in practice achieved through the following missions: to prevent aerial collisions between aircraft, prevent collisions between aircraft and watch out for obstacles in manoeuvring areas, and provide the pilot with such advice and information as may be useful to safe and efficient execution of flights.\(^{34}\)

French airspace is broadly divided into controlled and uncontrolled airspace, and within the latter only information service may be provided. Within controlled airspace (espaces contrôlés), air traffic control is provided in three types: aerodrome, approach and en route control.\(^{35}\) For the purpose of providing en route control, French airspace is divided into two at 6,000 metres (19,500 feet): above it being the upper airspace and below it the lower airspace. The upper airspace is entirely controlled by relevant sectors of regional control centres. In-flight information service is assured, in the case of en route control, by regional control centres and in the case of aerodrome control, by an organisation called AFIS.

In the United States the FAA operates the Air Traffic Service to provide aircraft with services and information and to ensure safety in air navigation. The Federal Aviation

\(^{30}\) A controlled airspace is an airspace of defined dimensions within which air traffic control service is provided to IFR and VFR flights in accordance with the airspace classification. Air Navigation Order 1989, SI 1989/2004, art 106(1) as amended; Shawcross, V(22) & VI(30) n.5.


\(^{32}\) Juglart, l(821).

\(^{33}\) Ibid, l(819) & (823).

\(^{34}\) Ibid.

\(^{35}\) Ibid, l(821)-(822). There are about 400 aerodromes in France, of which just over 100 provide approaching aircraft with air traffic control service. Ibid, l(820).
Act 1958\(^\text{36}\) has authorised the independent FAA to prescribe, through *Federal Aviation Rules and Regulations*,\(^\text{37}\) air traffic rules for the efficient utilisation of the navigable airspace, regulations relating to the safe altitude of flight and rules for the prevention of collision between aircraft.\(^\text{38}\) Each of the FAA's six regional offices is responsible for enforcing such regulations against any violations thereof within its area, while regional field offices known as Flight Standards District Offices are charged with overseeing aircraft operations and maintenance.\(^\text{39}\)

### 1.2 Aircraft Commander as the Cheapest Cost Avoider in VFR

1.2.1 Continuum of pilot-controller dependence: The pilot in command is primarily and ultimately responsible for, and has the final authority, as to safe operation and disposition of his aircraft, while he is in command.\(^\text{40}\) The aircraft commander (*le commandant de bord*) is thus responsible for the execution of the mission throughout the duration of the command.\(^\text{41}\) However, in order for the pilot to make correct decisions, he must rely on various information and advice (e.g. sudden deterioration in visibility or other local weather conditions) supplied or failed to be supplied by the controller. Indeed, a pilot's decisions at various stages of flight are dependent on such information and instructions given by controllers.\(^\text{42}\) The pilot is thus responsible for the execution of clearance or instructions received from the air traffic centre, and if an instruction is judged as not satisfactory, he must demand its modification.\(^\text{43}\) The pilot is thus prohibited from deviating from the controller's clearance or from operating his aircraft in contravention of the controller's instructions, except insofar as such deviation has been judged as absolutely justified by reason of safety.\(^\text{44}\)

The pilot and the controller thus share a close working relationship for the safety of aircraft, so that responsibility is mutual and reciprocal.\(^\text{45}\) In this sense, their relationship has been described as one of the 'continuum of dependence'\(^\text{46}\) or as under *concurrent*

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\(^{38}\) 49 USC Appd s 1348(a) & (c) (1988); Juglart, I(2228).


\(^{40}\) 14 CFR 91.3(a) (1986); Shawcross, VI(33): *Direction générale de l'aviation civile*, ch II, Domain of Application of Rules of the Air, r 2.4.1: ICAO, Annex 2 to the *Chicago Convention 1944*, sec 2.4.

\(^{41}\) Code, arts L.422-2, para 1 & L.422-3, para 2; Juglart, I(906).

\(^{42}\) Perron. Liability of ATC Agencies, at 209; Juglart, I(2198).

\(^{43}\) *Direction générale de l'aviation civile*, ch II, n.40 above, r 2.4.2; Juglart, I(2198).

\(^{44}\) 14 CFR 91.75; Juglart, I(906) n.23.


\(^{46}\) S B Early et al. The Expanding Liability of Air Traffic Controllers, 39 JALC (1973) 599, 622.
duties for the safety of aircraft. In order to determine who should be liable in a particular situation, what should be determined is therefore the balancing of relative position, i.e. who is in a better position to have superior knowledge material to safe operation under different meteorological conditions. The reason for equating superior knowledge with primary liability is the ability of a party with superior knowledge to take precautions at cheaper cost.

1.2.2 Notions of IFR and VFR: The rules of the air applicable to a particular flight are determined by meteorological conditions and the regime of flight chosen regardless of the phase of flight, i.e. take-off, en-route, approach or landing operations. To different meteorological conditions and regime of flight apply different rules and regulations which impose specific mandatory procedures on both the pilot and the ATC centre. Before flying into controlled airspace (espaces contrôlés), the aircraft commander must file a flight plan (plan de vol) with, and obtain clearance from, ATC units concerned. Such a flight plan must contain certain information (e.g. the envisaged itinerary, requested route, altitude, speed, time of departure, fuel endurance, time of passage at different points specified as such and time of arrival) for clearance by appropriate ATC units. The pilot must operate his aircraft in accordance with the flight plan unless he has later requested otherwise to, and has been approved by, the relevant ATC centre.

When meteorological conditions are such that they allow the pilot to see around, he can choose between visual flight rules (VFR: le vol à vue) and instrument flight rules (IFR: le vol aux instruments). While flying in VFR within controlled airspace, the pilot must exercise due care to 'see and avoid' other aircraft or potential danger and observe flight rules in respect of the visibility distance from cloud or the surface. He must maintain a continuous radio watch, exercise constant vigilance and comply with any instructions given by the relevant control unit. When meteorological conditions

47. H Geut, The Law: The Pilot and the Air Traffic Controller _ Division of Responsibilities, 13 Air L (1988) 256, 259; Sasseville, ATC Agencies, 248; Hamalian, n.19 above, at 84; Shawcross, VI(33).
49. I J Booth, Governmental Liability for Aviation Accidents Caused by Air Traffic Control Negligence, 1 Air L (1975-76) 161, 171; Neff v. US, n.45 above; Richardson v. US, [13 Avi 17,392] 372 F Supp 921 (ND Cal 1974); Shawcross VI(33) n.4.
50. Booth, ibid.
52. Ibid, r 31(1).
53. Juglart, l(818).
54. Rules of the Air Regulations 1991, ibid, r 24-26; Shawcross, VI(30), (31) & (34).
55. Ibid, r 27(3); 14 CFR 91.67(a) (1982).
do not permit visual flights (i.e. visibility below specified minima), the pilot would have to fly under IFR whereby he must fly at a minimum altitude above the highest obstacle. In IFR a pilot is presumed to be unable to see other aircraft or the ground (which is rebuttable), and the safety of aircraft and passengers carried therein is more in the hands of controllers and aircraft instruments. In American law the general ground visibility requirements recommended for IFR flights at take-off is one-half mile for aircraft with more than two engines, whereas the comparable figure for VFR flights at take-off must be at least three miles.

1.2.3 The pilot's duty to see and avoid: Under VFR conditions, since the pilot is in a superior position to see and avoid by maintaining vigilance, he must therefore assess potential risk and separate from other aircraft or obstacles. Although this is regardless of whether the flight is conducted under VFR or IFR or whether a traffic clearance is given or not, it is especially the case under VFR conditions. Safe operation of aircraft in this situation is the sole responsibility of the pilot who is in a better position to know or to have known those facts material to the safety of his aircraft, whereas the controller's functions have been ruled as merely secondary in assisting the pilot.

1.2.4 The pilot as the cheapest cost avoider of VFR risk: In light of the pilot's duty and indeed ability to avoid potential mishap at cheaper cost than the controller under VFR, he must be liable for any loss that may ensue from his failure to separate regardless of air traffic clearance, if adequate and timely warning were given by the controller. Thus, in US v. Schultetus involving a VFR mid-air collision, it was correctly held that the primary responsibility for separating between aircraft and avoiding accidents in VFR conditions rests with the crew, regardless of air traffic clearance. The court held that the controller's warning to the pilot of the danger discharged the United States of any liability for the collision. Likewise, in Spaulding

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56. Ibid, p 29.
57. Juglart, p(831); Calarie v. US, 18 Avi 18,393 (DC Ky 1984).
59. Ibid.
60. Thibodeaux v. US, 14 Avi 17,653 (ED Tex 1976) 17,654, aff'd (unreported 1978); 14 CFR 91.67(a) (1982).
61. See American Airlines, Inc. v. US, 418 F 2d 180. 193-94 (5th Cir 1969) (Repeated pilot errors found to be the sole proximate cause of the crash).
63. See ICAO. Annex 2 to the Chicago Convention 1944. sec 3.2 & note.
66. Ibid. 327-28.
The ATCA's liability

v. US, the pilot was correctly held negligent and liable, since thunderstorm had been apparent to him at take-off in VFR conditions and since he had been adequately warned of overcast skies and approaching thunderstorms along his proposed flight path. In the words of the court, "[t]he air traffic controller's duty to warn does not...relieve the pilot of his primary duty and responsibility".

1.3 The Air Traffic Controller as the Cheapest Cost Avoider in IFR

Example 6.1 Imagine a hypothetical situation where an airline pilot approaching an aerodrome in IFR on a pitch-black night radioed the control tower for landing instructions and stated that he was unfamiliar with the area. Suppose the controller on duty cleared the pilot for a straight-in approach to the runway without warning that the aerodrome runway was perched in between steep hills to be encountered near its approach end (or that there is a high chance of severe weather conditions upon its final approach like deterioration in visibility). Although after the clearance the controller thought the plane's approach altitude was low on the radarscope, he could not calculate the exact altitude of the aircraft because of radar limitations or poor reception (or the controller made an error in determining the plane's altitude by failing to subtract the airport elevation from the altitude expressed in mean sea level on the computer). As a result, the plane hit the hillside and crashed. Assuming that the pilot was experienced, well qualified and licensed in IFR flights and that little evidence was found in support of the pilot's misjudgement in maintaining the altitude, efficiency would require that the controller issue adequate warning against the hazard. For he is in the better position to avoid the risk under IFR conditions.

1.3.1 The controller's duty to separate and warn in general: The controller is generally under duty to separate or warn of hazards reasonably apparent to him but not to the pilot, whenever the aircraft is placed in a peril. Under both VFR and IFR

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67. [12 Avi 17,240] 455 F 2d 222, 227 (9th Cir 1972).
69. Spaulding v. US, n.67 above, at 226.
70. See Tigert, n.48 above, at 346 n.53.
71. See e.g. TT, 2 Jan. 1993, p.4. The FAA was reported to have been spending billions of dollars developing a new weather radar system, Int HT, 25 Oct. 1990, p.3; TT, 6 June 1989, p.4
72. Radar is a radio detection device which provides information on range, azimuth and/or elevation of objects by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation. ICAO, Definitions. Radars enable controllers to track the flight path of aircraft not only horizontally but vertically.
73. See Daley v. US, 792 F 2d 1081 (11th Cir 1986); Ross v. US, 640 F 2d 511, 520 (5th Cir 1981).
75. American Airlines, Inc. v. US, n.61 above, at 197.
conditions the controller must give not only advice, assistance, instructions and information including meteorological information but directions and guidance in order to avoid an accident or collision, while the aircraft is within controlled airspace.\textsuperscript{76} Especially, under IFR conditions the aircraft can hardly be said to be under the exclusive control of the pilot,\textsuperscript{77} but is rather in the hands of aircraft instruments and the controller. And since pilots are presumed to be unable physically to see each other, the controller is primarily responsible for the safety of aircraft and must thus separate or warn of hazards to avoid any accident. The pilot is not free to disregard, or must comply with, instructions and directions supplied by the controller, save in the event of an emergency where he may depart from them in the interest of safety.\textsuperscript{78}

1.3.2 The controller as the cheapest cost avoider of IFR risk: Since the primary concern of the controller rests with IFR aircraft, as a concomitant, the provision of advice and assistance to VFR traffic is subject to his workload created by his primary duty to IFR traffic.\textsuperscript{79} Constraints on available radars, congestion, workload and small aircraft traffic may well prevent controllers from providing timely traffic information, advice, instructions or alert to VFR aircraft considered material to safe air navigation.\textsuperscript{80} Thus, the efficient way for the controller to perform his duties and run the ATC system is to rely on the pilots in VFR conditions and to allocate more of his time and resources to IFR aircraft.\textsuperscript{81}

1.3.3 Case law: The Fifth Circuit in \textit{Gill v. United States}\textsuperscript{82} held the approach controller negligent in supplying the pilot with inaccurate, incomplete and even misleading in-flight weather information in time of severe weather in an extensive area. In \textit{Hennessey v. US},\textsuperscript{83} the pilot of a Lockheed Constellation, while taking off in turbulent and gusty weather conditions in the dark morning, was instructed by departure control to take a course that would pass his aircraft through a low-terrain 'gap' area in between mountain ridges. However, the pilot made an unusual left turn after take-off to deviate from the projected path, which the controller failed to detect.
The ATCA's liability

until it was too late to warn the pilot and avoid the crash into the ridge. The trial court in *Hennessey* ruled that the departure control knew the course deviation and was in a better position than the crew to avert the danger but failed to observe on his scope and warn timely about the aircraft's deviation from the assigned course. Although it was not made known why the pilot made a sudden left turn, the decision appears a correct one in light of the facts that the flight was in IFR and that there was little evidence to believe that the pilot was familiar with the particular topography, he was aware of the impending danger or he did not act with due diligence and care.

2. Simple Models for Single-ATCA Accidents

2.0.1 Assumptions: It is assumed that the degree of congestion at various ATC centres (which is more acute in some airports than in others) and meteorological conditions (which are more treacherous in some regions than in others) are more or less similar. It is also assumed that penal-administrative sanctions are in force against pilots and controllers alike for not complying with or violating safety standards or for not operating under such conditions as prescribed by the terms of their respective licences. Thus, quite apart from the ATCA liability, individual controllers themselves are indeed subjected to criminal, disciplinary as well as professional sanctions in favour of maintaining a high standard of skills and expertise and exercising appropriate care in discharging their duties. Again, in their everyday working situations, controllers are under constant factual and mental pressures to allocate their time and resources to as many aircraft flying within their controlled area as possible so that both safety and efficiency can be ensured to the greatest extent possible. Furthermore, the ATCA's vicarious liability for failure of its controllers to discharge their duties properly will induce it to invest in their training and education, oversee their work and discipline them for their injury-causing behaviour.

2.1 Factors Affecting Expected Losses

2.1.1 The ATCA's care: Although there are a multiple of factors that may affect an ATCA's level of care and thus ATC risk in the discharge of its functions, by far the

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84 Ibid. at 17,418-19.
85 Ibid. at 17,419.
86 Juglart, 1(2227).
most important one is the technological standard of an ATCA's equipment, which in turn depends largely on its investment in equipment modernisation. This is because ATC service is a process in which controllers have to rely heavily on radars, computers and other equipment when making critical decisions within various constraints. Computerised radar system often causes breakdown and results in interruption of service which in many cases lasts more than one minute. 88

Although computerised radar system will usually cover, locate and signal on the radarscope the respective position of aircraft within controlled airspace, it may not be equal to keeping up with the pace of growing traffic demand and congestion around hub airports. Small, light aircraft flying around airports not equipped with proper communication facilities create special dangers to safe and efficient flow of air traffic, since they are often outside the recognition or notice of radarscope. Again, an ageing or limited radar network 89 is unable to hook up different control areas within the same controlled airspace for information exchanges between ATC centres which are considered vital for safe and efficient flow of air traffic.

2.1.2 The victim's care: It would be fair to assume that the average passenger can do almost nothing to reduce the frequency and magnitude of ATCA-caused injury by taking extra care. This is because average air travellers would virtually have no information about ATC risk and because accident losses will almost entirely depend on the care exercised by the ATCA. This is also because there is in practice provided no first-party insurance against ATC risk. Especially, casual trippers would hardly expect their own injury or death to be caused by a wrongful act or omission of the ATCA. Since passengers cannot accurately assess the true risks inherent in these activities, they could hardly take any risk-reducing precautions.

2.2 No Transaction Costs

Assuming that a bargaining between the ATCA and victims (or their relatives) is not only possible and lawful but costless, every legal rule would lead to the efficient outcome, as the Coase Theorem demonstrates. 90 Under no transaction cost, both parties will get together to negotiate a mutually beneficial agreement, which is by definition efficient. The assumption of no transaction costs, however, is unrealistic,

88. See Juglart, I(2227) for statistics of such incidence.
89. Some computers installed at US ATC centres are at least 25 years old and stumbled or broke down completely at least 11 times in 1994. But replacement has been delayed because of the FAA's budget constraint and the inability of contractors to write the software for the new equipment. Int'l HT, 21 Aug. 1995, p.1 (Equipment Failures Stalk American Skies).
90. Ch 1: 3.1 above.
because bargaining would be infeasible or costly, given the number of victims involved. It would be obvious that agreements between the parties in stranger relationships as between passengers and the ATCA would be much more expensive to negotiate than in contractual relationships. The bargaining solution is further constrained by the fact that it is illegal for public officials to enter into bargaining or accept money in return for his behavioural change.91

2.3 Positive Transaction Costs and Court's Imperfect Information

Under the more realistic assumption of positive transaction costs, although air traffic service is provided ostensibly in the public interest, an ATCA needs to provide efficient service that will minimise accidents and their avoidance costs, given constraints on its budget, resources and staffing.92

Example 6.2 Imagine a regional ATC centre that has registered a certain accident record in the course of its activity. Suppose the ATC centre has three choices in relation to its safety record: to invest high, medium or low in system modernisation and controller training. It is assumed that the goal of the law governing ATC liability is to minimise the combined costs of passenger damage and its avoidance. For simplicity, it is assumed that the aircraft is under the exclusive control controllers and therefore that their warnings or instructions will be fully complied with by the pilots. Discussion here will be carried out on the assumption of risk-neutrality, since it is difficult to assume that public bodies act on risk aversion. In this Example, both the negligence rule and strict liability are efficient in terms of incentive creation, as explained below.

2.3.1 Negligence rule: Under the rule of negligence the ATCA will be liable only if it fails to meet the standard of care. Assuming that this standard is determined by the level of care that would be taken by the ATCA if it acted efficiently, this corresponds in the Example above to taking medium care. In this situation, the ATCA will be liable for passenger losses only if it chooses to take low care, in which case its cost of service plus expected liability payments is £250,000. If the ATCA exercises medium care, there will be no liability and its cost of service will be £100,000, whereas the corresponding figure for exercising high care and no liability will be £160,000. Given the cost at each level of care, the ATCA will be induced to meet the standard of care and take medium care.

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92. This is one of the major underlying assumptions of Professor Coase's seminal article, The Problem of Social Cost, at 17. Indeed, even the government may be considered a super-firm.
The ATCA's liability

Table 6.1
Aviation Accident Example: ATCA's Care Affects Expected Losses

<table>
<thead>
<tr>
<th>ATCA's Conduct of Duty of Care</th>
<th>ATCA's Cost of Service* Including Cost of Care</th>
<th>ATCA's Accident Probability</th>
<th>ATCA's Accident Probability if Accident</th>
<th>Estimated Passenger-Surface Losses</th>
<th>ATCA's Total Cost of Service (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>50,000</td>
<td>0.0020</td>
<td>100,000,000</td>
<td>200,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Medium</td>
<td>100,000</td>
<td>0.0012</td>
<td>100,000,000</td>
<td>120,000</td>
<td>220,000</td>
</tr>
<tr>
<td>High</td>
<td>160,000</td>
<td>0.0008</td>
<td>100,000,000</td>
<td>80,000</td>
<td>240,000</td>
</tr>
</tbody>
</table>

*ATCA's cost of service refers to fixed costs (e.g. investment in long-term capital assets such as radars, computers and other equipment) plus operating costs (e.g. costs for training controllers and maintaining equipment).

In order for the negligence rule to be efficient, it is essential that the court have accurate information about the costs incurred at each level of care and determine correctly the due care level corresponding to the efficient outcome. If the court makes errors in assessing and setting the correct level of due care applicable to an ATCA, it will be induced to take too much or too little level of care. For example, in Table 6.1 if the court mistakenly decides that the efficient behaviour of an ATCA in question is to take high care, which will then be due and standard care, the agency will be liable for passenger losses if it takes low or medium care. Then the ATCA's cost of service plus expected liability payments is £160,000 if it chooses to take high care and bears no liability, £220,000 if it chooses to take medium care, and £250,000 if it chooses to take low care. Consequently, the ATCA will be induced to take high care, an inefficient result. Conversely, if the court erroneously decides the efficient behaviour to be low care, the agency will be induced to take low care.

2.3.2 Strict liability: Under strict liability the ATCA will be liable for passenger damage regardless of whether it takes care or not. Given the ATCA's total cost of service plus expected liability payments in Table 6.1, it will take medium care, the

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93. Polinsky, 40.
efficient outcome. In order for strict liability to be efficient, it is necessary that the court have correct information about the victims' damages. If the court underestimates the victims' damages, the ATCA will be induced to take lower than optimal care. Suppose in Table 6.1 that the court estimated damages to be half the actual damages. Then, the agency's cost of service plus expected liability payments will be £150,000 (£50,000+£100,000) if it takes low care, £160,000 (£100,000+£60,000) if it takes medium care, and £200,000 (£160,000+£40,000) if it takes high care. Consequently, the agency will choose to take low care, an inefficient outcome. Conversely, if the court overestimates the victims' damages, the agency will be induced to take higher than optimal care.

The above discussion demonstrates that strict liability is preferred to the negligence rule to the extent that the court has imperfect information about the costs to be incurred at different levels of an ATC's care (which makes it unable to set the efficient due care level) but has correct information about the victims' damages.

2.3.3 Duty of care under domestic laws: In English law the ATCA owes a duty of care to those (e.g. airlines and passengers) who act or rely on these services for their activities. This duty is generally regarded in English law as concerned with the controller's functions relating to safe aircraft operations and the expeditious flow of air traffic. The duty is for a controller to exercise reasonable care and provide the pilot with all necessary instructions and advice to promote safety of aircraft within the area of his responsibility. Since the controller owes this duty to as many aircraft as may be operating within the relevant control zone, he must allocate his time and other resources as may best cater to the needs of a particular situation. The procedures to be observed by the controller in performing this duty are set out in official manuals, but it is questionable whether they can always be relied on as specifying the standard of care.

In America liability of public services may only be entertained on the basis of negligence or breach of the duty to take care. US courts often speak of a duty to
provide for the 'safe, orderly and expeditious' flow of air traffic with no single formula receiving general acceptance. Nevertheless, such a duty has been qualified as one of ordinary care or due diligence even in an emergency. In *Eastern Air Lines, Inc. v. Union Trust Co.*, the court held that when the government entered the business of operating an ATC tower, it assumed a role of private interests and as such was under duty to exercise reasonable care to warn the crew of impending danger. As to the procedures to be followed by controllers, operations manuals are regarded as prescribing merely the minimum standard, nor are they exhaustive, as will be discussed below. Thus, in American law again, the negligence standard applicable to the controller is not without ambiguity and uncertainty.

In French law, in order for administrative liability of the ATCA to be entertained, gross negligence (*faute lourde*) as opposed to ordinary fault (*faute simple*) is usually required, in view of the degree of difficulty involved in the public service activity. This has been made clear in a Conseil d'Etat decision on a mid-air collision over Nantes of 1973. This is especially so in relation to the ATCA's duty to warn (*la responsabilité des services d'alerte*). For example, it has been held as constituting a gross negligence to pass on information with delay to another control centre, and because of this, to render uncertain the communication by the pilots with the ground control centre. Nevertheless, it is not all too clear what constitutes a gross negligence, although the requirement of gross negligence has generally been explained as relating not to the gravity of the error committed by the public service but to the condition of the victim or the gravity of the injury caused.

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104. [4 Avi 17,546] 113 F Supp 80 (DDC 1953) holding both the US government and Eastern liable, 221 F 2d 62, 74 & 78-79 (DC Cir 1955) affirming judgment against the US but reversing as to Eastern, 350 US 907 (1955) affirming decision against the US but reversing as to Eastern. As a result the judgment against Eastern was affirmed, 239 F 2d 25 (DC Cir 1956).
106. Sec 4.1.2 below.
109. See E Quencez. La responsabilité des services de la circulation aérienne en cas d'accident d'aéronef. 39 RFDA (1985) 13, 22.
111. For examples of *faute lourde* as well as those of *faute simple*, see Quencez, n.109 above, at 22-23.
2.4 Public Service and Immunity/Suability of the ATC Agency

In the previous section, we have seen that both the negligence rule and strict liability create adequate incentives for the ATCA to exercise proper care in discharging its duties and functions. On the basis of this analysis, we can now evaluate the rule of governmental immunity in tort which is accorded to public authorities in some states on the grounds of the discretionary function exception. The question here is whether a breach of this duty creates an actionable cause of action and whether suability or immunity accords with the idea of the public interest. It is assumed here that in each accident situation involving public authorities' behaviour (taking care or not), only two options are available to the courts: either to grant or deny immunity and there will be no third option. In other words, the ATCA will only be immune or suable for passenger losses it may cause. Discussions here will be carried out on the assumption of the ATC's risk-neutrality, since public bodies rarely take out market insurance against the risk they create in the course of executing their duties.

2.4.1 Efficiency of immunity and suability under liability rules: If the rule is the negligence rule and if the ATCA is immune from any liability, it will obviously not be induced to take adequate care. Now, if the rule is strict liability and if the ATCA is immune, it will still not be induced to take optimal care, since anyway it would not be liable for their acts or omissions. Only when the ATCA is made suable, it will properly be induced to allocate adequate resources to accident avoidance and to exercise appropriate care. From the victims' viewpoint, if the ATCA should benefit from special immunities, they will be left to insure against their own losses. If in this case the victims have imperfect information, they will not be induced to buy adequate first-party insurance against ATC risk when they travel by air, an inefficient outcome. The ATCA, therefore, should be suable for the risk they create for efficiency grounds.

2.4.2 Public interest and suability: Consideration of the public service nature of ATC would also dictate suability of the ATCA, for immunity would allow capricious, arbitrary wealth distribution in society by leaving the victims uncompensated for the ATC-caused damage. Apart from the dilution of the ATCA's incentives to take adequate care, immunity will not serve the public interest, since it would discriminate against innocent victims without any corresponding economic benefits given. This might be an illegal taking of citizens' right to integrity to his life and limb. Creating

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112 See M L Spitzer, Notes: An Economic Analysis of Sovereign Immunity in Tort. 50 S Calif LR (1977) 515, 537.
special immunities for public authorities would also distort development of the law by artificially sheltering public bodies from liability,\(^\text{113}\) since the concrete exercise of ATC does not entail any discretionary power.\(^\text{114}\) Indeed, there is no justifiable ground to accord ATCA with any privileged status of immunity, save perhaps in terms of the competence jurisdiction in civil law countries where certain actions can only be entertained by special administrative tribunals.\(^\text{115}\)

2.4.3 Immunity or suability under domestic laws: In English law a breach of common law duty of care by the controller is actionable in negligence against the CAA on the basis that it has assumed the responsibility of operating the service and that there was a defect in the operating system (e.g. approach procedures) or that its employee was at fault in discharging his duty.\(^\text{116}\) Because of the CAA's vicarious liability for acts or omissions of its controllers, a direct action may lie against it for its role in selection, qualification and continuing supervision and monitoring of their work.\(^\text{117}\) Although no cause of action will arise against the ATCA from failure to perform this duty,\(^\text{118}\) this is materially different from any act or omission taking place in the course of providing the services. The CAA therefore virtually enjoys no immunity or privilege. The CAA is under duty, shared with the Secretary, to discharge any liability to a third party that is incurred by the Secretary and the CAA, either together or separately, in providing the services.\(^\text{119}\)

In France, since state is responsible for the provision of ATC services,\(^\text{120}\) any liability of the state arising therefrom is governed by the law of responsibility of public power \((\text{puissance publique})\).\(^\text{121}\) In theory, two types of civil remedy may be available to the victim (or his relatives) of ATC damage: one being on the basis of personal fault of the controller \((\text{faute personnelle détachable du service})\) and the other on the fault of public service \((\text{faute de service})\).\(^\text{122}\) An action against the ATC officer on the basis of personal fault, however, is too theoretical to be useful in view of the 'pocket' of any

\(^{113}\) Harlow, "Public" and "Private" Law, at 246.
\(^{116}\) See N R McGilchrist, Air Traffic Control _ the Operator's Liability, [1977] 2 LMCLQ 204; Civil Aviation Act 1982, s 72(1); Shawcross. VI(32).
\(^{117}\) T Scorer. The Liability of Aircraft Manufacturers and Certification Authorities in the United Kingdom, 10 Air L (1985) 28, 39.
\(^{118}\) Civil Aviation Act 1982, s 72(3).
\(^{119}\) Ibid. s 72(2); Shawcross. VI(7).
\(^{120}\) Sec 1.1.3 above; Juglart, I(824).
\(^{122}\) Juglart. I(826); Perron. n 42 above, at 208. For the distinction between the two different bases of action, see generally Brown & Bell, French Administrative Law. 176ff.
controller. The more probable solution is for the victim to rely on the fault of public service and bring an action against the state in the administrative court for default in the functioning of ATC service (défaillance du service de contrôle). Thus, French law again allows the victim to sue against the ATCA for gross negligence committed by its employees.

Despite suability in French law against the state for ATC-caused damage, however, uncertainty and unpredictability remain arising from the requirement of gross fault (faute lourde) rather than ordinary fault (faute simple). Further, the distinction between faute personnelle and faute de service complicates the determination of the correct negligence standard applicable to the controller. The utility of different standards for liability for public services is thus questionable, for different standards create uncertainty over the negligence standard.

In America it is established under the Federal Tort Claims Act (FTCA) that the federal government is liable for damage caused by the negligence of a public administration, subject to the 'discretionary' function exception. Under the Act, in order for a claimant to succeed in his claim, he must establish that the US government, if treated as a private person, owes a duty of care to the victim, that a government employee acted negligently and that such negligence was the proximate cause of the damage incurred. In the context of ATC services, since the FAA has assumed responsibility for providing such services, it owes a duty of care to individual members of the travelling public and must perform its functions with due care. In Eastern Airlines, Inc. v. Union Trust Co., the court correctly found that controllers' negligence did not fit in the discretionary function exception contemplated by the FTCA; and that discretion, if any, was not such a type as requiring policy-making discretion, nor did it involve any discretion to operate air traffic control negligently.

3. Causation and Choice of Law under Liability Rules

3.1 Causation

123. Quencez, n.109 above, at 15; Juglart, I(826); Harlow. Fault Liability, at 520.
124. 28 USC ss 1346(b), 2671, 2680 (1988).
125. Ibid, s 2680(a); ch 3: 2.7.4 above.
126. Ibid, s 1346(b).
128. N.104 above
129. 221 F 2d 62, 64-66.
130. Ibid, at 77-78; Ingham v. Eastern Airlines, Inc., n.127 above, 237-38 (the controller's failure to provide up-to-date weather information involves no discretion).
We noted in the previous section that the ATCA should be suable for damage it may cause in the course of its activity. In order for claimants to recover damages from the ATCA under the negligence rule, however, they must establish not only that the controller was negligent but that the negligent act or omission caused the damage suffered.

3.1.1 Difficulty with proving fault and establishing causal link under the negligence rule: Considering high technicalities involved in ATC service, victims of ATC damage are not expected to discharge burden of proof easily and to establish causal link between the controller's particular act or omission and the resulting damage. Increasing dependence by controllers on radar and computerised equipment renders even less important and relevant the assessment of controllers' conduct itself (e.g. defective or outmoded computers that caused losses). Again, since the applicable standard of due care is subject to constant evolution following the developments in aeronautical science and technology, as illustrated in the wake turbulence example, chronic uncertainty will prevail over the negligence standard. Uncertainty also remains because of coexistence of different standards (e.g. ordinary and gross negligence) used for the determination of negligence applicable to different classes of injurers as shown in French law.

Victims will then be faced with considerable uncertainty over proof of the controller's fault, let alone delays and litigation costs. Strict liability can eliminate most of these problems associated with the determination of the standard of care and with the proof of fault as well as some choice of law questions and will thus contribute to the formulation of a uniform, predictable law. Nevertheless, if an accident involves multiple injurers, even strict liability will end up with requiring the establishment of causal link and division of liability, which explains why the tax approach is preferred to strict liability.

3.1.2 Problems of using manuals as a guide to the negligence standard: It appears that proof of fault would greatly be facilitated if the claimants can establish the

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131. See generally ch 1: 5.1.
133. See sec 5.2 below.
134. Secs 2.3.3 & 2.4.3 above.
136. Sec 4.2 below; Sasseville. ATC Agencies. 247.
137. See sec 5 below.
violation by the controller of applicable regulations and procedures relating, among others, to separation of aircraft or issuance of warnings about any danger which the controller could observe or should have observed. For controllers are usually expected to act in accordance with and by reference to regulations as set out in the control procedures manual which as such is regarded as listing the scope of a controller's duties for the purpose of assisting the pilot with information and advice material to avoiding the risk. A failure to perform, or a breach of, these duties may serve as the barometer of giving rise to liability of the ATCA.

The problem with this approach, however, is that although official manuals serve as guidelines to the procedures that the controller should follow in discharging his duty, the manual does not exhaust every conceivable situation. Nor will every breach of, let alone deviations from, these procedures will automatically and necessarily lead to a negligence. Nor will strict compliance with these procedures necessarily preclude the attribution of negligence and thus relieve the controller of liability, since these procedures are merely intended as minimum guidelines and the controller may in certain circumstances be expected to do more. Nor will absence of any specific requirement in the manual justify failure to exercise due care and to issue warning vital for safe aircraft operation. Even if negligence is admitted, it does not automatically lead to establishment of causal connection.

3.1.3 Case law: In Delta Airlines, Inc. v. US, which arose from a DC-9 crash on approach under foggy weather conditions, the First Circuit accepted the utility of manuals as the barometer of the duty of care to be exercised in the interest of safe and efficient ATC system. However, after weighing the highly technical evidence disclosed, the court dismissed causal link between the controller's negligence and the crash. In Hartz v. US, the appellate court ruled that the controller's duty to warn in giving a take-off clearance to a small aircraft waiting behind a DC-7 could not be circumscribed

139. E.g. Department of Transportation (FAA) Order 7110.65C. Air Traffic Control (1982), foreword, quoted in Hamalian, n.19 above, at 63.
140. Ingham v. US, n.127 above (controller found to have contravened the FAA's ATC Procedures Manual by failing to report changed weather conditions at the first or earliest possible radio contact with the pilot), Shawcross, VI(36).
145. [10 Avi 17,606] 387 F 2d 870 (5th Cir 1968).
within the narrow limits and requirements of the operations manual. The court further held correctly that due care required a controller to issue clearance not only in accordance with, but over and beyond, the limits of the manual, as may be justified either by a particular situation or by dangerous conditions, in order to reasonably ensure the safety of flight.

3.1.4 Trend in causal requirement for public service risk: It is noteworthy in the context of determining causal link that French administrative liability arising from the state's public service activities have increasingly been based on risk liability (responsabilité objective). This explains why the Conseil d'Etat in the Carnes decision initiated risk liability on the grounds of égalité devant les charges publiques and why the state was held liable as an insurer of social risk. Thus, what is done in the public interest may still give rise to a right to compensation, and in this way the community shoulders the burden of the risk of public service activities. In short, French law shows a victim-oriented approach, replacing a punitive philosophy with a purely compensatory social insurance scheme.

3.2 Choice of Law

Theoretically, the controller's potential liability is supposedly governed by the law of the state that employs him. In practice, however, while performing his duties, the controller may be operating under several different legal systems. This is because the controller performs his duties in respect of an aircraft within a delegated Flight Information Region (FIR), which may be part of the high seas to which only the Rules of the Air apply, or which has been established over the waters claimed by several different countries. When an action is brought against an ATCA for its acts or omissions done in respect of an aircraft flying within one of these airspace, the court

147. Rudelson v. US, n.105 above, at 1329.
148. Ibid; Todd v. US, [13 Avi 17,260] 384 F Supp 1284 (MD Fla 1975), aff'd [14 Avi 17,879] 553 F 2d 384 (5th Cir 1977); Baker v. US, n.103 above, at 485 (unacceptable to characterise the procedures manuals as the 'Bible' of air traffic control or as having the force of law); Spaulding v. US, n.67 above, at 226; American Airlines, Inc. v. US, n.61 above.
150. (CE 21 June 1895), D 1896-3-65.
152. Harlow, ibid, at 521.
153. E McCluskey. Legal Liability of the Controller. 19 Controller (1980), No 1, 24, quoted in Sasseville. 244: For the British case, see 1.1.3 above; For the case of the airport at El Paso, Texas, which borrows Mexican airspace, see D A Trick. The Practical Problems of Approach and Landing Procedures from the Perspective of the Air Traffic Controller. 42 JALC (1976) 47, 49.
seized of the case will deal with choice of law issues in relation to e.g. cause of action, establishment of causal link and heads of damages. Is the proper law in this case the lex fori, lex loci delicti, the law of the state having jurisdiction over the controller or something else?

In Beattie v. US,¹⁵⁴ which arose from aeroplane crash in Antarctica allegedly caused by the negligence of US Navy air traffic controllers on duty on the continent, the issue was whether an action in tort against the US government was precluded under relevant law,¹⁵⁵ given the fact that the accident took place in Antarctica. The District Court reasoned that even though Antarctica is not part of the United States, the 'foreign country' exception applies only where the government of a foreign nation has or asserts sovereignty over the place or region in which the accident occurred.¹⁵⁶ Accordingly, the court held District of Columbia law, lex fori, to be the proper law applicable to the instant case.¹⁵⁷

4. Public Ownership, Natural Monopolies and Taxation

4.1 Public Service, Externalities and Liability Rules

As explained above, the ATCA is publicly owned/operated and its revenues are regulated for public interest goals.¹⁵⁸ The question is what economic implications and effects will result to the public firm's operation in terms of its achievement of both efficiency, an important goal of any organisation,¹⁵⁹ and redistribution if liability rules were imposed on the ATCA for the negligent provision of its services?

4.1.1 Effects of public provision of ATC service on efficiency: ATC service is usually provided on a monopoly basis and financed by government transfer payments (e.g. grants or subsidies), while their pricing is subject to economic regulation of price controls in the form of 'the revenue being not less than sufficient to meet its costs'.¹⁶⁰ This stipulation is what is often referred to as a 'break-even' obligation¹⁶¹ imposed on

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¹⁵⁵ Federal Tort Claims Act, 28 USC s 2680(k) (1988) which bars any claim arising in a foreign country.
¹⁵⁶ Beattie v. US, n.154 above, at 782 & 105ff & 141. See also the Antarctic Conservation Act 1978, 16 USC s 2404(e) (1988) (judicial review)
¹⁵⁷ Ibid. at 785 & 105.
¹⁵⁸ See 1.1.1 above and ch 5: 4.1.2 above.
¹⁵⁹ See ch 5: 4 above.
¹⁶⁰ See 5.1.4 below.
the ATCA in relation to productive efficiency. Whereas the meaning of the 'break-even' obligation is largely unambiguous and its determination can be made with relative ease by inspecting a set of accounts, nevertheless, the operation without a loss does not necessarily mean productive efficiency. And such an obligation will not create any incentives for the members of the Board of, and the managers of, a public corporation to make a profit.

Furthermore, if, as is often the case, a monopoly supplier of services is not allowed to charge a price well above his long-run marginal costs that are lower than his long-run average costs for certain levels of output, he will not achieve an adequate return on investments. And the alternatives designed to avoid the losses from monopolistic pricing have their own limits and constraints for regulators to adopt them. As such, the ATCA's allocation of resources for its service is made not by reference to the market demands or airlines' willingness to pay but on the basis of political decisions, while its organisation, management and operation including its economic decisions are subject to Parliament's control. The end result is that a considerable part of the costs of providing ATC service is borne by the general public (through subsidies, etc.) and that its price will not correctly reflect the true cost of passenger damage the ATCA may cause (externality).

4.1.2 Externalities and constraints on the efficiency of strict liability for ATC risk: Under strict liability proof of negligence is not required and ATCA will in theory be liable for every damage it causes. Again in theory, the efficiency of strict liability is not affected by imperfect information of the victims, since the ATCA will be forced to take optimal care and allocate the optimum amount of resources to accident avoidance. Nevertheless, if the loss were caused concurrently by different classes of injurers (e.g. ATCA and airlines or manufacturers) whom the victims were unable to correctly identify because of their imperfect information, they cannot bring a suit against the ATCA and this will cause externality. Victims' difficulty in identifying and establishing causal connection would further be aggravated where services are provided by different organisations depending on the altitude in airspace.

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162 Ogus, 275. The obligation, however, leaves unresolved the question how the depreciation of assets is to be assessed.  
163 Ogus, _ibid_.  
164 Ogus. 282.  
165 Ogus. 282-83.  
166 Kahn. I/2.  
167 See sec 5 below.  
168 Sec 1.1.4 above.
Under victims' imperfect information, they may also choose to sue the carrier rather than the ATCAs in consideration of unequal bargaining position. If this happens, even strict liability will not adequately induce ATCAs to take care or to invest in accident avoidance. Even if joint injurers are correctly identified, concurrent liability may require the establishment of causal link for the purpose of liability apportionment between them. Therefore, to the extent that there remains uncertainty over liability allocation between joint injurers, it would be difficult to remove externality. As a result, the ATCA may not adequately be induced to take adequate precautions, unless liability is apportioned in proportion to their relative accident-prone behaviour as evidenced by their respective accident record within a specified period. Another factor discrediting the adoption of strict liability for ATC risk concerns administrative cost of running the tort law system.

4.1.3 Strict liability combined with private insurance v. taxation: In order to remove the externality of ATC service, one author has proposed compulsory insurance to cover ATC risk. But apart from the question of the availability of private insurance policies yielding maximum utilities on the market, this may well be a costly solution because of administrative cost of checks and inspections, nor is it considered a feasible solution to the risk created by the usually risk-neutral public body. The tax approach, by contrast, creates dynamic and powerful incentives towards technological innovation. Since under the tax approach each of ATCAs will be taxed for their share of contribution to ATC risk, this will also remove externality. Tax rates can also be adjusted rather easily to impel the ATCA to develop or employ state-of-the-art equipment in order to avoid liability.

4.1.4 Public financing of ATC service in domestic laws: In the United Kingdom the CAA shares with the Secretary the duty to defray the cost of providing such services. The CAA's assets are made up of loans, grants made to it and charges paid to it, which means that the CAA may be subsidised from general tax revenues. The CAA may, upon the Secretary of State's consent or authorisation, borrow money for the discharge of its functions. The Secretary of State may also make to the CAA grants of such sums as he may consider fit out of money approved by Parliament or

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170 Civil Aviation Act 1982, s 72(2); Shawcross, VI(7).
171 Shawcross. II(53).
172 Civil Aviation Act 1982, ss 10, 12(2) & (4) & 10(3).
173 Ibid, s 12(1)(a).
The ATCA's liability

direct the CAA to transfer to him or to its reserves the whole or part of any excess of its revenue. The CAA's annual accounts and statement are subject to the control of Parliament and the CAA must conduct its affairs in such a manner as to secure that its revenue is not less than sufficient to meet its costs.

This so-called 'break-even' obligation, however, is no bar to allocative inefficiency or to the lack of proper incentives for the ATCA's managers to make a profit. The British Department of Transport has thus been studying the feasibility of breaking up the CAA and hand over many of its key activities to private companies, since it simply could not rely on public funding for its £150 million-a-year capital investment programme including radar network improvements. This was spurred by public outcry against over-loaded ATC service and ensuing routine delay. If privatised, the NATS could raise the necessary cash in the market for such improvements, and the CAA would then pay to the NATS a fee agreed for the services. The CAA, nevertheless, would remain responsible for the provision of air traffic services in British airspace. In America, the independent FAA operates on its account 203,008 miles of airways with 25 air route traffic control centres, 432 airport traffic towers, 324 flight service stations, 339 radars and over 2,700 navigational facilities.

4.2 Distributional Considerations

The justification for the distributional goal has been dealt with in detail in the context of airport noise and pollution control, and the main line of arguments there may be applicable without much modification in the bearing and distribution of ATC risk. Thus, where the ATCA is made liable for the negligent provision of ATC service, its liability payments will in practice be financed and borne by general taxpayers through a subsidy. This will unduly discriminate against taxpayers and is not desirable from distributional goals, since they already bear the costs of operating the ATCA including any inefficiency in its management and operation and since they do not derive direct benefits from ATC service. Nor is the bearing of ATC risk by taxpayers efficient, since

174. Ibid, s 13(1). Any such sums as received by the Secretary must be credited to the Consolidated Fund. See Ibid, s 61(8); 8 Halsbury's Laws, paras 136ff.
175. Ibid, s 15(1) & 15(2)(b) as substituted by the Civil Aviation Authority (Auditing of Accounts) Order 1984, SI 1984/65; Shawcross, II(53).
176. Ibid, s 8(1); Shawcross, II(53).
177. Sec 5.1.1 above.
178. TT, 28 July 1994, p.23 (Air Traffic Sell-off in Jeopardy) & 9 Dec. 1993, p.21. Under this privatisation plan, the National Air Traffic Services (NATS), a joint civil and military organisation responsible for all air traffic in British airspace, would be sold to the private sector.
180. Ch 5: 4.2.1 above.
it would not adequately induce controllers to exercise optimal care. The alternative to
this problem is therefore to allow the ATCA to raise its charges on airlines to make up
for its liability payments, rather than to make it rely on government transfer payments
or subsidy which will also need a usually long administrative process. The result would
probably be that airlines will also raise air fares to recover the increased ATC charges.
This solution is not only distributionally desirable but also efficient, since airline
passengers are deriving direct benefits from ATC service.

4.3 Economic Valuation of ATC Risk for Taxation

4.3.1 Level of taxes equal to expected costs in single-injurer cases: Assuming first
that there is only one ATCA in international society which is causing passenger
damage risk, the level of charges must be set to correspond to the expected cost of
passenger damage which the agency incurs. The expected cost can be computed on the
basis of the average cost of passenger damage the agency causes for a given period,
e.g. one year. Such a charge will adequately induce each agency to invest the optimal
amount of money in accident avoidance. The tax rates may have to be reviewed and
adjusted periodically, e.g. every 1-3 years, to reflect possible change in accident record
and resulting average passenger damage costs and to make up for inflationary effects.
Obviously, however, there are multiple ATCAs in international society causing
passenger damage risk, and this can be termed joint and multiple injurers as in the case
of multiple international airport operators causing noise-pollution.\(^{181}\)

4.3.2 Joint and multiple ATCAs and taxation by relative accident probability: For
the purpose of setting the level of charges to be levied on each society, it is first
necessary for international society to conduct collective valuation of ATC cost which
is equivalent to the aggregate accident cost which all the ATCAs of international
society cause. The aggregate cost of ATC risk can be calculated on the basis of the
average cost of total accidents involving passenger damage that all the national ATCAs
cause annually. Next, in order to create adequate incentives, the aggregate cost should
be attributed to each society in proportion to its relative accident record registered
over a given period of time, e.g. one year. For the accident frequency registered by a
particular ATCA evidences the average level of care it has exercised over a given
period of time.

4.3.3 Taxation of ATC cost under domestic laws: In English law the Secretary is
empowered to make regulations for requiring charges to be paid to him or to the CAA

\(^{181}\) Ch 5: 4.4.2 above.
in respect of air navigation services provided by him or by the CAA. Through the regulations, the Secretary determines the rates of the charges payable to him or to the CAA and may prescribe the rates as a function of the different classes or descriptions of aircraft as well as the interest rates for charges unpaid or in arrears. Such regulations may establish that the charges will vary depending on the times of landing or take-off. Under these regulations the CAA may make a scheme for establishing the amount of charges or a scale of charges payable to it in respect of the conduct of its functions other than air navigation services, having regard to the expense incurred by it and to other relevant factors. France has, since 1 September 1985, introduced the approach charge (redevance d'approche) for its air traffic terminal services (approach from 20-0 kms). The revenue from the new charge, to be collected not by airport administrators but directly by the accounting officer in charge of the budget, will be appropriated for a supplementary air navigation budget (BANA).

5. Joint and Multiple Injurers

We have so far considered the efficient control of passenger damage caused by the ATCA only or the pilot only. Often, however, losses are often caused not by the controller alone but in conjunction with pilot and/or the manufacturer. Losses incurred jointly by these different classes of injurers cause special legal problems, since it involves difficult questions of establishing causal link and determining liability allocation between them. This will be the case, especially in regard to increasing cases of collision around airports. The risk of collision caused jointly by these parties is increased according to the degree of concentration of aircraft around airports, since air corridors for access to airports have to be and indeed are restricted precisely to such times and zones as may cause minimum noise and discomfort to the residents living around airports. Congestion and resulting collision risk are often aggravated by the coexistence of small, light aircraft within the same zone which are outside the controller's control or recognition.

5.1 Concurrent Liability of the Pilot and Controller

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182. Civil Aviation Act 1982, s 73(1)(a); Shawcross, VI(7) & (16).
183. Ibid, s 73(6)(a) & 73(6); Shawcross, VI(16).
185. Civil Aviation Act 1982, s 11(1)(a)-(b) & 11(7).
188. Juglart, I(2227).
Example 6.3 Suppose the computerised radar network installed at an ATC centre was too outmoded to cover a sufficiently large area, let alone small private aircraft. Despite the risk of causing an accident, the centre cannot afford to replace the system with a new one because of high capital investment cost. Suppose a controller at this centre cleared a private aircraft to take off and while it was climbing up, he cleared a passenger aircraft flying under VFR conditions to land, which resulted in a mid-air collision. At the time, both were in each other's blind spot because of a third, light plane, which prevented the passenger aircraft crew from seeing and avoiding the climbing private aircraft.\(^{189}\) Although the two aircraft had both appeared on the controller's radarscope and were visible through the control tower window, the controller failed to warn the passenger aircraft's crew of the danger or to separate because his attention was directed to other traffic.\(^{190}\) Thus, the controller failed to combine information on his radarscope with his visual observation to warn or separate aircraft. In this case the efficient outcome would be to impose liability both on the ATC centre and the crew of the passenger airliner for failure to watch out.

5.1.1 Concurrent duties of controller and pilot: We have seen that the pilot should be primarily responsible for safe operation of aircraft in VFR conditions and the controller in IFR conditions.\(^{191}\) This, however, does not mean that a controller is absolved of his duty to warn or separate under VFR conditions, nor does it mean that the pilot is relieved of his duty to exercise due care and keep a lookout for any danger in IFR.\(^{192}\) Even a clearance cannot be cited as a pretext for violating whatever regulations established.\(^{193}\) In VFR, although the pilot is in a superior position to watch out for potential danger, the controller can also avoid an accident by warning or separation. Likewise, in IFR, although a pilot is presumed to be unable to see, not only is this rebuttable but he still may maintain vigilance over obstacles through radio contacts with the tower or over the functioning of various instruments (e.g. altimeter). If the pilot considers the instructions or clearance given by the controller not satisfactory for safe operation, he may demand a modification and in any case he cannot use the clearance as a pretext for shifting his duty to the controller.\(^{194}\) Thus, whether in VFR or IFR, whenever the pilot fails to see and avoid and at the same time

\(^{189}\) See *Universal Aviation Underwriters v. US.*, 496 F Supp 639 (D Colo 1980).

\(^{190}\) *Ibid.*, at 647.

\(^{191}\) Secs 1.2 & 1.3 above.

\(^{192}\) Juglart, l(2228) & (2198) in *fine; Todd v. US.* n.148 above.

\(^{193}\) *Direction générale de l'aviation civile*, ch II. Domain of Application of Rules of the Air, r 2.4.3; Juglart, l(2198).

\(^{194}\) See Juglart, l(906).
the controller also fails to warn of hazards or to separate, they must be held concurrently liable for the loss suffered.

5.1.2 Incentive of concurrent liability: If only the pilot were made to pay all the cost arising from the operation of his aircraft in VFR, the controller will not be induced to issue adequate and timely warning, issue clearance with due regard to dangerous situation (e.g. wake turbulence) or warn of changing weather conditions (deterioration in visibility) or other dangers. Likewise, if only the ATCA were made liable for the entire loss in IFR flights, pilots will be induced to relax their vigilance and take less than optimal care. They may, relying blindly on clearance, attempt to take off in weather conditions where visibility on the runway is zero miles in fog or to make a premature and reckless descent into unfamiliar topography such as mountainous terrain or may not be on the proper alert for the presence of other aircraft. This kind of incentive dilution can only be avoided by imposing concurrent liability on both pilot and controller.

5.1.3 Case law on concurrent liability: The tone for concurrent liability was set in Neff v. US, where the pilot attempted take-off despite obvious signs of an imminent thunderstorm spreading over the airfield and the plane crashed on take-off. The lower court attributed the crash to the controller's failure to warn the pilot of the impending storm, but the Court of Appeals reversed and held correctly that the crew were contributorily negligent for their attempt to take off, in disregard of compelling signs of an immediate, substantial danger such as severe turbulence. Likewise, in Todd v. US, the controller was correctly held liable in issuing approach and descent clearances over mountainous terrain under adverse weather conditions without determining the plane's position and without warning the pilot flying in IFR of possible obstacles. The pilot was correctly found concurrently liable for following blindly the clearances and commencing a premature and reckless descent into unfamiliar surroundings, since "the clearance simply granted the pilot a measure of discretion to be exercised in accordance with standards of due care and applicable regulations."

In Eastern Air Lines, Inc. v. Union Trust Co., a collision case mentioned earlier in the context of governmental liability under the FTCA, the ATCA was correctly held

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195. See Geut, n.47 above, at 266.
196. N.45 above.
197. At 920.
198. N.148 above.
liable for granting landing clearance to two aircraft in VFR on the same runway approximately at the same time without separating the two and without warning either pilot of the other's location or presence. Since it was in VFR flight, Eastern was concurrently liable for failure to see and avoid other aircraft. Similarly, in *US v. Miller*, the appellate court, reversing the trial court, held the controller liable for a mid-air collision arising from his failure to warn either of two aeroplanes in VFR converging at a ninety degree angle, while the pilot of one aircraft was held concurrently liable for violation of the right-of-way rules by failing to clear the area visually before entering the downwind leg of the traffic pattern.

In *Allegheny Airlines, Inc. v. US*, the airline's DC-9 descending for landing in IFR collided at around 3,000 feet with a smaller Piper Cherokee piloted by a student pilot in VFR with no transponder, which resulted in 83 deaths. The court held the controller negligent for his failure to detect on his radarscope the Piper and for subsequent failure to warn the DC-9 crew or separate the two within his control zone. Allegheny Airlines, however, was not allowed to recover for the loss of its plane from the US government because its crew failed to keep a proper lookout and was found contributorily negligent, even though the flight was in IFR.

In a recent French case involving the controller's landing advice and instructions and the pilot's operation upon the clearance, the Conseil d'Etat reversed the lower court's decision holding only the pilot liable and ruled that the pilot and controller were concurrent liable, each for one half of the loss. In the opinion of the Conseil d'Etat, the pilot was ultimately responsible for changing from an VFR to IFR flight, even though after having informed the control centre of the change and obtained due authorisation; at the same time, in authorising the change, the air traffic control centre responsible for the region of Paris was also at fault in misleading the pilot into changing the flight conditions by not informing the aircraft crew until its arrival near Reims that it would shift from the terrain fit for landing in IFR to a terrain accessible only by VFR.

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201. See also *Union Trust Co. v. US*, nn.104 & 142 above.
204. *Ibid.* at 1346.
205. At 1349.
206. At 1351.
209. See Juglart, II(2198).
The ATCA's liability

If the above decisions are economically sound judgements based on correct reasoning as is believed, the following decisions may well draw criticism. In *Ingham v. US*, the controller was held liable for his failure to make the pilots of an Eastern Airlines DC-7 adequately informed and warned of sudden deterioration in visibility from one mile to three-quarters, just over the VFR landing minimum of one-half mile, on its 12-minute final landing approach. In so ruling, the Second Circuit held that since a drop in visibility of 25 percent was such a critical change as to push existing weather conditions dangerously close to a landing minimum, it should have been reported to the crew in the interest of safety. The court’s reasoning, however, is flawed, since the flight was in VFR, since the court ignored the fact that the pilot was well aware of the adverse weather conditions likely to be encountered in the runway and since it also rejected its own statement that the pilot is in the best position to observe and assess the potential risk of the weather on the plane’s landing approach.

The decision in *Stork v. US* must also be criticised. In this case, the pilot was given clearance and attempted take-off when visibility on the runway was zero miles in fog, but poor visibility made the pilot lose control of the take-off roll and led to the crash on the runway. The majority of the court held that the controller had a duty to warn the pilot that take-off under poor weather conditions contravened FAA regulations and that the silence on the part of the controller was the proximate cause of the crash. Although it is true that the controller must have delayed clearance to avoid the accident or given adequate warning, nevertheless, the pilot was almost in the same position as the controller to look out for poor weather conditions and to delay take-off, regardless of the traffic clearance. This is reflected in the dissenting opinion: "At the time of this accident, the pilot of an aircraft was the sole judge as to whether or when weather conditions would permit a take-off; and the traffic controllers possessed no authority to deny take-off clearance".

Likewise, in *Hamilton v. US*, the controller cleared two aircraft to land at similar times and on similar courses without warning either aircraft of the other's presence.

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210. N. 127 above.
211. *Ibid*, at 233-34.
212. At 235 & 237.
214. 430 F 2d 1104 (9th Cir 1970).
216. At 1108.
217. At 1109.
218. 343 F Supp 426 (ND Cal 1971), aff'd 497 F 2d 370 (9th Cir 1974).
until it became apparent that they were on collision course. The court determined that although the duty to exercise due care is a concurrent one, the ultimate responsibility for the safe operation of the aircraft in VFR rests with the pilot regardless of traffic clearance, for a pilot is in a far better position in VFR to look out for other traffic. The court also held the controller not negligent for directing his attention to other aircraft within the control zone, since a controller was not supposed to pay attention to any one aircraft if he had reasonable grounds to believe that the pilot was carrying out his instructions and if other aircraft were present in the same zone. The court's decision was premised upon the supposition that radio communication by each of them with the tower made the other's presence nearby reasonably apparent. Nevertheless, although the pilot was correctly held liable for failing to watch out for hazards in VFR, the controller must also have been concurrently liable for his failure to warn or separate.

For similar grounds, we must be critical of decisions in Coatney v. Berkshire and Thibodeaux v. US both of which concerned VFR collision damage within the airport traffic area and held only the pilots concerned liable despite the controller's failure to warn or separate. The controller must also have been concurrently liable. In In Re Air Crash Disaster at New Orleans-Louisiana on March 20, 1969, the issue in dispute was whether the controller's statement "If you can see the runway or approach lights, affirmative you can land," given to the pilot of DC-3 approaching in very poor visibility, amounted to a landing clearance and proximately caused the crash. The court viewed this as neither a legal sanction to land nor as an encouragement for the pilot to attempt to land but rather as merely a clearance for a low level approach and held the pilot's negligence in attempting to land in very poor visibility was the proximate cause of the crash. This decision should also be criticised since the controller should have given clear, adequate warning.

In a recent case, the Fifth Circuit in Murff v. US reversed the trial court's verdict and correctly held the pilot and instructor of a Cessna 172 operating in VFR primarily responsible for a mid-air collision with a Fairchild F-27 then in IFR operation. But the court must also have held the controllers concurrently liable for failure to watch, warn

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220. At 431-32.
221. At 376.
222. 500 F 2d 290, 292 (8th Cir 1974).
223. 14 Avi 17.653 (ED Tex 1976), n.60 above; 17.654-55.
226. At [17.399] 278.
227. N.79 above.
and maintain separation of the two aircraft involved, just as the trial court did,\(^{228}\) so that liability could be apportioned between the Cessna operator and the US government.

5.2 Wake Turbulence

5.2.1 Notion of wake turbulence: Wake turbulence is a natural phenomenon of whirling vortices trailing from the wing tips of large aircraft, thrust steam turbulence or rotorcraft downwash.\(^{229}\) Wake turbulence is dangerous to small aircraft operating at low altitudes (e.g. during landing and take-off), since it may expose small aircraft to violent rolling or pitching or a sudden gain or loss in altitude. The effects of wake turbulence was not known as a separate risk until the 1960s and as such controllers' duty to separate or warn was denied in a 1959 crash case, Franklin v. US.\(^{230}\)

5.2.2 Controller as the cheapest cost avoider of wake turbulence risk: It would be reasonable to say that the controller is, by training, experience and vantage position, better qualified and positioned to assess the dangers to a light plane in landing or taking off behind a bigger jet regardless of VFR or IFR. A controller can avoid a wake turbulence damage at cheaper cost by warning the pilot of the danger, by denying take-off or landing clearance until after turbulence dissipates. Again, since wake turbulence is invisible, a pilot exercising due care in VFR can hardly see and avoid a potential wake turbulence damage from an earlier aircraft. For these reasons, the controller must be obligated to caution the pilots against the wake turbulence danger or to separate.

Both in Neal v. US\(^{231}\) and Yates v. United States,\(^{232}\) the controller was thus held liable for failure to issue a wake turbulence caution under IFR conditions. In Neal, the controller failed to separate a DC-9 from a private jet due to land two minutes behind it. The Fifth Circuit in Hartz v. US\(^{233}\) held that the controller's warning ("watch the prop wash") was neither sufficient nor adequate to caution Hartz of a danger which was then known to the controller and that the correct warning should have been phrased, "caution, turbulence, departing Eastern DC-7." The Court reversed the trial court and held upon reconsideration after remand\(^{234}\) that the controller was solely liable for damage.

\(^{228}\) Ibid, at 294.
\(^{229}\) Encyclopaedia Britannica, aerodynamics, vol 1, p 113.
\(^{231}\) 562 F 2d 338, 340 (5th Cir 1977).
\(^{232}\) N.78 above, at 884.
\(^{233}\) 415 F 2d 259 (5th Cir 1969).
5.2.3 Pilot's failure to obey warning in VFR and concurrent liability: In case the pilot disregarded a wake turbulence warning and caused damage, he should be solely or concurrently liable. In *Jemette v. US*, the controller duly warned the pilot flying in VFR of wake turbulence risk and was held not liable. Likewise, the court in *Miller v. US* held the controller not liable for failure to issue a second warning of wake turbulence, since Miller was an experienced pilot and well aware of the hazard himself while practising touch-and-go landings. In *Robinson v. US*, the ATC agency was held not liable for failure to warn of possible turbulence, since the pilot either knew or should have known of the turbulence risk and since the pilot breached his primary responsibility for the safe movement of his aircraft. In *Robinson*, the vortex damage occurred twelve minutes after the a larger aircraft passed on the runway, which was held not to be reasonably foreseeable by the controller.

In *US v. Furumizo*, where the pilot of a small aircraft was given take-off clearance after being adequately warned of possible wake turbulence from a departing aircraft, the Ninth Circuit held that a controller observing a pilot of a smaller aircraft start its take-off roll close to a big jet in disregard of the warning, should have warned the pilot of the danger again in the presence of imminent peril, or he should have denied landing or take-off clearance until after the turbulence settled. This decision, however, may be criticised, since the pilot was not acting on the controller's caution and must have been concurrently liable.

5.3 Concurrent Liability of the Pilot, Manufacturer and Controller

Although we have established that the pilot and controller are concurrently liable in certain conditions, the question remains as to how efficiently to allocate the loss between them or between them and the manufacturer.

Example 6.4 Suppose there occurred a mid-air collision involving two different types of aircraft registered in State A and B, respectively, over the airspace of State C, which resulted in passenger damage on a tiny village of State C. Suppose also later accident investigation established that not only the two carriers but State C's ATCA (e.g. wrong instruction) and the manufacturer (e.g. mechanical failure) of one of the
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The two aircraft were found to have caused or contributed to the accident. Here, the two aircraft operators and the manufacturer can reasonably be assumed to act in concert through the agency of the ATC-certifying body in order to minimise their joint expenses. In this joint tort example, in order to induce joint injurers to take optimal care, liability should be apportioned in proportion to their relative accident probability, rather than on the basis of their relative degree of fault.

5.3.1 Liability apportionment between multiple injurers on the basis of relative accident probability: Although in most concurrent liability cases liability is divided on the basis of comparative negligence, difficulties will arise where the exact degree of fault by each of joint injurers is not identifiable or is costly to identify and its determination is thus liable to error by the court in assessing their relative degree of negligence. Again, since whether under the negligence rule or strict liability the victims (or their relatives) of a collision will bring an action against either one or more of the injurers involved in the collision, the court would have to determine how their respective liability will be apportioned. Otherwise, one or more of the injurers who paid out compensation to the victims may well end up in bringing recourse actions for indemnity and contribution against the other injurers. In comparing respective accident probability of the aircraft operators, the manufacturer and the ATCA in Example 6.4 above, common units for the comparison of relative riskiness of their activities should be accidents per year involving passenger damage.

5.3.2 Liability allocation between multiple injurers under domestic laws: In Musini et Cie Iberia c. Etat français, which arose from a mid-air collision over Nantes between a Convair Coronado and a DC-9 in 1973, the administrative tribunal of Nantes attributed the cause of the collision largely to poor ATC service. The court defined the duty of an ATCA as one close to being absolute (proche d'une obligation de résultat) which is to assure the safety of flights it has taken under its care through the information which it communicates and through the instructions or orders which it gives. Consequently, any fault on its part which contributes to the occurrence of damage may give rise to liability of the state. Despite special circumstances that contributed to the collision, the tribunal characterised the service that led to collision

239. See Ch 2: 6.1.2 & Table 2.2.
240. Sec 4.1 above.
241. Drion, 86; ch 2: 6.2.2 above.
242. See ch 4: 6.2 above in the context of liability allocation among joint injurers for surface damage.
244. See J Thomas, 34 RFDA (1980) 419, 424; Perron, n.42 above, at 207.
245. E.g. military controllers replacing and acting on behalf of civilian ones then on strike, inadequate radar equipment, and communication problems between the controller and pilots. See generally A Kean, The Language of Air Traffic Control, [1990] J Bus L 524.
as amounting to gross negligence (fautes graves) and held the state 85 percent responsible for the collision. The court allocated the remaining 15 percent to the pilot of the DC-9 for his failure to exercise vigilance which constituted negligence.

In Mattschei v. US which involved a mid-air collision in VFR, the court ruled that the duty to exercise due care to avoid accidents is a concurrent one and found the controller negligent for his failure to warn the Cessna pilot of another plane's presence above and behind him. The Cessna pilot was held 70 percent liable, 50 percent for attempting to land on the wrong runway and 20 percent for failing to see and avoid the other aircraft under VFR. The government was held liable for the 30 percent balance of the damage caused. In Rudelson v. US which arose from a collision under VFR conditions, the court held the pilots of each aircraft 45 and 35 percent liable, respectively, for their failure to maintain vigilance, while the controller was 20 percent liable for failure to scan the entry corridor area. Likewise, in Rodriguez v. US both the controller and the pilot flying under VFR were correctly held concurrently liable for the losses caused. Ruling that the pilot and the controller equally owed a duty of care and were thus equally responsible for the safety of aircraft and passengers, the court held that their respective degree of negligence and contribution to the accident were factual questions and must be determined as such.

Although the above decisions are based on comparative negligence for liability apportionment as between multiple injurers, such rules may not work where the relative degree of fault cannot be ascertained. In the ground collision of two jumbo jets in 1977 at Tenerife airport on the Spanish Canary Islands involving about 580 victims and four main defendants - Pan Am, KLM, the manufacturer Boeing and the Spanish government (for its ATC service), no exact act or omission of negligence was identified as having caused the accident. Therefore, the negligence rule could have

247. The Conseil d'Etat, however, reversed and held the state liable for the entire damage. Juglart, 1(87).
248. 600 F 2d 205, 208 (9th Cir 1979).
250. N.105 above, at 1328.
251. F 2d 735 (3d Cir 1987).
253. In the words of Hans Raben, Director General of the Netherlands Civil Aviation, "None of the persons involved can be blamed for neglect of his duties. Each of these persons may perhaps be criticised separately; however this criticism must be limited to the observation that they all, in the normal performance of their duties, had not functioned in an optimal way in a particular aspect". See Lowenfeld. Accident Law, 7-196 & 7-197.
hardly been applicable to this situation to determine the respective liability of the defendants corresponding to their respective degree of fault. Even if presumption of fault under the Warsaw Convention is applicable, plaintiffs could have easily circumvented its applicability. This is because the plaintiffs acting on behalf of the victims on board the Pan Am aircraft could simply have brought actions against KLM, while those on behalf of the victims on board the KLM aircraft could have done the same against Pan Am.\footnote{254} Similarly, the manufacturer and the Spanish government (on behalf of its ATCA) could hardly have relied on the absence of negligence in the face of huge losses that occurred.

Under these circumstances, the four defendants started 'on an equal footing' to discharge their joint liability,\footnote{255} decided not to contest their liability on condition that the plaintiffs agreed not to claim punitive damages,\footnote{256} and pooled their resources and contributed jointly to a compensation fund in 4:3:2:1 proportions.\footnote{257} The court's job was thus reduced to determining the rightful beneficiaries and the quantum of damages payable to them. Although this outcome was achieved by an ad-hoc agreement between the parties in the course of the trial and as such its value as a precedent may be limited, this was not the first of such a solution, as already explained.\footnote{258} The important point is that the four injurers, in the absence of any evidence of their fault, conceded their liability and shared the losses between them in a mathematical formula. The effect is almost similar to having applied strict liability on all injurers on the assumption that the accident probability of the three different classes of injurers can be compared for liability apportionment. Here, the portion of liability of the two carriers and one manufacturer will be borne by their respective liability insurers, whereas that borne by the ATCA could be covered by the international supplementary compensation fund that may be created from taxing each society for its ATC service activities.

Conclusion

In this chapter, we took up the issue of passenger damage risk caused by ATC-certifying/licensing activities and examined how to minimise the combined cost of accidents and their avoidance. Although both ATC service and certifying-licensing activities are conducted ostensibly in the public interest, we dealt with them separately on the basis of a distinction between service and regulatory activities. In the case of

\footnote{254} Juglart, II(3272).
\footnote{255} Juglart, ibid.
\footnote{256} A F Lowenfeld, Accident Law, 7-200. The accident cost the insurers $161 million. Juglart, II(3424) & II(2510).
\footnote{257} Lowenfeld, ibid.
\footnote{258} See the Turkish Air Lines disaster case. ch 3: 6.2.2.
ATC risk, the issue was who, the pilot or the controller, has the superior knowledge about risk under different meteorological conditions and is thus in a better position to assess and avoid the danger at a cheaper cost. We noted that although pilot and controller share a close working relationship for the safety of aircraft operation, the pilot is in a superior position under VFR conditions to see and avoid and he thus must be liable for VFR accidents. On the other hand, under IFR conditions the controller is in a position to avoid an accident at a cheaper cost and as such he must be liable for failure to warn of hazards or separate.

On the basis of this background, we demonstrated that both the negligence rule and strict liability are efficient in terms of incentive creation. Nevertheless, if the court has imperfect information about the correct negligence standard corresponding to the efficient outcome, the negligence rule will not adequately induce the controller to take optimal care. Thus, insofar as the court has correct information about the victims' damages, strict liability is preferred to the negligence rule. We also found that the ATCA must be suable for any loss it may have caused in the course of providing ATC service. Immunity will not induce the ATCA to take optimal care, nor will it encourage it to invest adequately in equipment and training of controllers. The public interest rationale of ATC service as well as case law are also in support of the view that specific performance of ATC service does not at all involve any discretionary act or omission. This accords well with the idea of ATC which requires efficient traffic management under the controller's time and other constraints and in the face of congestion.

As to the efficiency of alternative liability rules governing ATC risk, although both the negligence rule and strict liability are efficient, the former tends to present victims with much difficulties in connection with proof of fault and establishment of causal link. The negligence standard is again elusive to specify, and even operations manuals have been ruled as neither exhaustive of every conceivable situation, nor establishing in any way the standard of care that controllers must exercise in a particular situation. Although strict liability can remove most of these problems, it cannot eliminate externality completely. Furthermore, public funding of ATC service, the lack of market insurance against ATC risk and distributional considerations also discredit strict liability and favour taxation. Under the tax approach, charges will be levied on ATC authorities by reference to their relative accident probability registered over a given period, subject to periodic adjustment of the rates, e.g. every 1-3 years, to reflect any change in their accident frequency and thus to induce the ATCA to take as much care as possible.
In the case of losses caused jointly by the pilot and the controller (e.g. the pilot failed to see and avoid, while the controller simultaneously failed to warn or separate, whether in VFR or IFR), efficiency would require concurrent liability and sharing of liability in proportion to the relative accident probability registered by the carrier and the ATCA. This is because an accident record evidences the average level of care exercised by each injurer over a given period and because the determination of the comparative degree of negligence of joint tortfeasors is costly and often liable to error. The possibility of the court making errors may explain why American case law largely relying on comparative negligence principles has often shown inconsistent, conflicting and thus inefficient results in apportioning liability between joint tortfeasors in cases of concurrent liability.

As to wake turbulence damage which was not recognised until the early 1960s, controllers have been found to be able to avoid such damage at a cheaper cost than the pilot, and the former must thus be liable for losses caused by wake turbulence. Nevertheless, there will also arise cases where both should be concurrently liable. This will be the case where the controller's warning of the hazard or separation (e.g. by means of the grant of clearance at enough intervals) was not adequate and the pilot also did not pay heed to, or simply ignored, the controller's warning. Finally, in an accident involving the pilot, manufacturer and controller, the rule developed in the pilot-controller concurrent liability should apply *mutatis mutandis* on efficiency grounds, i.e. liability apportioned between them in proportion to their relative accident probability.
CONCLUSION

The object of government in peace and in war is not the glory of rulers or of races, but the happiness of the common man.

------ Sir William Beveridge

The Conservative Party has never believed that the business of Government is the government of business.

------ Nigel Lawson

As observed in the INTRODUCTION, the aim of this work was to apply economic approach to evaluating the existing international and domestic legal regime for aviation liability and to establish a set of pointers towards building a new, coherent legal regime governing the entire range of risks inherent in international carriage by air. This study is thus aimed at demonstrating how economic ideas and tools of analysis can usefully be employed to assessing the efficiency of international instruments, domestic legislation and court decisions on civil liability for aviation and environmental risk and to suggesting a possible reform of civil liability. In order to do this, we have applied the primary economic criterion of efficiency, and equity where applicable, to evaluating the existing liability and property rules governing passenger, surface and environmental damage, using many simplified models under certain assumptions.

In so doing, we also undertook an analysis of the efficiency of regulatory regimes governing product safety and quality and environmental protection to investigate the respective role of, and the relationship between, civil liability and regulatory regimes in controlling such risks. As such, the main thrust of this study lies in the premise that where accident and environmental risks are unavoidable, the law of civil liability should be so efficiently formulated as to induce all the parties involved to minimise the social costs of accident and environmental harm plus their avoidance costs. The arguments have thus been built on the principal tenet of economic analysis that society, international and domestic, should make use of tort liability to promote an efficient allocation, and equitable distribution where relevant, of aviation losses among responsible parties. As the result of application of the efficiency and equity criteria in different contexts involving different injurers and victims, we can now sum up the major themes of this work.

1. Utility of Predictive and Normative Economic Analysis

Despite certain constraints on the assumptions of economic analysis, i.e. imperfect functioning of the product, professional service and insurance markets resulting from information deficits, externalities, monopoly and bounded rationality of individuals, efficiency is still a useful primary, although not the sole and exclusive, criterion by reference to which we can assess the desirability of a legal rule. Indeed, the question is not whether various markets work perfectly, which is impossible to achieve, but whether they work in a reasonably tolerable manner and how their defects can be remedied through the intervention of legal rules and regulatory regimes. Reasonable amount and quality of information are always available and accessible to consumers in relation to air fares, product and service quality, and insurance opportunities, while competition is the name of the game in the airline and insurance industry. Average consumers usually, if not always, act on financial incentive, while bounded rationality should not be over-exaggerated. Considerable competition, domestic or international, already exists, and competition is increasing. In Britain, for example, local authority-owned Luton is pitted against Stanstead operated by privately-owned BAA.

From this perspective, economic analysis is generally useful to understanding and predicting the behaviour of parties acting in the face of accident and environmental risk. Economic analysis shows how rational, utility-maximising individuals and firms arrive at decisions under the given liability rules and insurance opportunities. The value and validity of economic analysis depend on whether the assumptions postulated are realistic enough to capture the important features of the accident or harmful situation and on whether the analysis leads to understanding systematically the effects of liability and insurance on the parties' behaviour which would otherwise not be obvious. As to the question of whether liability rules do deter, although this is basically an empirical question, it can reasonably be argued that the threat of liability will significantly affect the behaviour of individuals and business concerns, given its effects on their financial position, adverse publicity, and insurance premiums.

4. Professor Terence Daintith has drawn my attention to this point during the revision of this work.
5. Shavell, 291.
The utility of normative analysis depends on whether and how much the analysis helps one to reach conclusions that were not clear before. In this connection, the analysis above has made it clear that strict liability has advantage over the negligence rule in restricting the injurer’s activity levels to the socially desirable levels and in minimising externalities; that insurance is socially beneficial; that the argument that liability insurance dilutes the deterrent objective or effect of tort liability is oversimplified; that insurance policies contain various features that create financial incentives for the insured to take adequate risk-reducing steps towards safety (e.g. coinsurance, deductibles, experience-based premium rating); and that deterrence will be diluted to the extent that there exists uncertainty about the cause of losses or about the exact degree of contribution by injurers to the occurrence of losses and that courts make consistent errors in their determination of the socially desirable levels of due care and activity to allow the injurer or polluter to escape liability.

2. Efficiency

Even in this age of technological innovation, human or mechanical failures take a fairly regular, and often disastrous, toll of life, limb and property. From this perspective, it is clear that the social costs of accidents/incidents and noise and pollution caused in the course of international carriage by air cannot entirely be eliminated once and for all. Total elimination of such risks is neither possible nor desirable, given the prohibited costs involved. These costs, therefore, should, for the general betterment of social welfare, be minimised through the use of liability rules governing accident and environmental harm. For these purposes, we have identified and applied consistently in various contexts three major criteria of efficiency _ incentive creation, efficient risk/loss allocation and least administrative costs^ to assessing the desirability of legal rules governing passenger, surface and environmental damage.
In passenger damage risk caused by the carrier and the manufacturer, efficiency should be the sole criterion for assessing the desirability of liability rules, since in these relationships, it is quite difficult, if not impossible, to redistribute income. Although the liability system (legal rules and court decisions) affects passengers (or their relatives entitled to compensation) representing different groups in terms of their needs for compensation, it does not affect all individuals but only those involved in litigation or out-of-court settlements. In this contractual/market relationship, there will be no carriage unless a passenger and a carrier both agree voluntarily, and as such there will occur little externalities. On the assumptions of the reasonably tolerable functioning of the insurance, product and service markets, every average passenger as the best judge of his own interest will be induced to buy the efficient amount of carriage by air products, which is especially the case with strict liability.

In the case of surface damage caused by aircraft operation, it is possible to redistribute income, given that the risk affects almost all third-party individuals. Nevertheless, if utility-maximising private insurance is available in the market, as it really is, it will be more efficient to leave the matter to the market than to tax aircraft operators for income distribution. The rational operator will then decide to buy adequate insurance against surface damage risk or to take appropriate risk-reducing steps. In both passenger and surface damage risk, therefore, it would be costly and ineffective to attempt to redistribute income under the liability system. And since there already is a social institution in operation (e.g. the income tax system) that reaches all individuals and firms and performs a redistributive function, the liability system need not concern itself too much with its distributional consequences. In other words, in these two types of risk, efficiency is the only criterion for evaluating the desirability of liability rules, and distributional considerations should not affect the choice of a desirable legal rule or the size of awards.

2.1 Incentive or Deterrence

As one of the three key criteria for assessing the efficiency of a legal rule, the incentive criterion has two aspects: the care and activity-level decision. The care decision, referring to the behaviour of the parties which affects risk, has been applied to passenger legal liability examples involving carriers and manufacturers where care corresponded to how each of these injurers will take precautions to reduce risk. The care decision has also been applied to the carrier's liability for surface damage and to

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10. Ch 2: 2.3 above.
11. See Shavell, 296.
the ATCA’s passenger legal liability. In the context of the liability of carriers and manufacturers for passenger damage, if only one carrier or manufacturer is involved in a loss-causing accident/incident, he should be strictly liable for the entire losses caused to a passenger’s life and limb. This is because the carrier or manufacturer, with superior knowledge about risk, can be better induced than passengers to take precautions and internalise accident costs.

The activity level decision has been taken up as the main factor affecting estimated damage in the context of the airport operator’s activity causing environmental and passenger damage. In this application, the activity level as the measure of risk referred to the number of aircraft movements at the airport for a given period of time. This is because noise and pollution damage are incidental to, and an unavoidable consequence of, aircraft operation and because the environmental harm has more to do with the airport operator’s activity level than with his care. Although passenger damage risk caused at airports is to some extent related to the operator’s care, in view of the possibility of the courts making errors in identifying correctly the responsible party and of relatively infrequent incidence of such losses, passenger damage caused at airports should also be linked to the operator’s activity level.

2.2 Relative Efficiency of the Negligence Rule and Strict Liability

The Rise of Strict Liability

International and regional agreements, domestic legislation and court decisions on the liability of the carrier and manufacturer for passenger damage have been increasingly moving toward some form of strict liability (with the defence of contributory negligence in the case of the carrier’s liability). This is evidenced in the adoption of e.g. the Montreal Agreement 1966, Guatemala Protocol 1971 and the EC Directive 1985. Similarly, aircraft operators are subject to strict liability with the same defence for surface damage under the Rome Convention system and in English and French law. The rise of strict liability is in line with developments occurring in tort law in general, and may be construed as the law’s attempt to restore a right balance in information between producers and consumers.

An American survey conducted in the context of tort law in general has shown that proof of fault under the negligence rule is still a great burden in the context of the general tort compensation process. The reason why victims have been denied

12. Ch 1: 1.3 & 3.3 above.
compensation in an overwhelming majority of cases was either no party was at fault, or fault could not be proved, or plaintiff was found contributorily negligent (then a complete bar to recovery). In a similar vein, an English survey found difficulties with proof of the defendant's negligence and lack of evidence to be two of the most frequently cited reasons for abandoning claims or not claiming at all. These findings are also relevant and applicable in large measure to aviation tort law, as demonstrated in the Tenerife disaster litigation involving the liability of airlines and the manufacturer (and the ATC agency).

In aviation accident law, a negligence standard may be an elusive goal to fix, given high technicalities associated with aircraft manufacture and operation and air traffic control service and with the uncertainty surrounding causation. If the courts with imperfect information were to make consistent errors in determining the level of due care applicable to each injurer, he will not be induced to exercise appropriate precautions. Furthermore, there often exists little correlation between the degree of fault committed and its contribution to the consequence of harm (or compensation due) that resulted. In other words, liability for a negligent behaviour is often out of proportion to the negligence giving rise to the harm. Under the parties' risk aversion, the negligence rule is not well in accord with efficient risk allocation or insurance premium-fixing practice which is based on the insured's past experience relating to the number of accidents or incidents covered by the policy for which legal liability is incurred (or the insured's loss claims data).

The most potent of all criticisms against fault liability is that it is difficult to define reasonable care in a particular case and to establish causal link between negligence and resulting harm. Since negligence represents a community standard of blameworthy behaviour as enunciated by the Hand Rule or the Restatement, reasonable conduct in one society may turn out unreasonable in another. Although the negligence standard must be set at the efficient level of care, such a standard is bound to change as aeronautical science and technology are developing. Leaving the issue of determining the applicable standard of care to the often inconsistent decisions of the courts of each

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14. Harris, Maclean et al. Compensation and Support for Illness and Injury, Table 2.12 & p.110-11 & Table 3.12.
15. Ch 6: 5.3.2 above.
16. Ch 1: 5.1.2 above.
18. US v. Carroll Towing Co., ch 1: 5.1.2 above.
19. Restatement (Second) of Torts, ss 291-293.
society\textsuperscript{20} will certainly not serve the interest of international society. This is because such uncertainty and unpredictability over the efficient standard will not promote utility-maximising decisions by injurers and victims as well as their insurers. For these reasons, the preference for the negligence standard in tort law has been ascribed not so much to a consideration of efficiency but to a preference of judges 'to subsidise industry and risk-taking'.\textsuperscript{21}

By contrast, strict liability not only creates powerful incentives for the injurer to take all justified care but also restricts, by means of the price mechanism, his participation in the activity to the socially optimal levels, thus helping to minimise possible externalities arising from his activity. Under strict liability, causation issues can rather easily be tackled: the causal requirement can be explained as a device for attributing accident/incident costs to the risk creator, while proximate cause can be determined on the basis of the probability of its occurrence. In relation to the liability of the carrier, manufacturer, airport operator or ATCA for passenger damage, it can reasonably be assumed that the injurer is equipped with superior knowledge about risk and better positioned to reduce risk by taking all justified steps or to internalise the costs in the prices they charge. The aircraft manufacturer, in particular, will adequately be induced to allocate the efficient amount of investment to safety research and development only when he is held liable for 'unforeseeable' losses caused by a defective design (development risk is no defence).

It is recognised that in the context of the liability of general aviation manufacturers, strict liability was first applied to \textit{Goldberg v. Kollsman Instruments Co.,}\textsuperscript{22} a 1963 case.\textsuperscript{23} What may be called a triumph of strict liability,\textsuperscript{24} however, is not without limitations. Although passengers can in most cases do very little to affect or reduce the risk, they can affect or reduce the occurrence or degree of injury in certain situations or may, if they are risk-averse, shift risk to the insurer by buying first-party insurance. Something similar can be said about the negligence rule. Hence, even under strict liability the defence of contributory negligence has a deterrent role to play in the carrier's liability for passenger and surface damage. This is the case with a passenger who can on the pilot's instructions wear seat belts during a wake turbulence without much costs and with the owner of a tall building on the ground who can install a light

\textsuperscript{20} E.g. M A Franklin, Replacing the Negligence Lottery: Compensation and Selective Reimbursement, 53 Va LR (1967) 774.
\textsuperscript{21} See ch 3, n.341 above.
\textsuperscript{22} 12 NY 2d 432, 191 NE 2d 81 [1963]; ch 1: 4.2.2. n.116 & ch 3: 3.2.4, above.
\textsuperscript{24} See \textit{ibid}, 32.
flashing on and off at the top of his building situated below and around the flight path to warn the pilot of the danger of collision at night.

In short, courts' errors in setting the correct damages distort parties' behaviour more under strict liability, whereas their errors in fleshing out the efficient legal standard of care distort parties' behaviour only under the negligence rule. Under strict liability, potential injurers will balance the costs and benefits of accidents at the margin and their precautions are elastic with regard to errors in damages, while under negligence injurers continue to conform to the standard even if small changes are introduced in the magnitude and probability of damages. Given information and error costs, a simple solution is for courts to use strict liability when damages are knowable and a negligence rule when efficient standards are knowable. Damages are knowable when injuries are monetised, and they are not knowable when injuries involve consumer surplus or uncertain payoffs. Efficient standards will emerge when repeated interactions between the people produce community norms. From this perspective, there may exist efficient community standards in relation to the carrier's liability for passenger damage, but it is not certain whether there exist any clear community norms with respect to liability of the manufacturer or the ATC agency for passenger damage.

Causation

As observed and demonstrated throughout, causation is still an issue as difficult and unsettled as it was, despite various efforts to set out its criteria. Needless to say, in order to produce the right amount of deterrence under negligence, it is essential for courts to determine the exact correlation between negligence and harm. But in an aviation accident, whereas disputes about the cause of an injury is relatively rare, the cause of an accident is not infrequently uncertain. Substantial difficulties often arise with regard to proof of fault and establishment of causal link. This is especially so when an accident or collision involves joint and multiple injurers and the exact degree of contribution to the accident by the respective injurers (multiple causation) is uncertain, as was the case with the ground collision at Tenerife. Indeed, absolute certainty is rarely possible when human events must be reconstructed and recounted by a preponderance of evidence.

26 Cooter, ibid.
27 Ibid.
28 Ibid.
29 Ibid., 14 & 23.
Deterrence will be diluted under the negligence rule to the extent that parties, especially injurers, are allowed to escape liability as a result of the courts' imperfect information about causation and making consistent errors in determining the probable cause of losses and the optimal levels of due care (or negligence) applicable to defendants in a particular case. Thus, whether as the cause or consequence of the current developments in tort law edging towards strict liability, modern law of tort comes to focus less on strict causation and more on contribution to the occurrence of the given harm. This is applicable not only to accident damage but also to environmental harm. In the absence of absolute scientific proof of causal link between various factors and the occurrence of harm, any one of the multiple simultaneously contributing factors that increases risk needs to be calculated as a cost worth internalising, even though it is not the sole or exclusive source of the harm caused.

In some countries, injured passengers may be awarded social security benefits for disability, plus medical care costs from public funds, on top of the compensation payable, which may breed externalities. But these benefits and medical costs are funded by the general tax revenue to which the injured is generally supposed to make contributions. This may also be explained in terms of the causal principle. If a man's benefit is earned by his own efforts, these efforts will count as the proximate cause of the benefit to the exclusion of other factors. Insofar as a benefit has been secured by plaintiff's own efforts, the benefit accruing to plaintiff upon the commission of defendant's wrongful act is not deductible from the damages payable by defendant. This can be illustrated in an example where plaintiff has taken out first-party private insurance against accident risk and later suffered from an injury. The plaintiff who has paid out the premium for the benefit of himself "should be entitled to the insurance moneys without losing any part of his claim against the tortfeasor." Thus, in Payne v. Railway Executive where, as was already explained, plaintiff was injured by defendant's negligence and invalided out of the Royal Navy, the court held the amount of a disability pension not deductible from the damages payable by defendant. The court correctly ruled that the entitlement to the pension was the consequence not of the tort, but of his service in the Navy and that the naval service

30. G L Priest, n.23 above, 38.
31. Priest, ibid.
32. See Ogus, 52 & 189.
34. Hart & Honoré, 160.
37. Ch 1: 5.2.1 above.
was the 'causa causans' of the receipt of the pension, while the injury was a mere 'causa sine qua non'. Again, in Parry v. Cleaver the House of Lords held that a pension, whether discretionary or not, and whether contributory or not, is the 'fruit, through insurance, of all the money which was set aside in the past in respect of his past work'. As to medical care costs, national health facilities have been held as either a gift or akin to the fruit of insurance. And most people pay income and other taxes towards the provision of national health service. Only insofar as the entitlement to national health service is given as a pure gift without regard to one's own contributions through his tax payments to NHS funds, there may be a justification for the deduction of the amount of medical care costs from the damages awarded for injury from an aviation accident.

2.3 Risk/Loss Allocation, Insurance and the Award of Damages

Where market insurance provides incomplete coverage of detrimental risk because of the moral hazard problem, social welfare is affected by the availability and nature of liability insurance. Under parties' risk aversion, it is insurance that allocates (and spreads) losses and deters injurers, contributing to enhancing safety. Thus, if, as assumed, accident/incident risk cannot be eliminated, it should be allocated or shared between the parties or shifted to the insurance company. One notable example of risk sharing between joint injurers can be found in the rule of contribution under English and American law. The tendency under the negligence rule to determine the objective standard of care in disregard of variations in the personal characteristics of the defendant is also attributed to insurance considerations.

The issue of how liability rules allocate passenger damage risk caused by the carrier or the manufacturer has a direct bearing on the measure of social welfare. Strict liability is preferred to the negligence rule to the extent that the carrier has superior information about risk and is thus able to avoid it at cheaper costs than passengers or that passengers are more risk averse than carriers. In view of the costs involved in risk differentiation between low- and high-risk insureds and in order to minimise moral

38. Ibid, at 36 per Cohen LJ.
40. Ibid, at 16 per Lord Reid.
42. See E J Weinrib, The Insurance Justification and Private Law, 14 J Leg Stud (1985) 681, 683; James, Accident Liability Reconsidered, 560; ch 1: 6.2 above
hazard and adverse selection problems,\textsuperscript{45} liability for passenger or surface damage should be allocated between joint injurers in proportion to their relative accident probability or insurance claims made.\textsuperscript{46} Liability allocation according to the injurers' relative accident probability will apply continual pressure on them to reduce risk and also remove uncertainty over causation in multiple injurer case. A similar method can be applied to losses caused jointly by two or more manufacturers.

It may be arguable that there may be some problem involved in the application of accident probability in relation to small firms or where the aggregate accident rates are low. And it is true that because of the difficulties facing the insurer in the segregation of risks into the narrowest possible insurance pools (adverse selection), relatively low-risk firms as well as some large firms\textsuperscript{47} have chosen to leave the commercial casualty insurance market to self-insure either directly or in the captive and mutual form.\textsuperscript{48} Nevertheless, accident probability represents the average level of care an injurer exercised over a given period and provides a more reliable guide to his risk propensity than the activity level (magnitude of risk). And it is not clear to what extent tort law in general, and indeed third-party liability insurance in particular,\textsuperscript{49} should be made to take account of distributional goals and to make a distinction between rich and poor insureds for the purpose of forming risk pools and setting premiums.

Furthermore, insurance against a risk is economically feasible only where a loss has a \textit{probabilistic} character: insurers have no comparative advantage in providing coverage for non-probabilistic losses and no efficiencies can be gained from aggregating claims having a non-probabilistic nature.\textsuperscript{50} The detailed method of applying accident probability would thus rather be left to the market and to insurers or actuaries who have superior information and every incentive to provide competitive policies. The Tenerife, \textit{Musni} and many other cases\textsuperscript{51} involving concurrent liability of the ATC agency and airlines (and manufacturers) may provide insurers with useful data on their relative risk propensity. It is also interesting in this context to note that a special

\textsuperscript{45} Ch 1: 6.3.2 & 6.3.3 above.
\textsuperscript{48} Premiums paid to captive and mutual insurers increased drastically in the 1980s, raising the proportion of self-insurance premiums to firms' total liability costs. G L Priest, n.23 above, 45-46.
\textsuperscript{49} See sec 3, para 1 \textit{in fine}, below.
\textsuperscript{51} See ch 6: 5.3.2 above.
agreement effected under the Eurocontrol Convention provides for the organisation to take out insurance against the risks associated with its air traffic services. Indeed, to make the commercial insurance policy more attractive to relatively low-risk firms, insurers have reduced insurance to relatively high-risk firms through increased deductibles, lower limits of aggregate coverage, and expanded coverage exclusions.

And what the law can do in relation to relatively disadvantaged small firms is to allow them to form risk pools for risk retention, in view of the fact that the risks and fixed capital costs of self-insurance or captive insurance are relatively high for small firms.

If, nevertheless, the accident rate really causes problems and the activity level (magnitude of risk) is instead adopted as the measure of risk propensity of airlines (or manufacturers or ATC agencies), an airline with a large fleet but with a low accident record will withdraw from the market insurance (adverse selection). This is what was witnessed in the failure to draw broad international acceptance by the two Rome Conventions which link the aircraft operator's liability limits for surface damage to the weight of the aircraft causing damage. Secondly, it is difficult to compare, on a common basis, the relative activity levels of joint tortfeasors involving carriers, manufacturers and the ATC agency. Thirdly, liability rules, especially the negligence rule, are generally applicable to precautions but not to activity levels.

A scheme of compulsory insurance as provided under the two Rome Conventions enables those with low assets to engage in a risky activity and also protects risk-averse or 'irrational' injurers from catastrophic financial losses, thus increasing their aggregate utilities and social welfare. The issue of efficient risk allocation through insurance also affects the formulation of other legal rules. Apart from the fact that most passenger losses caused by carriers and manufacturers are not 'intentional', the reason why punitive damages are rarely awarded for passenger damage is probably because of their uninsurability and probable derogation from the deterrence goal. Similarly, although it is efficient for the promotion of the deterrence goal to compensate both pecuniary and nonpecuniary losses (mental pain and suffering) related to physical injury, the risk of nonpecuniary losses is not insurable in the first-party insurance markets.

54. Priest, n.50 above, 1571; id. n.23 above, 45-46; P M Danzon, n.47 above, 539.
56. Danzon, ibid, 539.
57. INTRODUCTION: sec 2 above & ch 4: 1.1 & 1.3, above.
58. R D Cooter, n.25 above, 23.
59. Priest, n.50 above, 1553.
first-party insurance against nonpecuniary losses is associated with the insurer's adverse selection problems and the insured's moral hazard. It is also questionable that the substantial pain and suffering awards which average half the total judgment exactly equal the expected value of the loss incurred to victims.

As to the level of damages, in order to produce the efficient amount of deterrence, damages should be set to equal actual damages which usually refer to compensatory damages. Under a strict liability it is essential that damages be set at the compensatory level to internalise an externality and it is hard to justify punitive damage awards in the context of the carrier's and manufacturer's liability cases. However, if under the negligence rule the court with imperfect information makes consistent errors in setting the efficient standard (information and error costs) or if enforcement authorities fail to detect correctly the perpetrators because of e.g. high costs involved in monitoring (enforcement costs), deterrence will be diluted and can only be restored by holding the tortfeasor liable for punitive as well as compensatory damages.

2.4 Administrative Costs

Administrative costs or involuntary transaction costs have been considered in the context of the court's administrative costs incurred to apply liability rules and of the insurer's administrative (loading) costs for sales promotion, risk assessment and other transactions with insureds. In the former consideration, strict liability has been found to cause less costs than the negligence rule in determining liability and causal link. In the latter case, in order to avoid or minimise the problem of moral hazard and to induce insureds to take appropriate precautions, it is necessary for the insurer to achieve the optimum risk-differentiation at lower administrative costs. Insurers should thus set premium rates on the basis of insureds' accident or claims record. As long as objective data on accident or claims records are kept and maintained, this will also reduce administrative costs of segregating high-risk from low-risk insureds. Liability or loss allocation according to relative accident probability is simple and easy to apply and incurs no additional litigation for indemnity and contribution between joint injurers. As such, it will reduce administrative costs to the courts and insurers alike.

In the case of cause of action in passenger and surface damage examples involving the carrier and the manufacturer, the administrative cost reduction consideration

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60. Ibid, 1547.
61. Ibid, 1553-54; id, n.23 above, 42.
62. See Priest, n.23 above, 48.
63. R D Cooter, n.25 above, 15 & 23.
requires that an independent cause of action be presumed in respect of the *Warsaw Convention, EC Directive* as well as the *Rome Conventions*. In respect of choice of law questions, for purposes of administrative cost reduction, the *lex fori* should govern the determination of the law applicable to heads of damages. Administrative costs also weighed in choosing as the desirable legal rule taxation of airport operators and ATC authorities for environmental and passenger damage risk. This is because in these risk caused by public bodies, liability rules are expensive to run for so many separate small claims like noise, vibration or pollution.

### 3. Equity or Distributional Consideration

In environmental and passenger damage risk caused by airport operators and ATC agencies, efficiency is still the primary criterion for assessing the desirability of a legal rule. Imposing liability on airport operators and ATC agencies will adequately induce them to allocate an optimal amount of resources for the abatement of noise and pollution and for the avoidance of passenger damage. This also accords with distributional goals that airport operators and ATC agencies as the undertaker of useful but harmful activities must be made liable for their injurious effects. The problem is that liability rules are an inappropriate device for dealing with many small, diffuse claims (externalities) and an inaccurate means for controlling noise and pollution damage. When compared with a taxation or income transfer system, liability rules are also an ineffective, imprecise and costly device for equitable risk bearing and income redistribution. For example, third-party liability insurance delivery through the tort system is three to five times more costly than first-party delivery, and third-party insurance requires low-income insureds to subsidise pecuniary and nonpecuniary losses of high-income insureds.

Furthermore, if these public corporations were held liable for airport noise and pollution and negligent licensing/certification, this will in fact make general taxpayers bear these risks as well without comparable benefits, an undue discrimination against taxpayers. This is because taxpayers do not derive any direct benefits from the airport operator's and ATCA's activities and they are already burdened to subsidise part of the costs of their operation and to bear losses from any inefficiency in the operation of public firms. If airport operators are taxed for noise and pollution, they will shift all or

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64. This may be explained from the notion of strict enterprise liability or from the financial profit idea. See Stapleton, Product Liability, ch 8, esp. 190; ch 1: 5.1.5 above.
65. Ch 5: 2.3.3, 2.3.4 & 3.1.1 above.
67. Priest. n.23 above, 47; generally ch 1: 6.4 above.
68. Priest. n.50 above. 1559.
part of these costs to airlines (and thus to passengers) by raising the prices of airport services they charge on airlines. This is an efficient and equitable result, since the travelling public, as the direct beneficiaries of airport services, will be made to bear noise and pollution damage costs and since such costs will be spread into the travelling public.\textsuperscript{69} To this extent, taxation of these bodies for their injury-causing activities will redistributes income.

Alternatively, since airport operators are already imposing noise charges on airlines under the laws of the three domestic legal systems surveyed, they may further be allowed to levy pollution charges, instead of entitling international society to tax airport operators. In taxing airport operators, it is important to recognise that charges should be assigned between them in proportion to their relative total production of pollution emissions and passenger damage costs. Holding each society liable in proportion to its relative risk output is equivalent to allocating the costs according to its own market share in the world market of combined total environmental and passenger damage production caused by airport operators. Similarly, in ATCA-caused passenger damage cases, the levies should be charged in proportion to the probability of accidents each society registered over a given period through its ATC service.

Thus, in relation to environmental and passenger damage risk caused by airport operators and ATC agencies, the efficient and equitable solution is to resort to a social insurance scheme by holding each society liable for the risk-creating activities of its international airport operators and ATC agencies. As such, efficiency and equity will combine to make up a mutually complementary, integral whole as necessary and sufficient conditions for allocating and spreading these third-party risks to the responsible parties and to the benefiting travelling public. The contributions will be determined, charged and collected by individual international airport operators and ATC agencies or by an international body equipped with adequate information. In the latter case, charges collected will in the end make up a fund for compensating the victims of passenger and pollution damage caused by international airport operators and ATC agencies. If such a fund were managed by an international body, it should be operated with least administrative costs.

When both efficiency and distributional considerations are duly taken into account, the goal of the law of carriage by air as viewed from the victim's standpoint is to ensure that each victim deserves to get the prompt payment of a full and equitable

\textsuperscript{69} See James, Accident Liability Reconsidered, at 550.
measure of compensation. This will minimise the mental and financial trauma which victims or their relatives would otherwise have to suffer throughout the protracted litigation process under liability rules or through the out-of-court settlement process. From the viewpoint of international airport operators and ATC agencies, taxation will replace the uncertain risk of environmental and passenger losses with certain, calculable and thus manageable costs.

4. Civil Liability vs. Regulation As Mechanisms to Control Product Safety, Service Quality and Air Pollution

Traditional modes of social regulation based on legal compulsion and sanctions have no doubt serious flaws. In addition to the difficulties involved in the rational cost-benefit analysis, standards regimes are especially vulnerable to creating an incentive for pollution reduction because regulators are generally unable to set a rational standard in the absence of appropriate information necessary to calculate the costs and benefits of pollution to firms and to society. Secondly, inappropriate reliance on the competence and accountability of bureaucracies to devise appropriate solutions not only led to adverse consequences for the management of publicly owned corporations but also resulted in detailed specification and performance standards which are costly to administer and which often inhibit technological innovation by private firms. Thirdly, the traditional command-and-control approach also creates significant barriers to entry and have other anti-competitive consequences.

Despite these deficiencies in social regulation, they do not necessarily write social regulation off as of little utility and it is still inappropriate to speak of regulatory failure. First, difficulties associated with valuing pollution damage costs under social regulation also exist under liability rules. Secondly, the achievement of various statutes and regional instruments in consumer product safety and environmental protection should not be underestimated, however nebulous their language and regulatory standards are. And we have demonstrated that target and performance standards may induce actors to take due care under certain circumstances. Social regulation is also shifting to less interventionist forms: from detailed specification to target and

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70. See the Space Liability Convention 1972, ch 5, n.317 above, preamble, in the context of surface damage.
71. Ogus, 337 & 72.
72. Ch 1: 7.3.3 above.
73. Ch 1: 7.3.3 above.
74. Ogus, 337.
75. Ogus, 338.
76. Ch 2: 2.5 above.
performance standards and from prior approval to information regulation. Thirdly, there is the issue of quality in products and services which consumers cannot readily distinguish because of high technicalities involved and which cannot properly be addressed under liability rules. Licensing, for example, despite its anti-competitive effects, raises the average quality of service, and denies persons without required skills or qualifications access to the market. Although certification per se is not proof of a quality product or service, it nevertheless increases information that the practitioner has satisfied certain training requirement or other inputs, while leaving consumers with the freedom of choice.

The import and utility of regulation become more apparent in the economic goal of optimal control of airport noise and pollution, given the 'collective' nature of the problem, i.e. a large amount of damage thinly spread over a large population. Liability rules and monetary compensation are inadequate for the optimal control of noise and pollution, given the public goods nature of clean air and of the free-rider problem and resulting externalities. Courts, by laying down conditions that the level of damage sustained must exceed discomfort normally suffered in the urban environment, impose on victims a difficult task of establishing causal link and grant aircraft and airport operators exemption from liability for a reasonable level of noise and pollution. Distributional consideration also favours the regulatory approach to noise and pollution problems. Taxpayers are compelled to pay for the operation of courts, before which only the relatively rich can afford to bring an action to redress environmental damage suffered and which grant damages only to claims based on unreasonable and grave damage. It will also be inequitable for courts to hold liable only one of the parties, either aircraft or airport operator, responsible for damage.

For all these deficiencies, the role of civil liability in aircraft safety promotion and environmental protection cannot be underestimated in the sphere where the regulatory agency reacts only belatedly and incompletely. The existence of civil liability allows courts to adjudicate on the specific problems that can hardly be foreseen by the regulatory agency, and it acts as a 'safety valve' inasmuch as the regulatory agency fails to take into due consideration legitimate claims of the population overflown or residing

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77. Ogus. 338.
78. For the meaning of quality, see ch 1, n 317 above
80. Juglart. 1 (2103).
81. Kay & Vickers. ibid, 249.
82. Juglart. 1(2103); 49 USC s 47506 (1996); ch 5: 2.4.4 above.
83. Juglart. ibid; ch 5: 2.5.6 above.
84. Juglart. ibid.
adjacent to airports.\textsuperscript{85} Whereas regulation can hardly deal with all the particular cases, judges can provide an individual solution.\textsuperscript{86} Although civil liability is largely ineffective for many small, diffuse claims for noise and pollution damage, it can nevertheless act as a 'sting' or 'incentive' for the regulatory agency to adopt necessary and required steps where the agency delays acting.\textsuperscript{87}

On the other hand, regulation through standards, certification/licensing and economic instruments may be more effective to dealing with the phenomenon of modern pollution affecting the general public. Even if economic regulation has its own limitations, without it monopolies, natural or otherwise, held by public corporations, especially in relation to their monopolistic pricing, cannot properly be restrained with minimum detriment to efficiency.\textsuperscript{88} Nor should the importance and utility of economic instruments adopted in pollution control be easily discarded. There can, of course, be discrepancies between the \textit{goals or objectives} of regulation and the actual \textit{result} of operating a regulatory standard, as in the case of tort liability. Regulation can nevertheless achieve a great deal in the prevention of accidents and noise and pollution and in the reduction of the effects of their occurrences.\textsuperscript{89} Whereas regulation may not deal with all the specific situations, it can address safety and pollution generally and act not just on the \textit{effects} of pollution but also on the \textit{source} of pollution.\textsuperscript{90} Regulation may also prohibit certain pollution (target standards) and thus to repair in kind, instead of allowing victims compensation of an estimated sum of damages in money.\textsuperscript{91}

Considered from this perspective, regulation and civil liability are mutually complementary. The former, because of the monitoring problem, is concerned with inputs to the supply of products or services (and their qualities) and to environmental protection (ex ante control), whereas the latter is mainly concerned with outputs (ex post control).\textsuperscript{92} Taxpayers' interest in and pressure for equitable benefits from regulation is significant, as reflected in the growing demand for greater agency accountability, adequate information release, and public participation in decision-making.\textsuperscript{93} It will thus be necessary and desirable that the two different regimes need to

\textsuperscript{85} Juglart, \textit{ibid.}
\textsuperscript{86} Juglart, I(2101).
\textsuperscript{87} Juglart, I(2103).
\textsuperscript{88} Ch 1: 7.2.4 above, ch 5: 4.1.2 & 4.1.3 above.
\textsuperscript{89} See Juglart, I(2103), \textit{in fine}.
\textsuperscript{90} Juglart, I(2102); ch 5: 2.5.2 above for regulation of aircraft emissions.
\textsuperscript{91} Juglart, I(2102).
\textsuperscript{93} Ogus, 211.
be co-ordinated within their respective sphere of application of their proper functional competence towards a common goal.\textsuperscript{94}

In view of the fact that all regulation imposes costs on businesses and consumers, however, the future of reform in social regulation should be directed toward proportionality and flexibility, as set out in the UK's Deregulation Initiative 1993.\textsuperscript{95} By proportionality is meant the costs of regulation justified by its benefits. Costs of regulation include direct burdens on business and those to be incurred by reduced competition, while in calculating benefits particular attention should be given to risk assessment and management and to the need to reflect less apparent behavioural responses to regulation like changes in consumer demand. Concern for flexibility suggests less interventionist regulatory policy through information regulation (certification rather than licensing), self-regulation, and economic instruments (notably taxation).\textsuperscript{96} This will leave firms with greater freedom to develop innovative and cheapest means of meeting the regulatory goal and with less burdens on business and competition. Again, to help promote rational economic regulation (i.e. allocative efficiency and an adequate return to investors and taxpayers), the scope of discretion of regulators should more clearly be spelt out and laid down in legislation, while special consideration must be given to consumer interests in the disclosure of accounts and other information.\textsuperscript{97}

5. Utility of and Constraints on Economic Analysis

It may be recognisable that probably the most difficult problem in applying economic approach to legal rules would relate to valuation of the relevant costs and benefits, especially where valuation involves nonmarketed items, such as loss of life or limbs.\textsuperscript{98} Some may thus question the premise of economic analysis that a rational individual will volunteer to be killed or to cripple his limb in exchange even for a huge amount of money.\textsuperscript{99} Nevertheless, this sort of scepticism is as irrelevant as asking whether markets function work 'perfectly' rather than asking whether they work 'in a reasonably tolerable manner'. Perfection in safety is a mere ideal and may not be achievable even at prohibitive costs. Such scepticism is thus not quite relevant to a risky situation involving a certain probability of harm. The more relevant question will be "how much

\textsuperscript{94} Juglart, I(2102).
\textsuperscript{95} Ogus, 338-39.
\textsuperscript{96} Ogus, 339.
\textsuperscript{97} Ogus, 341.
\textsuperscript{98} Polinsky, 135 & 137-38.
\textsuperscript{99} In extreme cases, however, persons with heavy debts may choose to have themselves killed by a hired murderer for insurance money.
is one prepared to pay to reduce the probability of such harm or injury?" This is indeed a standardised, typical question we have answered in various contexts in this work. As to the issue of valuation of life or limbs or pollution damage, this is a question which courts and insurers have tackled in determining damages and insurance payouts and which is not peculiar to economic analysis.

Indeed, whether or not the framers of the *Warsaw Convention 1929* and the two *Rome Conventions* had efficiency as their primary goals, it is one of the main themes of this study that various rules provided under these instruments or the interpretations by domestic courts applying them generally demonstrate, or are generally moving toward, an efficient outcome. Without the *Warsaw Convention* and its succeeding instruments, the goal of promoting and facilitating predictable international transactions through international carriage by air would have been greatly compromised. Critics of economic analysis may also argue that environmental costs or benefits are hard to quantify and some of them are prone to be ignored, e.g. costs of usual annoyance caused by noise or the benefits of clean air. Nevertheless, despite certain difficulties involved, we have seen that international community has succeeded in their collective valuation, as exemplified in the adoption of the *Montreal Protocol 1987* and many other environment-related instruments.

From this perspective, to ensure a maximum degree of uniformity and predictability in a system of integrated aviation liability, agreement among a majority of, if not all, rational members of international society is necessary for any consensus on the proposed integrated regime to be reached. Collective and concerted approach by a majority would facilitate commercial activities in this field as has been demonstrated in the adoption of the *Warsaw Convention* which was the first united response by the then international society to the risk occasioned by the commercial carriage by air activity. Such a common legal regime, if achieved, would make international transactions easier and more predictable and the behaviour of parties more easily controllable. It would thus enable international community to reduce transaction costs and facilitate commercial relations, contributing to the general betterment of welfare. There underlie incentives for a collective and concerted approach by members of international society and for an integrated approach to aviation liability by all the parties to carriage by air services.

100. Ch 5; 4.4.2 above.

101. See e.g. W E Butler (ed), *Control over Compliance with International Law* (Dordrecht: Martinus Nijhoff 1991). See the INTRODUCTION: 2, above.
It may still be argued that the economic models we have employed in this study may provide only one view, rather than the total view, of legal phenomena, i.e. the operation of liability rules and regulation governing aviation and environmental risk. Again, the economic goals and values assumed may have neglected certain other aspects of the legal relationships, e.g. morality or paternalism, etc.103 These constraints on economic analysis, however, must be weighed against its compensating advantages. Such constraints may stem from the conflicting goals which a legal system is normatively committed to and which it cannot achieve simultaneously. In particular, economics plays "an essential role in identifying the attributes and implications of liability insurance",104 an indispensable component of the tort process. Thus, even if economic approach can provide only one view of the cathedral, it is a view well worth pursuing, since it is a view obtained not in an ad hoc manner but in a principled, systematic and coherent way. Such a view will enhance our understanding of, and the possibility of resolving, the problems involving aviation accidents, noise and pollution.

6. Purpose and Future of Tort Liability

We have already shown that insurance has a pervasive influence on the operation of liability rules. Thus, the purpose and future of tort law must be seen in conjunction with its functional relationship with insurance. Recalling that tort liability is imposed for the dual functions of compensation and deterrence105 and that the compensation purpose can now also be achieved by a private or social insurance scheme, the main purpose of the tort liability system must be that it creates incentives to reduce risk and promote safety.106 The relationship between tort liability and insurance is interdependent and mutually influencing. Liability rules precede the operation of insurance, and liability insurance follows a tort judgment.107

Nevertheless, when the insurance factor enters the tort process, tort liability is relegated into a secondary position in the process, merely entitling victims to liability insurance for indemnification. Tort liability becomes a mere conduit for allocating the losses to the injurer, and the compensatory function of tort law as well as part of the deterrence goal is in fact carried out by insurance guaranteeing passengers a uniform

103. See Calabresi & Melamed, 1128.
105. Ch 1: 4.2.1 above.
106. Shavell, 297.
indemnification. Although the fact that defendant carrier or manufacturer is insured against passenger or third-party legal liability does not necessarily guarantee a plaintiff's success, the presence of insurance is more often than not a necessary, though not a sufficient, condition for bringing a worthwhile claim. Again, insurance does create financial incentives to deter the injurer through its premium-rating techniques (e.g. by rewarding or penalising insureds on the basis of their safety records or claims made).

On the other hand, the role of tort law or aviation accident law should not be underestimated. Thus, if the law were to confine liability to cases where liability insurance exists, injurers will be discouraged from paying premiums willingly for a risk for which they will not be liable. And even if the tort system may be reduced merely to a regime of compulsory insurance, there should be liability rules governing: who should be held liable under what conditions (causation) and to what extent, who should be entitled to bring the action and to compensation, how to assess damages, how the losses insured against will be defined, who will be obliged to take out insurance and pay the premiums, whether losses should be apportioned as between joint injurers, and how the relationship will be defined between the insurer and the insured.

In this regard, some measures of reform in tort law may be introduced, such as imposition of monetary caps on non-economic damages and caps or other limitations on punitive damages in negligence cases. Viewed from this perspective, it is an exaggeration to talk about the informality with which a group of insurance market leaders may assume an alleged 'semi-judicial role' of long-term consequences. For these reasons, although the interdependent relationship between tort law and insurance cannot be denied, tort law should retain its obligations imposed on the carrier and manufacturer to provide services or to produce products with optimal safety. This is because the function and future of tort law lie in its role of deterrence.

108. See Juglart, II(3461).
111. P Danzon, n.47 above, 517.
112. Fatal Accidents Act 1976 (c. 30), s 2.
113. Ibid, s 1(2) & 1(3).
114. Ibid, s 3.
115. See e.g. R A Epstein, Plaintiff's Conduct in Products Liability Actions: Comparative Negligence, Automatic Division and Multiple Parties, 45 JALC (1979) 87.
117. Priest, n.50 above, 1587-88.
119. See Priest, n.23 above, 49.


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