The growth and survival of firms in the heating and ventilating industry.

Stephen Louis Gruneberg

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To the memory of my late father, Rudi
and
to my dear mother, Vicky
Abstract

This research is concerned with heating and ventilating contractors, focusing on their growth and survival from 1945 to 1996. This study of 2,100 individual members of the Heating and Ventilating Contractors Association, (HVCA) over a period of 50 years has been placed in the industrial context of the wider heating and ventilating industry, the construction industry and the economy as a whole.

The aim of this research is to study the behaviour and performance of a group of specialist firms in the construction industry. Using the annual wage returns of the members of the HVCA one of the main aims of this research is to demonstrate that firms’ survival is related to their life time average rate of annual growth. The research has found that those heating and ventilating firms that grow within a given range tend to survive longest, although growth rate is by no means a predictor of success and survival. However, it is argued that although firms need to grow in order to survive, in a market that is not growing in aggregate, the growth of all individual firms is not sustainable in the long run and consequently not a single major firm has survived as an independent legal entity.

The research found that since the Second World War two distinct periods (one of growth followed by one of stagnation) can be detected in the data. The heating and ventilating industry increased as a proportion of total construction output up to 1972 but from then until 1996 the heating and ventilating share of construction output did not grow. However, the volatility of heating and ventilating output increased after 1972 and the response of firms to these conditions has been a tendency to casualise employment and concentrate on the design and management aspects of heating and ventilating installations.

The theoretical issues of this research relate to the market structure, conduct and performance paradigm, business cycles and population ecology. Taking the membership of the HVCA as a whole, the concentration of the heating and ventilating industry appears to have declined slightly during the period of the study.
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<td>Association of Heating, Ventilating and Domestic Engineering Employers</td>
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<td>ANCI</td>
<td>All new construction cost index</td>
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<td>APTC</td>
<td>Administrative, professional, technical and clerical staff</td>
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<td>ARIMA</td>
<td>Auto-regression integrated moving average</td>
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<td>BCIS</td>
<td>Building Cost Information Service</td>
</tr>
<tr>
<td>BOOT</td>
<td>Build, own, operate, and transfer</td>
</tr>
<tr>
<td>BSRIA</td>
<td>Building Services Research and Information Association</td>
</tr>
<tr>
<td>CDM</td>
<td>Construction (Design and Management) Regulations 1994</td>
</tr>
<tr>
<td>CFR</td>
<td>Construction and Forecasting Research Ltd</td>
</tr>
<tr>
<td>CI</td>
<td>Construction industry</td>
</tr>
<tr>
<td>CNC</td>
<td>Cost of New Construction Index</td>
</tr>
<tr>
<td>COP</td>
<td>Census of Production</td>
</tr>
<tr>
<td>DETR</td>
<td>Department of the Environment, Transport and the Regions</td>
</tr>
<tr>
<td>DLO</td>
<td>Direct Labour Organisations</td>
</tr>
<tr>
<td>DoE</td>
<td>Department of the Environment</td>
</tr>
<tr>
<td>DTI</td>
<td>Department of Trade and Industry</td>
</tr>
<tr>
<td>GCPI</td>
<td>Gross construction product index</td>
</tr>
<tr>
<td>GDFCF</td>
<td>Gross domestic fixed capital formation</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross domestic product</td>
</tr>
<tr>
<td>GDPD</td>
<td>Gross domestic product deflator</td>
</tr>
<tr>
<td>GDPI</td>
<td>Gross domestic product index</td>
</tr>
<tr>
<td>Geom.</td>
<td>Geometric mean</td>
</tr>
<tr>
<td>GVA</td>
<td>Gross value added</td>
</tr>
<tr>
<td>HCS</td>
<td>Housing and Construction Statistics</td>
</tr>
<tr>
<td>HVCA</td>
<td>Heating and Ventilating Contractors Association</td>
</tr>
<tr>
<td>HVI</td>
<td>Heating and ventilating industry</td>
</tr>
<tr>
<td>LOSC</td>
<td>Labour only subcontracted labour</td>
</tr>
<tr>
<td>M and E</td>
<td>Mechanical and electrical (services)</td>
</tr>
<tr>
<td>MCG</td>
<td>Major Contractors Group</td>
</tr>
<tr>
<td>MIRAS</td>
<td>Mortgage Interest Relief at Source</td>
</tr>
<tr>
<td>MPBW</td>
<td>Ministry of Public Building and Works</td>
</tr>
<tr>
<td>NRV</td>
<td>Net realisable value</td>
</tr>
<tr>
<td>NWCI</td>
<td>New works construction index</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>ONS</td>
<td>Office for National Statistics</td>
</tr>
<tr>
<td>PAYE</td>
<td>Pay as you earn</td>
</tr>
<tr>
<td>PCC</td>
<td>Private Contractors’ Census</td>
</tr>
<tr>
<td>PFI</td>
<td>Private Finance Initiative</td>
</tr>
<tr>
<td>PSA</td>
<td>Property Services Agency</td>
</tr>
<tr>
<td>PSBR</td>
<td>Public Sector Borrowing Requirement</td>
</tr>
<tr>
<td>PV</td>
<td>Discounted present value</td>
</tr>
<tr>
<td>RC</td>
<td>Replacement cost</td>
</tr>
<tr>
<td>RPI</td>
<td>General index of Retail Prices (All items),</td>
</tr>
<tr>
<td>SET</td>
<td>Selective employment tax</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>SIC</td>
<td>Standard Industrial Classification</td>
</tr>
<tr>
<td>SME</td>
<td>Small and medium sized enterprises</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>TSTWCS</td>
<td>Temporary Short Time Working Compensation Scheme</td>
</tr>
<tr>
<td>VAT</td>
<td>Value added tax</td>
</tr>
<tr>
<td>WBA</td>
<td>Works and Building Priority Committee A list</td>
</tr>
<tr>
<td>WBA/MAT</td>
<td>WBA Works and Building Priority Committee A list and Materials Certificate</td>
</tr>
<tr>
<td>WBZ</td>
<td>Works and Building Priority Committee Z list</td>
</tr>
</tbody>
</table>
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Part 1  Introduction
Chapter 1 Introduction - the heating and ventilating industry: an examination of a core sector of the real construction industry

"Most firms in the construction industry are either small, private companies, partnerships or sole traders, and very little statistical information of a financial character, or indeed non-financial character, is available for this highly important sector of the industry." Fleming M.C., (1980), Construction and the Related Professions, Pergamon, p.252.

1.1 Introduction

1.1.1 This thesis is about the heating and ventilating industry and heating and ventilating engineers. At the level of the industry it is concerned with changes in demand and changes in industrial structure. At the level of the firm it is concerned with the relationship between the rate of growth and survival.

1.1.2 Much research into the construction industry has focused its attention, though not exclusively, on main contractors, as has most of the literature, including text books like Raftery (1991), Ruddock (1992) and Gruneberg (1997) or even the more advanced works like Ball (1988), Hillebrandt (1984) and Hillebrandt and Cannon (1989 and 1990) and papers such as Kale and Arditi (2001). Most commentaries on the construction industry are given from the point of view of main contractors, usually assuming them to be large firms. Clearly Latham (1994) and Egan (1998) both refer to subcontracting but the former is mainly concerned with the problems of main contracting and large projects and the latter is focused on clients' needs and demonstration projects.

1.1.3 They examine the construction industry from the point of view of main contractors who engage subcontractors to carry out specialist work packages, while retaining a large proportion of value adding work for themselves. However, this perspective has become increasingly obsolete as main contractors have shed direct labour and used less and less of their own equipment. Although their management role ensures that a high percentage of the construction costs of clients is retained by main contractors, a smaller proportion of the actual building process is undertaken in-house than previously.

1.1.4 Instead the strategy of survival of main contractors has been to use specialist contractors, to employ labour only subcontractors, and to hire plant. Currently, main contractors have transformed themselves into management contractors providing professional management skills and knowledge. Therefore a gap, though by no means a vacuum, has opened up in the literature concerning the central role of specialist firms in the construction industry. Relatively little work has been carried out on subcontractors apart from Hillebrandt (1971), Clarke (1981), Ive (1983), Gray and Flanagan (1989) and most recently Hughes, Gray and Murdoch (1997) and Constantino, Pietroforte and Hamill (2001).
1.1.5 This study also discusses construction from the point of view of subcontractors, which are often only small or medium sized enterprises (SMEs) as are the vast majority of firms in the construction industry (Fleming 1980 p.252). The official definitions of small and medium sized firms are frequently altered to reflect inflation or government policy. Table 1.1 presents the official definitions current in 1992 and 1999. To qualify as a small or medium sized company, a firm had to meet at least two of the three criteria. In 1992 small enterprises employed less than 50 persons with a gross aggregate turnover of less than £3.36m, and net assets of less than £1.68m. Similarly, medium sized enterprises employed between 51 and 250 persons with a gross aggregate turnover of less than £13.44m and assets up to £6.78m. In 1999 although the number of employees remained the same, the financial definitions had become more restrictive.

Table 1.1 Maximum size of small and medium sized enterprise in 1992 and 1999.

<table>
<thead>
<tr>
<th>Measures of size</th>
<th>1992</th>
<th>1999</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross aggregate turnover not more than:</td>
<td>£3.36m</td>
<td>£13.44m</td>
</tr>
<tr>
<td>Balance sheet total not more than:</td>
<td>£1.68m</td>
<td>£6.78m</td>
</tr>
<tr>
<td>Av. weekly number of employees not more</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Sources: Oldcorn, (1996) p.74

1.1.6 It is generally small and medium sized enterprises, which actually carry out the work, transforming materials and prefabricated components into finished buildings. They form the core of the real construction industry, and are the centre of a continuous battle for survival as conflicting interests compete to off-load risks during the building production process.

1.1.7 Main contractors have increasingly become detached from the process. According to Gray and Flanagan (1989, p.10) the process of increasing the degree of subcontracting in construction had been completed by 1989, by which time 90 per cent of work was being subcontracted. Main contractors have increasingly focused their efforts on organising and managing projects and the building process on behalf of clients, because of the need to co-ordinate the collection of disparate firms from different technical backgrounds required for the completion of a building. These specialist firms are usually hired on an ad hoc basis as and when required by main contractors and form several specialist sub-divisions, markets or industries within the construction sector.

1.1.8 Gray and Flanagan (1989 p.9) describe building work on site as a process of assembling prefabricated components. It is a mixture of many traditional trades and updated techniques, materials and plant. As the number of manufactured components increases, the firms supplying these are often used to assemble them on site employing their own dedicated and trained workforce. Other firms specialise in fixing particular types of components supplied to them by particular manufacturers. This is the case, for example, with heating and ventilating contractors.
1.1.9 Thus, it is not possible to generalise about subcontract firms in construction because of the large variety of types and sub-industries in which they operate. For example, the form of subcontracting depends on the variety of functions and roles the subcontractors are expected to undertake. Gray and Flanagan (1989 p.11) divide types of subcontractor according to their contribution to the building process. Their four categories are:
- fix only
- supply and fix
- design, supply and fix
- full design, manufacture, supply and fix.

1.1.10 Heterogeneity in the population of construction industry subcontractors also includes differences of form in terms of types of technology, skills and capital structures. As firms in specialist building markets often have little in common with specialist firms in other sub-industries, what may be true of one sub-industry does not necessarily apply to another. Specific technologies, labour skills and capital structures mean that any in-depth research must focus on particular types of firms. For this reason it was decided to concentrate this study on one particular industry, namely that of heating and ventilating engineers.

1.1.11 In 1948 the heating and ventilating contractor’s business was defined as,

'...mainly to plan to bring together in their proper sequence a relatively large number of highly specialised parts and with his technical staff and skilled operators, to build these parts into an efficient installation with the utmost speed.' AHVDEE, 1948, p.67.

1.1.12 The role and function of heating, ventilating, air-conditioning and refrigeration contractors has remained essentially the same to the present. The role of these specialist contractors can be viewed as subcontractors within the construction industry.

Figure 1.1 Heating and ventilating contractors and plumbing firms, 1948-1996

1.1.13 In 1949 the Council of the Association of Heating, Ventilating and Domestic Engineering Employers (AHVDEE) conceded that the heating and ventilating industry
formed 'a very small part of the industrial whole and was a very recent development as a branch of engineering' (AHVDEE, 1949 p.119). Since then the heating and ventilating industry has grown in size and importance relative to plumbing as illustrated in Figure 1.1.

1.1.14 To view the relative importance of the heating and ventilating specialist subcontractors as a group of firms studied in this research, Table 1.2 shows the number of firms operating in various years, including 1990 when the number of firms and employment in construction peaked. The percentage of employment in each type of firm is also given for 1985 and 1996. Heating and ventilating only constituted 6 per cent of employment of all trades in 1985, dropping to 5 per cent by 1996.

Table 1.2 Number of heating and ventilating contractors compared to different types of building firms between 1973-96 and employment in 1985 and 1996

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>General builders</td>
<td>39659</td>
<td>31889</td>
<td>67475</td>
<td>78981</td>
<td>50615</td>
<td>34</td>
<td>26</td>
</tr>
<tr>
<td>Building and civil engs.</td>
<td>2364</td>
<td>2054</td>
<td>3623</td>
<td>4773</td>
<td>4984</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>Civil engs.</td>
<td>2114</td>
<td>1633</td>
<td>2662</td>
<td>3742</td>
<td>10781</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Total main trades</td>
<td>44137</td>
<td>35576</td>
<td>73760</td>
<td>87496</td>
<td>66380</td>
<td>55</td>
<td>43</td>
</tr>
<tr>
<td>Heating and ventilating contractors</td>
<td>3284</td>
<td>2906</td>
<td>8461</td>
<td>9624</td>
<td>6697</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>All other trades</td>
<td>49155</td>
<td>39160</td>
<td>85604</td>
<td>112673</td>
<td>90238</td>
<td>39</td>
<td>52</td>
</tr>
<tr>
<td>Total all trades</td>
<td>96576</td>
<td>77642</td>
<td>167825</td>
<td>209793</td>
<td>163315</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Housing and Construction Statistics 1978-88 and 1987-97 Tables 3.1(b) and Table 3.5 (b)
Notes: 1 Table 3.1(b)
2 Percentage of total construction employment
3 There is a discontinuity in the series in the series of civil engineers between 1995 and 1996 relating to increased coverage especially of firms with 7 or fewer employees, which accounts for the rise in the number of firms

1.2 The essential model of the construction industry

1.2.1 At the inception stage a project may be little more than a set of ideas, drawings and contracts involving the developer, designers, and other consultants. Once production gets under way the essential model of the construction industry as a process of transformation begins with materials and component suppliers, who provide the material inputs into the process 1. These inputs are then transformed into buildings or other built structures by subcontractors who undertake the work on site usually in the form of work packages which define their specialist role. Main contractors take overall responsibility for the production

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1 For simplicity of usage, management contractors will be treated as a form of main contracting, and trade contractors working under a management form of contract will be treated as subcontractors.
process and may or may not contribute to the actual assembly processes on site. For developers it is only on completion that a physical output exists.

1.2.2 Figure 1.2 shows the progression of materials and components through the assembly process to the finished building in 3 phases - prefabrication, fabrication and post-fabrication. The main contractors and subcontractors undertake the core of construction fabrication activity. Other participants in the building process include architects who design, quantity surveyors who cost and monitor, and property agents who market the finished product. However, they are not considered central to an understanding of the production processes involved, because their roles can be subsumed within the firms or organisations described in Figure 1.2 without loss of meaning. To some extent their roles have been externalised in construction. Similar tendencies can be seen in manufacturing industry which appears to be increasingly adopting market transactions as a means of employing expertise, such as management consultancies, telephone sales and computing services.

Figure 1.2 Types of firms involved in the three phases of construction production

1.2.3 Using the model shown in Figure 1.3, it can be seen that demand is put to the construction industry through orders given to main contractors, who in turn pass instructions on to subcontractors (in this case heating and ventilating engineers) through a tendering process. Of course specialist firms may be nominated by architects or developers, though Hughes, Gray and Murdoch (1997, p.25) point out the recent decline in this practice. It is also understood that construction management procurement systems entail direct contracts between clients and specialist firms. However, even under construction management systems, the co-ordination of work is carried out through the construction manager, who usually selects specialist firms through a competitive tendering process to find the lowest price specialist. Main contractors thus mediate construction demand put to subcontractors.
1.2.4 As specialist contractors come sandwiched between main contractors and materials and component suppliers, they in turn mediate demand for their supplies. There is little research on manufacturing suppliers to the construction industry, though for some studies of brick and cement, see *Construction History Journal*. Links between construction and the industries providing inputs into the building process may be described as ranging from weak to strong, depending on the degree of interdependence of specific types of specialist construction firms and their suppliers. Broadly speaking three types of linkage may be identified. Strong links exist where construction is the exclusive or almost exclusive user of the output. Such a relationship exists between heating and ventilating contractors and heating and ventilating equipment manufacturers. Weak links characterise those industries in which producers supply a number of industries besides construction. Glaziers, for example, may be said to have weak links with the glass industry, which provides material inputs into the automotive industry, fibre optics, the glassware industry and the light-bulb industry as well as providing windows for buildings. To the extent that building only constitutes a proportion of demand for glass, the links between the two industries are weakened. Finally, there are specialist firms in the construction industry with no established links with outside industry, such as demolition contractors.

Figure 1.3 Model showing relationship of the heating and ventilating contractors’ industry to resources and construction demand

- **Economic conditions**
- **Developer clients**
- Derived demand for construction
- Competitive tendering
- Negotiation
- **Specialist labour**
- Supply
- Demand
- **Main contractors**
- Supply
- Competitive tendering
- Nomination
- **Heating and ventilating contractors**
- Supply
- Demand
- **Heating and ventilating plant manufacturers**
1.2.5 Input-output tables make it quite clear that a sizeable proportion of output from other industries as a whole forms the material and component inputs of the building industry. Having entered the construction process, these inputs become the base on which construction firms add value. Because the value of prefabricated components has increased as a proportion of final building costs, the share in final building costs of site operations has declined. Manufacturers, subcontractors, and main contractors therefore compete to receive a share of the final construction costs and main contractors and subcontractors also compete for a share of value added. Competition within the construction industry is discussed in Chapter 10 Section 4, with regard to the position of heating and ventilating contractors and market penetration by different types of construction firm. This study focuses on the difficulties faced by a particular group of subcontractors in this conflict and their ability to survive.

1.3 Subcontractors and their main contractors

1.3.1 Construction firms are continuously buffeted by changing market conditions. Because of their need to be flexible, main contractors and clients use specialist firms, which provide specialist skills and equipment. In Table 1.3 Ball (1988 p.123) shows that the proportion of work subcontracted in construction increases the larger the firm. The 38 largest firms employed 11 per cent of the workforce and produced 18 per cent of the gross output of construction, of which they themselves carried out 60 per cent of the work and subcontracted the other 40 per cent to other firms. In effect the largest 38 firms only carried out 14 per cent of the total value of work done even as early as 1982.

<table>
<thead>
<tr>
<th>Size of firm</th>
<th>No. of firms</th>
<th>Employment</th>
<th>Gross output</th>
<th>Value of work done</th>
<th>Average value of work subcontracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-7</td>
<td>125619</td>
<td>28</td>
<td>18</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>8-24</td>
<td>13624</td>
<td>18</td>
<td>14</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>25-144</td>
<td>4324</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>115-599</td>
<td>714</td>
<td>16</td>
<td>22</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>600-1,199</td>
<td>76</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>34</td>
</tr>
<tr>
<td>1200+</td>
<td>38</td>
<td>11</td>
<td>18</td>
<td>14</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>144395</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>37</td>
</tr>
</tbody>
</table>

Total values: £6712m £4900m £1814m

1 Data are for October 1982, or third quarter of 1982 where relevant.
2 Employment includes working proprietors as well as employees.
3 Gross output is value of work done plus value of work subcontracted.
4 Expressed as a percentage of the gross output of the size category.
Source: Housing and Construction Statistics 1972-1982
1.3.2 The financial benefit to main contractors of employing subcontractors is that cost prediction risk is spread and financial burdens can be transferred to some extent on to external firms, especially by manipulation of cash flows within projects. Late payments and non payment caused by disputes drive many subcontractors to the wall. Undoubtedly specialist subcontractors face a number of difficulties by virtue of their position in the building production process. The nature of their forward vertical relationship with main contractors and clients and their backward vertical relationship with suppliers and manufacturers both during periods of expansion and contraction may well provide insights into the role of subcontractors and their practices and efficiency. For example, labour costs may be more volatile over the business cycle as a result of the subcontract arrangement or alternatively there may be indications that subcontractors have adopted strategies to smooth variations in wage costs in response to changes in the demand for construction.

1.3.3 In view of their role as specialist subcontractors in construction, this research examines aspects of the structure, conduct and performance of the heating and ventilating industry since the Second World War. The economics of this research can be located at the theoretical intersection of the structure, conduct performance paradigm, business cycle theory and organisational demography.

1.3.4 A number of economic issues emerge from this discussion of the relationship between subcontractors and main contractors. If main contractors squeeze subcontractors in some phases of the cycle, especially during recessions, do subcontractors enjoy a reverse role when demand is growing? Are subcontractors able to pass on lower prices in the form of lower wages to avoid being squeezed, or is the drop in turnover the major factor which squeezes profits and cannot be avoided? What effect do changes in the relationship between main and subcontractors over the business cycle have on the employment levels of subcontractors? To what extent are employment levels an indicator of the activity levels of subcontractors? What other factors determine the employment of labour by subcontractors? Are there any good practices which firms could adopt? If such practices could be identified it may be possible to validate them by, for example, demonstrating that those firms had higher survival rates.

1.4 Growth and survival

1.4.1 This research therefore examines the strategies open to firms in the heating and ventilating industry. In particular the study looks at the strategies and performance of firms in the light of the specific difficulties they have to contend with as heating and ventilating engineers operating as subcontractors in the construction industry.

1.4.2 The strategies of subcontractor firms emerge in response to their business environment in aggregate over time and lead some firms to grow faster than others with the result one might expect industry concentration to increase. However, McCloughan (1995) refers to Gibrat’s law as central to understanding industrial concentration in terms of stochastic processes. In statistical terms it is a somewhat random process. According to
Gibrat (1931) the initial size of a firm does not affect its rate of expansion. Over a specified period the distribution of growth rates is the same for all firm sizes.

1.4.3 In contrast, Cabral (1995) points out that more recent findings have shown that there is a negative relationship between growth and size. At first this had been thought to be due to sample bias as small firms would be more likely to exit the industry if they experienced negative growth in the early stages, thus depriving the sample of slow growing small firms (Mansfield 1962). However, Cabral cites a number of other papers (Evans (1987a, b), Hall (1987) and Dunne, Roberts and Samuelson (1989) that argue that the negative correlation between size and growth are not the result of bias.

1.4.4 Indeed, in a survey of 100 manufacturing industries in the US, Evans (1987b, p. 568) found a number of relationships of interest to this research. The rate of growth of firms declined with both size in 89 per cent of industries and with age in 76 per cent of industries but the probability of survival increased with size and age in 81 per cent and 83 per cent of industries respectively. He also found that the variability of firms’ annual growth rates declined with age. These results were consistent with the view that over time entrepreneurs learn about their limitations. However, Evans (1987b, p. 580) states that replication of his results based on more refined data sets would be vital before his results were accepted. This research is based on such a data set, being based on a population of specific firms over a very long run.

1.4.5 In fact Cabral argues that small firms adopt a short-term wait-and-see approach in the initial stages before investing in capital equipment: large firms take long-term capacity investment decisions at the start. As a result growth of small firms is higher in their early stages as decisions to expand are taken in the light of experience, whereas large firms, having made their investment at the beginning of the period, do not require to expand capacity to the same extent in subsequent years. The reason for this behaviour pattern, according to Cabral, is that as small firms are more likely to exit the industry than large firms, they take a higher risk of losing the sunk cost element of investment decisions than larger firms. He supports this argument by stating there is empirical evidence that the probability of survival is greater the larger the initial size of firm. Thus in looking at the growth rates of a cohort of firms over a period of between 5 and 10 years, Cabral suggests there will tend to be a negative correlation between growth and initial firm size. He concludes that in view of the existence of sunk costs, ‘Gibrat’s law no longer holds’ (Cabral 1995, p. 165).

1.4.6 Other research, which has focused on growth and survival, includes Audretsch and Mahmood (1992) and Olley and Parkes (1992). The former discusses growth and survival in 18 different industries in the US, and notes that the range of firms by size in any cohort increases with age. The latter looked at the implications of technological change and deregulation in the US telecommunications industry, the consequences of which included increased entry and exit rates and an implicit increase in the productivity of the industry. Chapter 9 provides a fuller review of the literature on growth and survival of firms.
1.5 The aims of this research

1.5.1 In view of the rapid turnover of firms in the heating and ventilating industry, their vulnerability and their tendency to become insolvent, there is a need to examine the behaviour of firms. This research sets out to show if and how their growth strategies affect their ability to survive and to suggest new strategies for firms.

1.5.2 As a group of specialist contractors heating and ventilating engineers provide a distinct service using a specific technology and set of techniques with particular skills and materials. By looking at these firms in detail, their role in the process can be better understood. Their contribution to the process in terms of their value added is considered. As a result it may be possible to identify or at least discuss the different sources of value added in the process. Instead of seeking to improve the construction industry by adopting blanket proposals, it may make more sense to target those areas within construction in which value added can be most easily achieved and this can be done if improvements in value added can be identified. These may be in the prefabricated components rather than the installers or site assemblers. This study examines one aspect of this issue namely the value added by heating and ventilating contractors, as proxied by the total wage bills of firms.

1.5.3 This research examines in turn the heating and ventilating industry from three broad perspectives.

• The first perspective concerns the relationship between the heating and ventilating industry and the construction industry. From the analysis of the relationship between the construction industry and the heating and ventilating industry it is shown that although heating and ventilating work tends to take place towards the end of the construction process, there is no significant time lag between construction demand and heating and ventilating output, using annual data.

• The second perspective considers the heating and ventilating industry as a whole in terms of the economics of its own industrial structure. The structural issue concerns the prevalence of small and medium sized enterprises (SMEs) in the heating and ventilating industry and the dominance of the largest companies. Has the growth in the market, if any, been captured by the SMEs or by the industry leaders?

• The third perspective is an analysis of the relationship between the implicit growth and survival strategies of individual firms in the heating and ventilating industry in response to their economic and industrial environment. Although the rate of growth is only one of the factors determining firms’ survival, it is seen as the key element in a company’s implicit survival plan, consistent with the Penrosian model discussed in Chapter 9. The rate of growth of a firm provides a summary statistic of the relative position of a firm compared to its competitors and its market. It is also a variable over which there is a degree of internal control by a firm’s managers. The relationship between growth and survival is examined in the context of growth targets, risk and the business cycle.

1.5.4 The research is in six parts. The first part is the introduction. The second part is concerned with the hypotheses and methodology. The third part gives the historical context of the heating and ventilating industry and its changing relationship with the rest of the construction industry. The fourth part of the thesis provides the theoretical background
covering the literature review and the economic theory of the growth of the firm based on the work of Penrose. The fifth part presents the findings and the final part consists of the conclusions.

1.6 Concluding remarks

1.6.1 This research distinguishes between the role of main contractors and that of the specialist firms which carry out much of the work on site. The features of specialist subcontractors discussed in this chapter have highlighted the following points:

- Specialist firms operate (though not exclusively) at the interface between the construction industry and material and component suppliers to the construction industry.
- Main contractors have become more concerned with the management of the process rather than the actual work on site, which is carried out by specialist firms.
- The changing importance of specialist firms is reflected in the percentage of total construction direct employment in the main trades, which declined from 55 to 43 per cent between 1985 and 1996 while the percentage of employment in specialist firms increased from 45 to 57 per cent.

1.6.2 However, different types of specialist firm vary to such an extent it is necessary to study them separately according to the trades to which they belong. In this study heating and ventilating contractors are considered as an example of a major specialism in the building industry. The population of heating and ventilating firms is studied first in relation to the construction industry as a whole, and then in terms of heating and ventilating market. Finally, the firms are analysed in terms of their individual behaviour and implicit strategies. The following chapter will deal with the hypotheses under these three broad headings.
Part 2 Methodology
Chapter 2  Hypotheses

2.1  Introduction

2.1.1  This chapter sets out the hypotheses discussed in this thesis. Figure 2.1 illustrates the general framework of the research. Some of the hypotheses proposed in this chapter present difficulties beyond the scope of this research or for practical reasons lie beyond the limits of resources available at this stage. Nevertheless they are relevant as part of the logical progression of the theories and arguments presented in this thesis. From these possible hypotheses a number are selected and tested.

Figure 2.1 From propositions to analysis

2.2  Propositions and hypotheses: (1) The relationship between the heating and ventilating industry and the construction industry

2.2.1  The relationship between the heating and ventilating industry and the construction industry is essentially that the construction industry forms the first round purchaser of the output of heating and ventilating contractors. Within the mix of specialisms which constitute the construction industry the relative importance of heating and ventilating has increased over the period of this study. One reason for this is that services have increased in complexity along with the specifications and expectations of clients. Other factors such as
fuel prices also have an impact on the heating and ventilating industry as it becomes relatively more expensive to heat (or to cool) buildings. This in turn encourages the introduction of energy efficiency measures which tend to increase the workload of heating and ventilating engineers. If this is the case then one might expect that official output data would confirm that the heating and ventilating industry contributes a continually growing share of the output of the construction industry.

2.2.2 It might be argued therefore that:

i. *if buildings become more complex and technologically more sophisticated in their services over time, it follows that the trend growth rate of the output of the heating and ventilating industry will exceed the trend growth rate of the construction industry, and, perhaps exceed the trend rate of growth of GDP.*

2.2.3 The growth trends in heating and ventilating and construction are examined in Chapter 12, Sections 12.2 and 12.3.

2.2.4 If the importance of the contribution of heating and ventilating services in construction has increased, there is also the question of the extent to which the heating and ventilating industry has itself become dependent on main contractors in the construction industry for the bulk and timing of its sales, rather than depending on direct transactions with building owners.

ii. *If the annual variation of output of the heating and ventilating industry follows a pattern significantly different from the construction sector, as a whole, then demand for heating and ventilating cannot necessarily be predicted from construction output.*

\[ \Delta Q_{\text{HV}} = b_0 + b_1 \Delta Q_{\text{CI}} + e \]  

(2.1)

where \( \Delta Q_{\text{HV}} \) = change in annual output of the heating and ventilating industry  
\( \Delta Q_{\text{CI}} \) = change in annual output of the construction industry  
and \( e \) = error of prediction

2.2.5 Time lags will also be introduced into Equation 2.1. These issues are dealt with in Sections 12.3, 12.4 and 12.5.
2.3 Propositions and hypotheses: (2) The structure of the heating and ventilating industry

2.3.1 The second theme of this research is concerned with the structure of the heating and ventilating industry. Structure may be measured in terms of the number of firms, firm concentration ratios, and the height of barriers to entry and exit. The size of any market may be given by:

\[ M = \text{bars} \cdot n \]  

(2.2)

where \( M \) = size of market
\( \text{bars} \) = average size of firm, as measured by output
and \( n \) = number of firms.

\[ \text{Bars} = \frac{M}{n} \]  

(2.3)

and:

\[ \Delta M = f(\Delta \text{bars} \cdot \Delta n) \]  

(2.4)

where \( \Delta M \) = change in size of market
\( \Delta \text{bars} \) = change in average size
and \( \Delta n \) = change in number of firms.

2.3.2 Thus from Equation 2.4 a change in market size may come about as a consequence of a combination of changes in either or both the average size of firms and the number of firms.

If barriers to entry are relatively low, then the number of firms in the heating and ventilating industry would grow faster than industry sales. If this is the case the growth rate of the output of the heating and ventilating industry as a whole in any year will be higher than the average growth rate of turnover (sales) of individual firms in the industry.

2.3.3 Ease of entry and exit can be measured as the difference between the annual growth rate of the market compared to the annual growth rate of average sales per firm. Average growth rate of the market can be based on estimates of annual output based on official data or aggregate annual wage returns. Average annual sales can be based on annual output divided by the number of firms or aggregate wage returns divided by the number of HVCA members filing returns in any given year. This measure of competitiveness will vary from year to year reflecting the severity of competition in any given period, and reflect the short run conditions facing the market. Comparing the average growth rates of the market and average sales over a number of years provides a measure of general competitiveness of the industry.
2.3.4 If the hypothesis is correct that barriers to entry into the heating and ventilating market are relatively low, then we would expect the number of firms in any given year, \( t \), to grow faster than industry sales. Provided changes are positive, then it follows that:

\[
\text{if } \frac{\Delta M/M}{n} > \frac{\Delta n/n}{n} \quad (2.5)
\]

\[
\text{then } \bar{s}_t > \bar{s}_{t-1} \quad (2.6)
\]

and if \( \frac{\Delta M/M}{n} < \frac{\Delta n/n}{n} \)

\[
\text{then } \bar{s}_t < \bar{s}_{t-1}
\]

where \( \Delta M/M = \) growth rate of the market  
\( \Delta n/n = \) rate of change in the number of firms  
and \( \bar{s}_t = \) average size of firm in year \( t \).

2.3.5 The implication is that the additional sales are largely picked up by new entrants rather than incumbent firms. Thus:

\[
H_0: A_Q^{HN/}\% \leq \sqrt[N]{\Pi(A_{TO}^{HVCH/}\%)} \quad (2.7)
\]

\[
H_A: A_Q^{HN/}\% > \sqrt[N]{\Pi(A_{TO}^{HVCH/}\%)} \quad (2.8)
\]

where \( A_{TO}^{HVCH/}\% = \) growth rate of output of the ith firm in the heating and ventilating industry in year \( t \)
\( N = \) number of firms in the heating and ventilating industry
\( A_Q^{HN/}\% = \) growth rate of output of the heating and ventilating industry as a whole in year \( t \).

2.3.6 The null hypothesis states that in year \( t \) the growth rate of the industry as a whole is less than or equal to the geometric mean of the growth rates of firms. The alternative hypothesis is that the market rate of growth exceeds the average annual rate of growth of firms. These issues are discussed in Chapter 13, in Section 13.2.

2.3.7 It is possible for the average rate of growth of individual firms to exceed the market rate of growth even in the long run but this can only be achieved at the expense of a high rate of mortality relative to the rate of founding and a relatively high churning of firms. Figure 2.2 illustrates this proposition. Even without an increase in the number of firms, the geometric average rate of growth of firms may exceed the market rate of growth using a simple model of a market comprising firms \( A \) to \( N \). Assume the rate of growth and the history of each firm are the same for all firms. For example firm \( D \) is formed at a point in time \( 1 \) and grows at a given rate until it ceases trade at a later point in time \( 2 \). Each firm survives for only a short period and is replaced. The average rate of growth of each firm is reflected in the gradient of its output over time.

2.3.8 The market, which is the aggregate output of firms at any given point in time is given by the heavy line, ignoring minor fluctuations. This shows the market growing rapidly to
begin with, followed by a period (from 3 to 4 in Figure 2.2) of no growth, ending with a period of decline. There is no growth in the market between 3 and 4 because each firm that enters immediately replaces a firm that dies. At a typical time, for example 2, one firm, such as firm D, with output $x$, dies. It is replaced by one new firm with an initial output of zero. This permits $x$ to be distributed among survivors (such as firms E to F), who can therefore continue to grow. In the next year G begins to grow, sharing with firm F in the redistribution of output formerly taken by newly deceased firm E.

**Figure 2.2** The average growth rate of a market and the average growth rate of firms

![Figure 2.2](image)

2.3.9 The average rate of growth of the market is therefore quite distinct from, and lower than, the average growth rate of the firms which comprise it. For example, the average rate of growth of the market from the setting up of firm A to the demise of firm N is the gradient of the dotted straight line joining 0 to N. The rate of growth of individual firms is greater the less the number of firms, especially if the market is not able to expand to absorb the additional firms. A static market increases the level of competitiveness and the mortality rate of firms, compared to a market that is growing.

2.3.10 There is, however, a notional rate of change in the number of firms, $\Delta n/n^*$, such that the average growth rates of the individual firms, $\bar{A} \bar{s}/\bar{s}$, given by their slopes in Figure 2.2, is equal to the rate of growth of the market, $\Delta M/M$, represented by the slope ON. That is, there is some rate of growth in the number of firms such that:

$$\bar{A} \bar{s}/\bar{s} = \Delta M/M. \quad (2.9)$$
The proposition is that the actual growth in the number of firms is greater than $\Delta n/n^*$. As a result:

$$\Delta \bar{s}/s > \Delta M/M.$$  \hfill (2.10)

Equation 2.8 states that the average rate of growth of firms is greater than the rate of growth of the market.

2.3.11 The proposition is that the average growth rate of individual firms can be greater than the market growth rate so that the number of firms stays constant if entry barriers are high or entry to the industry is severely constrained. However, in the heating and ventilating industry there are relatively low barriers to entry because the minimum efficient scale of operation occurs at low levels of output due to the high proportion of relatively small jobs undertaken. This is typical of the size distribution of work in heating and ventilating as it is throughout construction. Low barriers can also be seen in the number of firms in the heating and ventilating industry, which increased from 3,284 in 1973 to a peak of 9,774 in 1992 (Housing and Construction Statistics, Private Contractors Census, Table 3.1, DETR). In the same years the number of firms in the HVCA rose from 776 to 1,237, having peaked in 1991 at 1,285 (Annual Reports, HVCA). Many firms were started in response to the increased use of casual labour by the larger firms. Workers often set themselves up as smaller concerns encouraged to do so by the introduction of the 714 Certificate system in the late 1960s, starting as self employed and moving on to employ others.

2.3.12 Thus the organisational density (to adopt the terminology used by Carroll and Hannan (2000, p7)) or number of firms in the heating and ventilating industry actually increased between the 1970s and the 1990s. However, heating and ventilating firms which close down tend to be larger than newly founded firms. If the increase in density increases the size of the market the additional firms are enough to compensate for the fact that the new firms tend to be smaller than the departing firms. In that case the overall mean growth rate of firms will tend to be less than or equal to the growth rate of the market.

2.3.13 Relating size of firm to growth rates,

iv. if economies of scale confer an advantage of size, then growth rates of firms would be size dependent, (contrary to Gibrat's Law), and it would follow that

(a) the larger the firm the higher the rate of growth,
(b) over the passage of time, the higher would become the n-firm concentration ratio and
(c) the higher would become the Herfindahl index.

2.3.14 Taking proposition (a) the correlation of size and growth rates is given by the following:

$$\langle WR_{it}, \{[WR_{it+n} - WR_{it}]/WR_{it}\} \rangle = r$$  \hfill (2.11)

where $WR_{it} =$ size of firm $i$ as measured by wage returns in year $t$

and $WR_{it+n} =$ size of firm $i$ as measured by wage returns in year $t + n$
The relationship between firm size and growth rates is dealt with in Chapter 13, Section 13.3.

2.3.15 The null and alternative hypotheses of iv(b) are given as:

\[ H_0: \frac{\prod_{t=1}^{n} (\text{CRHV}_{t} - \text{CRHV}_{t-1})}{\text{CRHV}_{t}} \leq 0 \quad (2.12) \]

\[ H_A: \frac{\prod_{t=1}^{n} (\text{CRHV}_{t} - \text{CRHV}_{t-1})}{\text{CRHV}_{t}} > 0 \quad (2.13) \]

where \( \text{CRHV}_{t} \) = concentration ratio of the heating and ventilating industry in year \( t \).

2.3.16 The null hypothesis states that the average rate of increase in the concentration ratio is less than or equal to zero. This is discussed in Chapter 13, Section, 13.4.

2.3.17 Proposition iv(c) may also be stated algebraically as:

\[ H_0: \frac{\prod_{t=1}^{n} (\text{HH}_{t} - \text{HH}_{t-1})}{\text{HH}_{t}} \leq 0 \quad (2.14) \]

\[ H_A: \frac{\prod_{t=1}^{n} (\text{HH}_{t} - \text{HH}_{t-1})}{\text{HH}_{t}} > 0 \quad (2.15) \]

where \( \text{HH}_{t} \) = Herfindahl index of the heating and ventilating industry in year \( t \).

2.3.18 The null hypothesis states that the average rate of increase in the Herfindahl index is less than or equal to zero. This hypothesis is also discussed in Chapter 13, Section 13.5.

2.3.19 Alfred Marshall likened firms to the trees of the forest. Although many do not survive in the early years, a few grow and in turn become as large or larger than their rivals. Eventually however, age tells and they gradually ‘lose their vitality’ (Marshall, 1920 p.263). This he saw as a natural process for trees and equally for firms as the energy and ability of the founders of the firm age and are replaced by people with less ‘creative genius’, unless the firm becomes a joint-stock company. As a joint-stock company it may still grow as it has greater access to capital, but its rate of growth is likely to be relatively slower than its younger competitors. If Marshall’s hypothesis applies to heating and ventilating contractors, then one would expect to find that:

\[ \text{v.} \quad \text{new entrants tend to experience relatively rapid growth and higher mortality rates compared to established enterprises.} \]

2.3.20 This proposition is concerned with the age of firms rather than their size (though age and size tend to be related), and is consistent with Hannan and Carroll (1992, p72). They suggest that because smaller firms can be set up more easily than large organisations, these young firms’ mortality rates tend to be higher. This hypothesis may be divided into two parts. The first refers to the growth rates of new entrants compared to mature firms, defining a mature firm as one with 5 or more years trading by year \( t \). ‘New entrants’ refers to those
firms joining the HVCA in any given year, although the year of their incorporation is usually before then. The null hypothesis of the first part of $v$ is given as:

$$H_0: \sqrt{\frac{N_e}{N_m}} \left( \frac{\sqrt[(N_e - 1)]{(WR_e, t + n - WR_e, t)} / \sqrt[(N_m - 1)]{(WR_m, t + n - WR_m, t)}} / \sqrt{WR_e, t} \right) \leq \sqrt{\frac{N_e}{N_m}} \left( \frac{\sqrt[(N_e - 1)]{(WR_e, t + n - WR_e, t)} / \sqrt[(N_m - 1)]{(WR_m, t + n - WR_m, t)}} / \sqrt{WR_e, t} \right)$$  (2.16)

$$H_A: \sqrt{\frac{N_e}{N_m}} \left( \frac{\sqrt[(N_e - 1)]{(WR_e, t + n - WR_e, t)} / \sqrt[(N_m - 1)]{(WR_m, t + n - WR_m, t)}} / \sqrt{WR_e, t} \right) > \sqrt{\frac{N_e}{N_m}} \left( \frac{\sqrt[(N_e - 1)]{(WR_e, t + n - WR_e, t)} / \sqrt[(N_m - 1)]{(WR_m, t + n - WR_m, t)}} / \sqrt{WR_e, t} \right)$$  (2.17)

where $WR_e, t$ = wage returns of new entrant $e$ in year $t$

$WR_m, t$ = wage returns of mature firm $m$ in year $t$

$N_e$ = number of new entrants

$N_m$ = number of mature firms

2.3.21 The null hypothesis states that the average growth rate of new entrants is less than or equal to the average growth rate of mature or established firms. This is discussed in Chapter 14, Section 14.2.

2.3.22 The second part of $v$ refers to differences in the survival rates of new and established firms. The null hypothesis is given as:

$$v (b) \ H_0: \frac{\sum_{e, t + n} S_e}{E_t} \geq \frac{\sum_{m, t + n} S_m}{M_t}$$  (2.18)

$$H_A: \frac{\sum_{e, t + n} S_e}{E_t} < \frac{\sum_{m, t + n} S_m}{M_t}$$  (2.19)

where $S_{e, t + n}$ = number of years $n$ survival after year $t$ of new entrant $e$

$S_{m, t + n}$ = number of years $n$ survival after year $t$ of mature firm $m$

$E_t$ = number of new entrants in year $t$

$M_t$ = number of established (mature) firms in year $t$

2.3.23 The null hypothesis states that the average number of years survival of new entrants is greater than or equal to the average number of years survival of mature or established firms. This is also discussed in Chapter 14, Section 14.2.

2.4 Propositions and hypotheses: (3) The growth and survival strategies of firms in the heating and ventilating industry

2.4.1 The central hypotheses of this research are concerned with the growth and survival strategies of firms in the heating and ventilating industry. The following hypotheses link the survival and growth rates of individual firms. Firms, which grow rapidly, may do so organically because of the success of new technology and/or the superior benefits of the components they supply and fix, or because they respond positively to contingent offers of work as and when they arise regardless of the consequences on their cash flows. Their growth may be planned or unplanned. Penrose (1959) has argued that growth itself is necessary in order to make good use of interstices. Hence, growth improves capacity utilisation but only up to an optimum rate of growth.
2.4.2 In studying the population of members of the HVCA, several issues raised by Hannan and Carroll (1992) and Carroll and Hannan (2000) in terms of population ecology are considered. They, in line with other management writers such as Porter (1985), see firms’ growth as a consequence of competitive advantages. Firms thus seek competitive advantage in order to survive. If the fastest growers survive longest then it follows that growth is usually a sign of having a competitive advantage. Hence, it follows that:

vi. in the heating and ventilating industry, relatively fast growth is a predictor of survival.

2.4.3 To test this proposition the relationship between growth rates and years survived is used. If firms that survive the longest have significantly higher growth rates than the rest of the population then relatively high growth rates are associated with survival. Because of competitive advantage and because of positive Penrose effects concerned with capital utilisation, surviving firms tend to have significantly higher growth rates than other firms. Hence;

\[ H_0: \text{bar} \Delta \text{WR}_s \% \neq \text{bar} \Delta \text{WR}_N \% \]
\[ H_A: \text{bar} \Delta \text{WR}_s \% = \text{bar} \Delta \text{WR}_N \% \]

where \( \text{bar} \Delta \text{WR}_s \% \) = average rate of growth of survivors
and \( \text{bar} \Delta \text{WR}_N \% \) = average rate of growth of non-survivors

2.4.4 The null hypothesis is that there is no significant difference between the mean growth rates of survivors and the mean growth rates of firms which did not survive. If firms that grow fastest do not survive, their growth may be due more to an implicit unplanned reactive management strategy, or it may be opportunistic behaviour on the part of the owners to sell either for personal gain or to gain accelerated access to a larger market. There are also negative Penrose effects such as loss of efficiency from excessive growth. These become stronger at very high growth rates. This hypothesis is discussed in Chapter 14, Section 14.3.

2.4.5 Regardless of the existence or not of a relationship between growth and survival, it is possible to identify the range of growth rates associated with a minimum chance of failure as measured by the survival index. Hence:

vii. firms that grow within a range around a target growth rate minimise the chance of failure.

2.4.6 Firms that grow too quickly run the risk of over-trading. Firms that grow too slowly or not at all incur the additional burden of owning under-utilised resources, according to Penrose (1959), as discussed in paragraph 7.4.12. This issue is developed in Chapter 14, Section 14.4.

2.4.7 Annual variance of a firm’s growth rates may be used as a measure of risk associated with its performance. Firms face opportunities to grow, which they are not obliged to take. Whether firm \( i \) takes these opportunities or not will depend upon its attitude to risk (given the assumption that firms recognise that fast growth is risky).
2.4.8 Assuming also that a firm’s growth opportunities in year \( t+1 \) are independent of its opportunities in year \( t \) (i.e. that it does not possess a sustained competitive advantage), then variance in growth rates (up or down) can be seen as depending upon the firm’s attitude to risk. The risk loving firms are therefore predicted to show higher variance. This cannot of course be tested without direct independent measurement of attitude to risk. However, if we accept this link as theoretically plausible, it follows that we would expect to find a negative relationship between variance and survival rate (the risk lovers will tend to have the highest variance but, necessarily, lower survival rates).

2.4.9 If we find such an association *ex post* (empirically) this line of reasoning provides an explanation, provided that we are prepared to assume that firms foresee the risks they are taking clearly enough consciously to trade short-run returns against longer-run survival risk. An alternative explanation, however, can be constructed in terms of firms operating under uncertainty and bounded rationality, in which firms do not accurately foresee the risks they are taking.

2.4.10 It may be argued that for any given rate of growth of the \( i \)th firm, taken as its average annual growth rate over the whole period, variance can also be a predictor of survival, on the assumption that lower variances reflect attitudes towards risk, planning strategies and managed cash flows. Consequently, it may be possible to test the predictability of survival based on the variance of annual growth rates. Hence;

\[ \text{viii. the higher the coefficient of variation of annual growth rates, the less likely firms are to survive.} \]

Thus, \((C_i, S_i) = r\) \hspace{2cm} (2.22)

where \( C_i \) = ratio of variance to mean growth rate of firm \( i \)

\( S_i \) = survival index of firm \( i \)

and \( r \) = correlation coefficient of mean growth rates and survival index

\[ H_0 : \quad r = 0 \]

\[ H_A : \quad r \neq 0 \]

2.4.11 This hypothesis is tested in Chapter 14, Section 14.5. A relatively high variation in output growth implies that firms will incur additional costs relative to their competitors as they alternate between having excess capacity in one period and insufficient capacity to meet demand in the next. This is not to say that sales and capacity are not volatile. One of the problems facing firms in construction and heating and ventilating is precisely the problem of matching volatile sales patterns with equivalent changes in capacity.

2.4.12 Variance is concerned with a general pattern of behaviour over a number of years. However, the decisions of management in any one year can lead firms into serious difficulties. One such decision is concerned with rapid expansion. Related to risk-taking is the willingness to take on far more work than in a preceding year causing firms to expand
very rapidly. In the process this may exhaust working capital and lead to cash flow difficulties, the phenomenon of over-trading.

2.4.13 In construction because output decisions are more difficult to control and because of the discrete nature of projects, the lumpiness of the output and the unpredictable nature of the tendering process, contractors may frequently expand more rapidly than prudent, leading them to cease trading. If this is indeed the case, then it follows that:

ix. the higher the peak rate of growth the less likely firms are to survive.

2.4.14 The null hypothesis is:

\[ \frac{(WR_i, p - WR_{i, p-1})/WR_{i, p-1} J_i}{S_i} = r \]  

(2.23)

where \( WR_{i, p} \) = wage returns of firm \( i \) in given peak year of growth \( p \)

\( S_i \) = survival index of firm \( i \)

and \( r \) = correlation coefficient

\[ H_0: \quad r = 0 \]

\[ H_\alpha: \quad r \neq 0 \]

2.4.15 The null hypothesis states that there is no relationship between peak rates and survival indices. This hypothesis is discussed in Chapter 14, Section 14.6.

2.4.16 Having discussed growth and survival in general, it is necessary to introduce the business cycle into the analysis to take into account the fact that conditions are constantly in a state of flux, with identifiable crisis years occurring from time to time at irregular intervals. Apart from growth rates, size of firm at foundation and year of founding may also be possible determinants of survival. To test the significance of these covariates on the survival chances of firms, Cox regressions were used. The year of founding is assumed to be the year of joining the HVCA. The model of the Cox regression is given as:

\[ \log h(t) = a(t) + \beta_0 + \beta_1 G + \beta_2 S + \beta_3 J \]  

(2.24)

where \( \log h(t) \) = log hazard rate

\( G \) = growth rate

\( S \) = size in 1955 or on joining the HVCA in subsequent years

and \( J \) = year of joining the HVCA

2.4.17 Equation 2.24 states that the log hazard rate of firms surviving to a given year is a function of growth size and the year of joining the HVCA. The principles of log hazard models are discussed in more detail in Sections 10.4 and 14.3 and their application to growth rates and survival in Sections 14.3 and 14.6.
2.4.18 Taking the year of founding as a covariate of survival implies that firms’ survival chances may vary depending on the cycle phase. Thus:

\[ \text{x. firms survive for different periods depending on the phase of the business cycle in which the firms were founded.} \]

2.4.19 If firms are set up (or are trading) at the beginning of a recovery period they have a greater opportunity to acquire experience and to accumulate cash reserves to enable them to survive the recession than those firms set up in other phases of the cycle. This corresponds to organisational imprinting discussed by Hannan and Carroll (1992, pp 31-2) and Stinchcombe (1965). To test proposition x, which is discussed in Chapter 14, Section 14.6, the null hypothesis states that there is no relationship between the year of founding (defined as the year of joining the HVCA) and the firm’s survival index. This can be given as:

\[
(S_{i,f,g}, Y_f) = \tau
\]

where \( S_{i,f,g} \) = survival index of firm i founded in year f with given growth rate g and \( Y_f \) = year of founding.

\[ H_0: \tau = 0 \]

\[ H_A: \tau \neq 0. \]

2.5 Concluding remarks

2.5.1 This chapter raises a number of issues concerning the industrial performance of the heating and ventilating industry as a whole in comparison with the rest of the construction industry. Within heating and ventilating a number of issues are raised regarding the structure of the industry with a view to understanding the causes and effects of the level of competitiveness to be found in the heating and ventilating market. Finally the performance of firms is discussed in terms of their annual rates of growth and survival to ascertain which if any strategies may be of benefit to firms.

2.5.2 The following chapter deals with the general methodology of the research. In order to investigate the heating and ventilating industry and the issues raised in this chapter a number of sources of data were identified. In particular the annual wage returns posted by members of the Heating and Ventilating Contractors Association are discussed in detail. The next chapter discusses these sources of data and their limitations. A number of operational definitions were also found to be necessary, in particular the term “survival” in the context of the theory of the firm.
Chapter 3 General methodology and sources of data

3.1 Introduction

3.1.1 As the on-site production process in the construction industry has increasingly moved towards specialist subcontractors it seems timely to investigate the implications of the central role of subcontractors from the point of view of subcontractors. However, soon after embarking on this research it became apparent that any in-depth study of subcontractors in the construction industry could not safely generalise about subcontractors on the basis of a study of one type of specialist firm. Technologies, materials, skills, capital structures and relationships with suppliers and main contractors vary to such an extent that each specialism in construction forms its own construction sub-industry and social structure of construction production (Gruneberg and Ive, 2000, p.17).

3.1.2 For this reason it was decided to identify a group of specialist firms within construction which formed a coherent group of firms with similar characteristics. Penrose (1959, p.103) points out that in practice because firms vary so much in terms of their products or services, resources used, locations, and methods of organisation it is difficult to attribute differences to any particular variable. This should also be kept in mind when comparing heating and ventilating contractors carrying out different work packages on different sites in different locations, on different projects on different types of buildings and structures. Although heating and ventilating contractors form a heterogeneous group of firms, they are clearly defined as a specialism within construction in Housing and Construction Statistics and the annual Private Contractors' Census.

3.1.3 Using these sources the annual heating and ventilating output at current prices was estimated by multiplying the third quarter DETR data in Housing and Construction Statistics by 4. This data was then deflated using a price index, referred to in this research as the Gross Construction Product Index (GCPI), and comparisons made with total annual construction industry output from 1955 to 1997 at 1995 prices, provided by the DETR. The GCPI for the period 1955 to 1996 was found by dividing construction output at current prices by construction output at constant 1995 prices. Both output time series were supplied directly by the DETR Construction Market Intelligence Division. The implied deflator formed by the inverse of the GCPI was then used to deflate a number of other current price series, including the HVCA annual wage returns.

3.1.4 As with any research it was necessary to obtain different sources of information. Apart from obtaining government statistics it was decided to approach the industry itself. In order to identify specific firms the trade association of heating and ventilating contractors, the Heating and Ventilating Contractors Association (HVCA), was contacted. With their cooperation and help it was not only possible to identify firms from historical membership lists but it was also possible to trace the historical record of the heating and ventilating industry from the annual reports of the HVCA. The annual historical record of events seen from the point of view of the heating and ventilating industry thus provided the political, industrial relations and economic context of the raw statistical data.
3.1.5 In order to trace the performance of firms in the industry it was thought necessary to study the accounts of a sample of member firms. An exploratory study was undertaken but this revealed a number of shortcomings especially in the consistent presentation of accounts, especially of small firms whose owners' purchases and perks were often disguised, for example, as capital expenditures on properties belonging to the firms.

3.1.6 It was therefore decided to study the accounts of firms in the Major Contractors Group, comprising most of the largest members of the HVCA. Although these firms were amongst the largest in the HVCA the annual records held at Companies House soon revealed that most had become subsidiaries of other companies or were part of group accounts and therefore difficult to analyse with consistency. Moreover, in some years only one or two accounts were useable for this research and often major changes in one firm's set of accounts had a significant effect on the aggregate figures.

3.1.7 Clearly a third set of data was required and this was located in the form of the annual wage returns submitted to the HVCA as the basis for the calculation of annual membership fees. The records of the annual wage return data can be found in the Annual Returns and Payments ledgers, which go back to the founding of the Association in 1904. In 1971, some tidy mind decided in its wisdom to extract and destroy the names and records of members who had left prior to 1960. The same exercise was repeated for 1961, but fortunately for our purposes, since then all details received by the HVCA and filed in the ledgers appear to have been preserved, with the exception of the years between 1980 and 1987. In the Annual Returns and Payments Ledger of the HVCA are the following hand written initialled notes:

Sheets for members removed from the Roll in 1960 or earlier extracted and destroyed 23rd March 1971.

And

Sheets for members removed from the Roll in 1961 destroyed 30th July 1973. See old register of members (in safe), which has alphabetical index.

3.1.8 This can be confirmed by the sequence of folio numbers of firms joining since 1961, which are in sequence, whereas for firms joining before 1961 only those surviving after that date can be found. Fortunately, some of the missing data has been retrieved from the computer records, when they were set up in 1980. The wage return data collected was the post-war data from 1945 as the pre-war data was not seen as relevant here for discussion of current strategic planning issues.

3.1.9 As this research is at the intersection of business cycle theory, the structure, conduct, performance paradigm in industrial economics and organisational demography, the literature search and study focused on the effect of the business cycle on industries and firms, theories of growth of the firm, time series analysis and statistics, and population studies. Use has also been made of the structure, conduct and performance paradigm, especially of concentration ratios and entry and exit rates.
3.2 Dynamic organisational demographics

3.2.1 One major methodological problem to be overcome or at least taken into account is the dynamic composition of firms in any given industry over time. A good example of this problem is given by Mueller (1986 pp.2-7). The Federal Trade Commission (1972) carried out a survey of the 1,000 largest manufacturers in 1950. A similar study was repeated in 1972. However, by 1972, 384 companies in the 1950 list had been acquired and only 583 of the original list still existed, though not all of them were still in the top one thousand. Indeed, in 1972 no information could even be found on 28 firms in the original list.

3.2.2 If such a state of affairs can obtain with the largest of companies, then the problems of continuity of data for much smaller enterprises is even greater. Moreover, it is proposed to study firms over a much longer period of time than in Mueller’s study. Thus the data in this study is not continuous for firms, as it is comprised of different firms in different years. Sometimes they overlap, as firms joined and left at different times and remained as members for different lengths of time. Only a relatively few, if any, survived for the whole period of the research. Much of the study of organisational demography is concerned with the analysis of the changing composition of populations of heterogeneous firms.

3.2.3 A comprehensive account of the changing population of firms is provided by Hannan and Carroll (1992 p.4) who discuss changes in organisational populations in terms of the selection of firms as survivors in a competitive environment. Their approach is discussed in more detail in Chapter 9.1. They maintain that firms rarely succeed in adapting to changing circumstances in the long run and hence few firms survive indefinitely. They favour an approach, which considers the social and economic conditions, which lead to the founding and mortality of firms, which in turn alters the structure of organisational populations. The changing composition of a population of firms can be analysed using a stock and flow model. The net flow effect of firms entering and leaving a market tends to follow a long run pattern of growth in numbers reaching a peak followed by a period of stability and/or gradual decline. Similar patterns have been noted by Geroski and Mazzucato (1999). However, the pattern in heating and ventilating since 1945, according to the annual number of members of the HVCA, has been stable or increasing.

3.3 Statistical sources and limitations of the data

3.3.1 Official data on construction in general and the heating and ventilating industry in particular can be found in Housing and Construction Statistics, and in the annual Census of Production. Table 3.1 is based on an extract from Business Monitor, Table 1, (PA 500 (1992) p.9), which breaks down construction output and costs in 1992 in terms of value added by SIC 1980 codes 500 to 504.

3.3.2 From Table 3.1, over 25 per cent of total value added in construction involves civil engineering firms, SIC 502. If one excludes these firms from the calculation of the building process, it can be seen that according to official statistics, firms classed to 501, which were engaged in construction and repair of buildings, contributed approximately 87 per cent of
Gross value added. This figure can be compared to less than 13 per cent by those firms installing fixtures and fittings and building completion work. From this breakdown of those firms employing 20 or more it is difficult to measure the contribution of main contractors compared to subcontractors. However, if SIC 500 and 501 are meant to largely represent main contractors and 503 and 504 services and finishing trades, the distribution of value added in the construction process is not particularly useful or accurate, even given that it excludes those firms employing less than 20 people.

Table 3.1 Gross output and gross value added by type of undertaking in 1992

<table>
<thead>
<tr>
<th>SIC</th>
<th>500</th>
<th>501</th>
<th>502</th>
<th>503</th>
<th>504</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross output (£m)</td>
<td>4,492.4</td>
<td>20,194.2</td>
<td>10,243.9</td>
<td>5,131.9</td>
<td>2,079.2</td>
<td>42,141.6</td>
</tr>
<tr>
<td>Gross output as % of total</td>
<td>10.66%</td>
<td>47.92%</td>
<td>24.31%</td>
<td>12.18%</td>
<td>4.93%</td>
<td></td>
</tr>
<tr>
<td>GVA at factor cost (£m)</td>
<td>873.3</td>
<td>11,298.5</td>
<td>4,824.4</td>
<td>1,225.6</td>
<td>535.7</td>
<td>18,757.5</td>
</tr>
<tr>
<td>GVA at factor cost as % of total</td>
<td>4.66%</td>
<td>60.23%</td>
<td>25.72%</td>
<td>6.53%</td>
<td>2.86%</td>
<td></td>
</tr>
<tr>
<td>Gross output (£m)</td>
<td>4,492.4</td>
<td>20,194.2</td>
<td>5,131.9</td>
<td>2,079.2</td>
<td>31,897.7</td>
<td></td>
</tr>
<tr>
<td>% of total gross output excl. civil engineering</td>
<td>14.08%</td>
<td>63.31%</td>
<td>16.09%</td>
<td>6.52%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GVA at factor cost (£m)</td>
<td>873.3</td>
<td>11,298.5</td>
<td>1,225.6</td>
<td>535.7</td>
<td>13,933.1</td>
<td></td>
</tr>
<tr>
<td>% of total GVA excl. civil engineering</td>
<td>6.27%</td>
<td>81.09%</td>
<td>8.80%</td>
<td>3.84%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: SIC 500 is defined as general construction and demolition work; 501 construction and repair of buildings; 502 civil engineering; 503 installation of fixtures and fittings; and; 504 building completion work.
Source: PA500 Business Monitor 1992, Table 1, Output and costs of UK undertakings employing 20 or more, 1992.
GVA = gross value added

3.3.3 There is therefore a need to find an alternative measure of output which might be used to analyse value added within the construction industry which also takes into account the large number of small firms in the sector. In looking at the heating and ventilating industry three main sources of statistical data for this research were used:
   a. Annual wage return data, HVCA.
   b. Housing and Construction Statistics, DETR
   c. Company accounts data, Companies House

3.4 Annual wage returns

3.4.1 The specialist firms targeted by this research can be defined precisely in terms of their trade association, the Heating and Ventilating Contractors Association (HVCA).
Membership is voluntary and largely self-selected, through an application and vetting procedure. Currently a firm must have been in trade for at least 2 years before applying to join.
3.4.2 In order to investigate long run changes and trends in the heating and ventilating industry and to find specific factors affecting particular categories of firms, it was necessary to find a series of relevant data over at least two business cycles. The wage return data of the Heating and Ventilating Contractors Association enable such an analysis of individual firms to be made.

3.4.3 Two sets of ledgers were found to be of use; the Off List Membership list and the Membership list. The first ledger lists firms which were no longer trading by 1980, while the second set of ledgers contains the records of active members when the membership list was transferred to a computerised system in 1980. For membership data since 1980, the source of information is a computer printout of all members since 1980, supplied by the Heating and Ventilating Contractors' Association. From the ledgers located in London it is possible to establish the declared annual certified wage returns of each member in the Association's membership lists for the years 1945 to 1979. The computer archives based in Penrith, provide the same data for the period from 1987 to 1996.

3.4.4 All statistical analysis depends on the collection, recording and accuracy of the data. The annual wage returns are the audited annual wages certified by each firm's accountants. The care taken in gathering annual wage returns is illustrated by the examples of correspondence given in Appendix 1. The annual wage return data has been entered according to the year in which it appears in the ledger. These returns came into the Association continuously during the year and related to the previous year's accounts of the members. A time lag is therefore introduced into the data of approximately one year. Consequently the wage return data refers to the period 1945 to 1996.

3.4.5 The recorded annual wage return data was checked at all stages. The sources of data were the ledgers of the Heating and Ventilating Contractors Association. There are three sets of ledgers: the Off List Membership list, the Membership list and the Ductwork Group. The last ledger was not used, being a duplicate of the firms in the other two ledgers but relating only to their membership of the ductwork grouping within the HVCA. Careful hand-written note was taken in the first place, figures being checked at random. These hand-written sheets were then transferred to the computer. The following data checks were carried out during inputting to the computer spreadsheet:

- the relationship of the data and year of companies were checked against the data and year of other companies.
- Folio numbers were checked periodically and automatically during data processing.
- Random checks on data and years were also carried out.

3.4.6 A comparison of annual wage returns with the time series of the estimated annual output of the heating and ventilating industry based on official data over similar periods confirms the usefulness of wage returns. Figure 3.1 combines the two series by showing the ratio of annual heating and ventilating output to wage returns varied between 5.76 in 1964 and 10.99 in 1974. One reason for the annual variation in the ratio may have been partly as a result of prices and incomes policies and partly due to the increasing use of labour only subcontractors, whose wages were not included in the annual wage returns, submitted to the HVCA until the 1980s. Although HVCA data for 1980 to 1986 is not available, from 1975 to
1995 the ratio of heating and ventilating industry output to aggregate HVCA wage returns varied between a low of 8.28 in 1977 and a high of 10.22 in 1993. Though it varied from year to year, since 1971 there has been no tendency for the ratio to increase over time. If this is the case, then the wage return data implies no significant change in the share of wages in gross output has taken place since the early 1970s. Therefore, there are grounds for assuming a straight-line relationship between long run wage return data and industry output. Chapter 11 considers in more detail the behaviour of aggregate wage returns in relation to aggregate employment, total industry output and HVCA firms' total turnover.

**Figure 3.1** Ratio of annual heating and ventilating output to wage returns 1957 to 1996

Notes:
Declared total wage returns 1948-96 based on annual HVCA wage roll, excluding assessed firms' assessments and 'no data' cells.
Sources: Membership Annual Returns and Payments Ledger, Alphabetical List of Members
Firms Off Roll Annual Returns and Payments Ledger, Alphabetical List of Members
HVCA computer printout, June 1998, Penrith
Sources: 1957-63 data taken from HVCA Annual Report, 1964-5, p 46
1963 data taken from HVCA Annual Report, 1963-4, p 42
1964 data taken from HVCA Annual Report, 1965-6, p 54
1965-76 data taken from HVCA Annual Report, 1977-8, Appendix E
1977-78 data taken from HVCA Annual Report, 1979-80, Appendix E
1979-80 data taken from HVCA Annual Report, 1980-81, Appendix F
1981-84 data taken from HVCA Annual Report, 1985-86, Appendix G
1985-94 data taken from HCS 1984-1994, Table 3.3
Original source: Department of the Environment.

3.4.7 Using data over such a long period as in Figure 3.1 has advantages and disadvantages. The definition and composition of the wage return data altered over time as labour only subcontracting increased. Payments to labour only subcontractors were not always included.
in the wage returns until the 1980s when payments to casually employed labour only subcontracted labour (LOSC) were recognised by the HVCA as part of the wage bill of firms. The earlier data therefore increasingly tended to underestimate the actual level of the wage bill. Insofar as labour only subcontracting was increasing in relative importance in this earlier period, it follows that the true rate of increase in wage bills from year to year was also understated. After 1987, members were asked to file the wage return data broken down according to direct and indirect wage costs. The wage totals used in this analysis aggregate both types of employment after 1987, but not necessarily in the years before 1979.

3.4.8 Nevertheless the data provides some continuity over the half century covered. Moreover, it is possible to disaggregate this wage data in a way not possible with official statistics, which only record annual totals. The data found in the annual wage returns ledgers permits an analysis of the number of new firms joining as well as the number of firms leaving the HVCA. These flows are omitted from official data, such as the annual Private Contractors Census (PCC) data, which only shows net change - gross flows are not given. By using a survey of individual firms it is possible to analyse growth rates and survival according to various characteristics of firms during different phases of the business cycle.

3.4.9 There were three major crises or periods of extended decline in construction during the period under study in 1973-77, 1979-81 and 1990-93 but as insufficient wage return data is available for 1979-81, the two major crises to be examined are 1973-77 and 1990-93. To some extent archival research must be shaped by the material itself.

3.4.10 Allowing for the usual terms of confidentiality of individual firms and members, the Heating and Ventilating Contractors' Association kindly made their historical data openly and unconditionally available for the purpose of this research. The Annual Returns and Payments ledgers and the internal HVCA computer data provide the wage returns data for 1945 to 1979 and 1987 to 1996 respectively. Other sources of information provided by the Heating and Ventilating Contractors' Association were the Year Books and Annual Reports, which provide the historical context from the point of view of heating and ventilating contractors.

3.4.11 The Year Books were first published in 1947 and continued as Annual Reports to the present, though some of the earlier editions were found to be missing and in recent years (since 1991) the Annual Reports have been reduced in volume and content. Each Year Book contained a number of items, many providing unwitting historical evidence. In each edition there were a number of advertisements, a statement by the president, followed by a number of short articles on a variety of technical and business aspects of the “industry” or “trade” of heating and ventilating installations. From the second edition for a number of years, an active contractor was invited to contribute a member’s perspective of the previous year’s trading. These articles were always anonymous and provided an opportunity for a member of the HVCA to express opinions (often humorously). Industrial and trade agreements including rates of pay for apprentices, operatives and draughtsmen were also included in each year’s publication. The Year Books also included alphabetical lists of members and their addresses. Finally, an index of members according to services and products offered was given.
for the use of professionals, such as architects and engineers, working closely with heating and ventilating contractors. Later, the Year Book was replaced by Annual Reports and a separate Specifiers' Guide, which was designed for the marketing purposes of members.

3.4.12 On being elected to the Association, each firm is given a folio number, in general issued in sequence. These folio numbers range from 2 to 4200, representing both the current membership, and firms which have been past members of the Association since its formation. Unfortunately the computerised wage returns and membership fee data for the period 1980 to 1988 were deleted, destroyed or lost.

3.4.13 For the data prior to 1980, of the 2500 folio numbers representing members of the HVCA, around 500 are missing. The removal of these firms from the ledgers biases the early data in favour of those firms, which survived beyond 1961. This accounts for some of the missing firms in the records for the years 1945 to 1960. The sequence of folio numbers indicates the year of joining and provides the number of firms joining in any given year. From the annual total membership given in the ledgers and the information given in the annual reports it is possible to compare the totals for each year to confirm consistency.

3.4.14 Many of the surviving folios of firms prior to 1980 and since 1987 contain missing data or data that was assessed by the HVCA for subscription fee purposes, and these assessments have been excluded from the study. Since 1970 most firms have been assessed in at least one year of their membership. Only data declared by members themselves has been included in this study. Thus there are two reasons for gaps in the data; namely, folios missing altogether and incomplete data in some folios.

3.4.15 Although the Membership Secretary of the HVCA informed the author some folio numbers may have been used a second time for a new or different firm rather than a returning firm, the practice does not appear to have occurred in the data. It will be assumed that where folio numbers were used for a second time for a new firm, it made no significant difference to the data either because the number of occasions must have been small or the size of firms would have been insignificant. Otherwise, it is assumed firms’ records were maintained and new firms were given new folio numbers.

<table>
<thead>
<tr>
<th>Table 3.2 Analysis of folios and wage returns used in this research</th>
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<tbody>
<tr>
<td>Period</td>
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<tr>
<td>--------------</td>
</tr>
<tr>
<td>1946-80</td>
</tr>
<tr>
<td>1988-97</td>
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<td>1988-97</td>
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</tbody>
</table>

Notes:<sup>1</sup> Out of sequence folios, F5113 and F5174 are included.<sup>2</sup> Excluding pre-1980 folio numbers.
3.4.16 Table 3.2 shows the number of folios used in the research in the two periods of the study. In the first period from 1946 to 1980, 78 per cent of folio numbers have been used. In the period from 1988 to 1997 only 51 per cent of all folio numbers were used. This apparently low percentage of firms is because only 617 firms of those in trade before 1980 survived to 1988 and beyond. However, 80 per cent of the folios of those firms, which joined the HVCA after 1980, have been included in the survey. Thus, of the 2,124 firms in the post 1988 study, 1,507 firms joined the HVCA after 1980 and the remaining 617 firms were pre-1980 firms, which had survived. The statistical information to be gleaned from the HVCA wage returns can only be as sound as the remaining surviving data.

3.4.17 Because the aim of the study is to examine trends since the Second World War, it was decided to begin the study using data for 1945. In any case, the exceptional conditions of the Second World War distorted long run trends. The extreme restrictions on trade caused both by manpower shortages and government imposts and decrees would have rendered the period prior to 1945 useless for developing theories about the behaviour of firms at the end of the century. During the war the shortage of workers meant that apprentices were upgraded in order to carry out the work their older skilled colleagues would have done but were unavailable to do as many had volunteered for war service (HVCA Interview). Even after the war, according to the Association’s Year Book, (AHVDEE, 1948 pp.65-66) production was disrupted and the market distorted by government measures designed to direct resources to areas of greatest need or to control imports and supplies of foreign currency. No doubt these restrictions were not always perceived by the membership of the HVCA as being in the best interests of firms in the heating and ventilating industry.

3.4.18 For these historical reasons and the practical considerations of consistency and veracity of data, it was decided that the main body of the statistical analysis should cover the period starting in 1957. In 1957 the Private Contractors Census first began to publish heating and ventilating industry data separate from other specialist contractors in construction (Fleming, 1980 and 1986). This series is included in Housing and Construction Statistics, and the Annual Construction Statistics on the DETR website, (currently the DTI website) making it possible to carry out a long run comparison between official heating and ventilating industry data and the wage returns of the HVCA.

3.4.19 In the Annual Returns and Payments ledger, the list of firms is in alphabetical order. Each folio contains the wage returns submitted annually by each firm. These returns are taken from the audited accounts of the member firms, signed by their respective auditors, and are then filed by the HVCA throughout the year. Returns applied to the previous year’s activities and the accounting years of members varied. This data therefore introduces some noise into the statistics as the year in which the data is recorded refers to a period immediately prior to the reported year, or a period overlapping with the previous year and the year it is recorded in the Association’s files. Nevertheless, as this research is primarily concerned with long run trends, each firm’s wage return is assumed to apply to the year prior to the date it was posted or filed in the HVCA ledgers. It is recognised that this does make a simplifying assumption about the accounting time lag in the data. Time is therefore treated as a discrete variable in this research.
3.4.20 Other information contained in each firm’s folio record is the fee paid and the date of payment. The Annual Returns and Payments ledger also shows the reasons or circumstances of membership withdrawal. These include resignation, expulsion, suspension, deceased, liquidation, ceasing to trade and the return of unopened mail.

3.4.21 Thus, the main body of data found in the ledgers of the HVCA represents the annual wage returns of members of the Association between 1945 and 1996. Other data from the HVCA and Companies House refer to the membership, its location, year of joining and leaving the HVCA and its industrial classification. These strands of data split the research into various themes concerning the formation, growth and survival of firms from 1945 to near the end of the century, and their entry and exit into and out of the industry.

3.4.22 Table 3.3 shows the various sets of data and the years used in this research. The years given are either the start or end year of a series, the intermediate years are omitted. Deflated Gross Domestic Product (GDP) data is available from 1946, construction output from 1955 and separate heating and ventilating industry output from 1957. Wage return data was found for 1945 until 1979 and again from 1987 until 1996.

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<td>xy</td>
<td>xy</td>
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<td>xy</td>
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</tr>
</tbody>
</table>

3.4.23 Of course, data on construction output is available for the period prior to 1955. However, 1955 was the first year of the GCPI 1995 = 100 series and the source of the earlier data was the Census of Production rather than the Ministry of Public Building and Works (MPBW), which would have caused discontinuities in the data which were therefore not used in the analysis. However, because the data used is left truncated in 1957, it is useful to have some information prior to the truncation. For example, one may give an operational definition of a “mature” firm as one with at least 5 years trading. This allows a comparison to be made between new entrants and established firms in 1957, based on evidence that the mature firms were members of the HVCA in 1952 or earlier.

3.4.24 The HVCA data is not a sample of firms but is in fact a survey of the population of members of the HVCA based on the Association’s membership list records for the period 1946 to 1997 as at July 1998. No sampling of the data was carried out. However, as noted above, the data is not complete. Moreover, assessed data has been omitted, which therefore
means that the aggregate data must understate the annual total wage bill of members of the HVCA. Using the population rather than a sample has been necessary because:

- there would have been too few large firms if only a sample had been used,
- in 1946 the membership of the HVCA stood at only 237 firms, making it unnecessary to sample. In any case any segmented sample of such a small population would have created segments that would have been too small to be useful, and finally,
- had a sample been used firms failing in later years would have been too few to measure for significance.

3.4.25 However the use of the population of firms means that the annual aggregate wage bills of the HVCA membership combines an increasing number of firms over time reflecting the growth of the HVCA as well as the growth of individual members. Thus the aggregate data reflects any relative growth there was of the HVCA compared to the total heating and ventilating contractors’ market. This relationship between the number of members of the HVCA compared to the number of firms in the heating and ventilating industry can be seen in Figure 8.3.

3.5 Defining survival (the ultimate objective) and size

3.5.1 For firms in the heating and ventilating industry, like any industrial sector, the key issue is one of survival. By surviving the firm continues to provide wages and profit. The survival of a firm may be defined as its continuing right to trade independently. The firm’s survival is little more than its continued existence as an identifiable legal entity. This narrow definition of survival may be referred to as entity-survival. Entity survival adopts the point of view of shareholders or owners. As a surviving entity the firm represents an investment opportunity. Thus the concept of entity survival entails both the legal survival of the firm as a corporate body and the organisational survival of the firm as an administrative system, what Carroll and Hannan (2000) refer to as legitimation.

3.5.2 As Penrose (1959, p.22) has argued, the conventional economic theoretical definition of the firm is too narrow. It assumes the firm produces one product. Moreover, the composition of a firm may change in terms of its personnel, owners, products, geographical location and even its legal form. Nevertheless, a firm as such maintains continuity as a coordinated administrative organisation and a “collection of productive resources.” (Penrose, 1959, p.31).

3.5.3 Even this dynamic concept of entity-survival ignores the social relations of the people working within an organisation. When a firm expands, people are less likely to feel their jobs are threatened. When a firm is in decline, because sales, market share or its relative competitiveness are in decline, it follows that a large proportion of the people working for the firm may feel their positions are insecure. Industrial relations are affected as the relative bargaining strengths of managers and the managed impinge on day to day working relations. Decline erodes the strength of the source of wages and profits coming from total value added. Consequently, the firm may be forced to cut investment, reduce employment or sell off assets. As far as employment and the firm’s physical assets are concerned, they do not cease to exist simply because the firm no longer has a use for them but their continued application within the firm ends.
3.5.4 Beneath this superficial definition of survival, namely entity-survival, firms continuously change their form and size, with new products, personnel, technologies, factories and offices, and shareholders. This may be seen as a continuous process of industrial adaptation to changing market conditions and new technology.

3.5.5 Moving from the legal and financial connotations of the term *survival* to a resource based definition, we may refer to *size-survival*. Here, the term *size-survival* is defined as the continued employment in period $t+1$ of at least all existing quantities of resources used in period $t$, though not necessarily in the same proportions. Size-survival of the firm is not an all-or-nothing concept. The term as applied to firms is not a life or death matter. This is because a firm is made up of separate co-operating individuals, plant and equipment and other capital resources both financial and non-financial.

3.5.6 There is a need here to establish an operational definition of size-survival, as different resources are involved and size can be measured in a number of different ways. Resources may include labour, plant and materials, but labour varies in terms of ability and effort, plant in terms of technology and age, and materials in terms of types and quality. A further difficulty in measuring the amount of resources used is whether to measure physical size or total value. Aggregate values depend on particular combinations of resources used even after conversion to constant prices. One type of resource (e.g. labour) may be partly replaced by another (e.g. plant) due to changes in technology or production methods.

3.5.7 Edwards, Kay, and Mayer (1987, p.40) suggest the use of value-to-the-owner rules for assessing the value of assets. They point to three methods of valuing capital in year $t$ ($V_t$): the replacement cost value, ($RC_t$), the net realisable value, ($NRV_t$), and the discounted present value of future cash flows, ($PV_t$). Each method of valuation is applied to a given fixed asset and the value-to-the-owner rules are then applied to find the value, which minimises the loss to the owner if the owner were to be deprived of the asset. Table 3.4 provides the set of rules to be followed.

<table>
<thead>
<tr>
<th>Case</th>
<th>Relationship between $RC_t$, $NRV_t$ and $PV_t$</th>
<th>Value to the owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$PV_t &gt; RC_t &gt; NRV_t$</td>
<td>$RC_t$</td>
</tr>
<tr>
<td>2</td>
<td>$PV_t &gt; NRV_t &gt; RC_t$</td>
<td>$RC_t$</td>
</tr>
<tr>
<td>3</td>
<td>$RC_t &gt; PV_t &gt; NRV_t$</td>
<td>$PV_t$</td>
</tr>
<tr>
<td>4</td>
<td>$RC_t &gt; NRV_t &gt; PV_t$</td>
<td>$NRV_t$</td>
</tr>
<tr>
<td>5</td>
<td>$NRV_t &gt; PV_t &gt; RC_t$</td>
<td>$RC_t$</td>
</tr>
<tr>
<td>6</td>
<td>$NRV_t &gt; RC_t &gt; PV_t$</td>
<td>$RC_t$</td>
</tr>
</tbody>
</table>

3.5.8 In the first case in Table 3.4, for example, if the present value method produces a value greater than the cost of replacement and the replacement method valuation is greater than the net realisable value, then the replacement value is the preferred valuation. The logic of this decision rule is that the net present value of the operating asset as a functioning part of a business is worth more than the cost of replacement and therefore it would be worthwhile replacing such an asset if necessary. The owner would therefore only have to find the replacement cost in order to remain in business and earn the future cash flow. The option of selling the existing asset yields a lower value than the gains of the other two options and therefore would not be chosen.

3.5.9 As the replacement cost of an asset is invariably greater than its realisable value, Edwards et al. suggest the rules can be simplified to:

$$V_t = \begin{cases} RC_t & \text{if } PV_t \geq RC_t \geq NRV_t \\ RV_t & \text{if } RC_t > NRV_t > PV_t \\ NRV_t & \text{if } RC_t > PV_t > NRV_t \end{cases}$$

While Edwards et al. (1987, pp.41-48) advocate the use of the value-to-the-owner rules, they concede that the rules have little theoretical basis in themselves in conceptual terms, that the criteria themselves are subjective and the capitalisation of assets depends on the uses intended for them.

3.5.10 Thus, disregarding historical cost and depreciation valuation techniques, physical assets may be valued as the discounted present value of future net cash flows attributable to their use. This net income stream is affected by value added and therefore may grow as value added increases, in turn affecting the valuation of the assets. As far as the owners of the firm are concerned, capital assets survive as long as the firm can continue to produce sufficient surpluses. Thus in capital circuit terms, survival of the firm depends on the amount of capital employed in period $t+1$ being equal to or greater than capital employed in period $t$.

3.5.11 Because of all these difficulties of capital measurement it is necessary to make a simplifying assumption about the measurement of size. As methods of installing heating and ventilating equipment do not change dramatically from one year to the next, and productivity changes are similarly relatively gradual, it is possible to use the total wages paid to labour as a measure of size. In this research, size is measured as the total wage return submitted by firms to the Heating and Ventilating Contractors’ Association, as it was on the basis of wages paid that annual membership fees were calculated, on the assumption that the larger the firm the greater the annual wage return. In any case such a measure places the workforce at the centre of the purpose of production. After all people work to make a living and such a measure shows the firm’s ability to meet one of the aims reported in Grinyer’s (1972) survey of construction firms, (see Chapter 9).

3.5.12 It is of course quite possible for a large firm with expanding real resources to incur large financial losses, which threaten both its continued size-survival and entity-survival. A third definition of survival is output-survival by a firm. This concept involves the maintenance of at least a given level of sales but perhaps with far fewer employees and other resources, either because of the casualisation of the workforce or the application of information technology and robotics.
3.5.13 Consider the following three cases involving the introduction of new technology, which itself may be thought of as a resource of the firm. When new technology is introduced output may be increased without the need for additional labour or material resources. Alternatively, innovation permits firms to produce the same output using fewer inputs. Thirdly, if new technology allows the firm to produce and sell more while increasing the resources required, the new processes (and/or products) invariably reduce the unit cost of production.

3.5.14 According to the resource-based definition of size-survival suggested here, the first case represents a no growth scenario. However, the new technology allows value added by the firm to increase, thus ensuring its size-survival, and its potential for growth in the future. In the second scenario, the substitution of resources by the new technology does indeed lead to downsizing, with the cost of process innovation being borne by the workforce and suppliers. As a result of the changes introduced into such a firm, technology is often perceived as a threat to the workforce. Their productivity is increased but a proportion of employees is often made redundant as a consequence (further increasing the productivity of the remaining workers). In this example, the firm survives as an entity and in terms of output-survival, but does not size-survive. Firms, which may be smaller in resource terms, can produce more than before, depending on the technology used. In the third case, the firm adopts new technology, which enables it to expand its sales. It therefore survives as an entity in resource use terms and in output terms.

3.5.15 When a firm decides to downsize in order to remain in existence, it invariably does so at the expense of individuals, who lose their jobs, and by liquidating assets. Those resources no longer required by the firm may be unemployed or allocated to other firms or uses. While the firm itself may continue to trade as a smaller entity, (in resource terms), as far as the redundant resources are concerned the firm has failed to maintain its resource base size. Once a firm begins a path of negative growth, the possibilities open to it are eventual liquidation, take-over by another firm, merger with another firm, or reversal of decline. In all but the last option its continued separate entity existence ceases. With the last option, the firm returns to a growth path.

3.5.16 Firms may also experience loss of turnover and consequent loss of resources following a systemic decline in demand, which affects all firms in a market. Such threats to a firm's size survival may result from business cycle fluctuations, government policies or other economic shocks. To the extent and depending on the speed the market recovers, the firm may be able to survive. However, its strength and ability to survive such recessionary shocks depend to some extent on its explicit and implicit strategic planning for such eventualities. If firm strategies contribute to survival, what then matters is ordered growth, allowing for sufficient working capital and liquid reserves.

3.5.17 While the term "entity-survival" may refer to companies remaining in trade as independent enterprises, it is difficult to find major firms established prior to 1958, which have actually survived as independent trading entities. Either firms succumbed to adverse trading conditions or they tended to be taken over. There are very few cases of firms taking
over firms outside the heating and ventilating industry and even fewer outside mechanical and electrical services. The issue of the measurement of survival in this research is dealt with in the following chapter.

3.6 Concluding remarks

3.6.1 This chapter has discussed a number of general background methodological issues including sources of data, the meaning of survival and the measurement of size. The main sources of data used are based on Housing and Construction Statistics, the annual Private Contractors Census and the annual returns of the Heating and Ventilating Contractors Association. The accounts of the members of the HVCA Major Contractors Group were also used.

3.6.2 This chapter discussed the term “firm survival” which was found to involve a number of different and diverse measures. Survival could be taken as the survival of the firm as an independent legal entity, as a combination of a quantity of resources or as a provider of a level of output. An operational definition of survival is there required before an analysis of growth and survival can be carried out. An index of survival was devised to meet this need. This and other statistical methods used in the analysis are considered in the following chapter.
Chapter 4  Statistical methodology

4.1 Introduction

4.1.1 This chapter discusses the specific techniques used to investigate the data and the reasons for selecting the methods chosen. In particular the chapter deals with the two methods used for estimating long run growth rates. As growth rate is seen as a determinant of survival it is apparent that an operational definition of survival is required. There is therefore a discussion on the definition of the term survival used in the research. Other areas of methodology discussed in this chapter include concentration ratios and the method of deflating data. The chapter concludes with a discussion of an exploratory study, which was carried out on a sample of accounts of HVCA members.

4.2 The measurement of growth rates

4.2.1 Evans (1987a p.570) measures firm growth as:

\[ g = \ln \left[ \frac{S_{t'}}{S_t} \right] / (t' - t) \]  

(4.1)

where  
\( g \) = growth rate  
\( S \) = size of firm  
\( t \) = the first year of the study  
\( t' \) = the last year of the study

4.2.2 This method only takes the first and last year of a time series into account. Evans' study was a relatively short run study only covering the years between 1976 and 1980. In contrast the data of the firms in this study cover the period from 1945 to 1996. Evans was therefore able to take the two years, which applied to all firms in his study. In this research many firms joined and left the population of firms during the period under study. Many firms did not survive.

4.2.3 One method often used to measure annual real growth is the conventional geometric mean of the annual percentage changes of given variables (Wonnacott and Wonnacott, 1990 p.667, Ibbotson Associates 1999, and Inter Company Comparisons, 1993, p. 8) and is similar to that used by Mueller (1986 p.138), who uses the geometric mean based on the nth root of the dividend of the value of assets in the last year over the value of assets in the first year, \( n \) being the number of years between the first and last years. The formula for this average growth rate is:

\[ G = \sqrt[n]{\prod[1 + (x_t - x_{t-1})/x_{t-1}]} - 1 \]  

(4.2)

where  
\( G \) = the growth rate  
\( x_t \) = wage return in year \( t \)  
\( n \) = number of years  
\( \Pi \) = product of all annual growth rates, \( t = 1 \) (base year) to \( t = n \).

4.2.4 This equation was used to calculate the average growth rate of firms in any given year where \( n \) is the number of firms, but could not be used to calculate the growth rates of
individual firms. Calculating the geometric mean of annual growth rates relies on data for consecutive years. Because the available wage return data excludes the years 1980 to 1986 for all firms and missing data occurs in almost all folios in one year or another, regression analysis was used to find growth rates. This method involved finding the natural logs of the annual real wage returns of individual firms at constant 1995 prices. The linear regression of the time series of the log-transformed annual wage returns for each firm was calculated and the linear trend was used as the measure of their individual growth rates. The growth rate of the HVCA members as a whole is calculated using the regression co-efficient of the time series of the log-transformed annual aggregate wage returns. In algebraic terms, the model of growth is given as:

\[ WR = ae^{bt} \]  \hspace{1cm} (4.3)

where \( WR = \) annual wage returns
\( a = \) constant
\( b = \) growth rate, and
\( t = \) time

Transforming into logs, equation 4.3 becomes:

\[ \ln WR = \ln a + bt \ln e \]  \hspace{1cm} (4.4)

\( \ln e = 1 \)

Equation 4.4 then simplifies to:

\[ \ln WR = \ln a + bt \]  \hspace{1cm} (4.5)

The coefficient, \( b \), is then used as the measure of annual growth.

4.2.5 The geometric mean is extremely useful because it captures the annual changes in firms from one year to the next, especially over short periods. However, the geometric mean can be misleading when data is missing. If a firm is not expanding in the period prior to the missing data and does not expand after the period of missing data then the geometric mean would show no growth. If it did increase in size in the years when data was missing the geometric mean would fail to record this. This is particularly relevant when dealing with the gap in the wage return data between 1980 and 1987. For this reason in this research the calculation of long run growth rates of firms based on wage return data relies on the linear trend of the annual wage returns of individual firms. However, where comparisons of the performance of different categories of firms over relatively short periods of up to ten years are discussed, the geometric mean growth rates of firms has been used.

4.2.6 Allowing for the fact the geometric mean growth rate may be misleading where data is missing, it is still useful, for example, in Table 14.1, where comparisons are drawn between new and incumbent firms in the first 10 years after joining the HVCA. Of course, growth rates based on the geometric mean are not comparable to growth rates based on the linear trend.
4.2.7 Linear trends have been used to establish long run life-time growth rates of individual firms. Geometric mean growth rates based on the annual changes in wage returns have been used where a year by year or less than life-time comparison is made between different types of firm, such as new and incumbent firms, large and small firms and firms with varying peak year rates of growth.

4.2.8 To illustrate the use of tests of statistical significance, for example, $z$-tests, the following conventional method was adopted. The $z$-test may be used to compare sample means based on the notion that the means of two samples from the same population would tend to vary around the population mean, with differences of means occurring within a known range (Black 1997, p.344). The $z$-test is based on the following equation:

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$ (4.6)

where $\bar{x}_1 = \text{mean of first sample}$

$\sigma_1^2 = \text{variance of first sample}$

and $n_1 = \text{size of first sample}$.

Where a null hypothesis is being tested such that $\bar{x}_1 = \bar{x}_2$, provided the value of $z$ is less than or equal to $\pm 1.96$ at the 95 per cent confidence level, the null hypothesis cannot be rejected.

4.2.9 In this research beta, $\beta$, is adopted as a measure of volatility, including the volatility of wage returns or growth rates. The equation for $\beta$ (Brealey and Myers, 1996 p.162) is given as:

$$\beta = \frac{\sigma_{im}}{\sigma_m^2}$$ (4.7)

where $\beta = \text{measure of volatility}$

$\sigma_{im} = \text{covariance of firm} \ i \ \text{and the market}$

$\sigma_m = \text{variance of the market}$

This ratio is also used to compare heating and ventilating output to construction industry output.

4.3 The measurement of survival

4.3.1 In this research the term “survival” refers to a firm’s continuous membership of the HVCA without it necessarily remaining independent. Although this weaker operational definition is used, the concepts of resource-, entity- and output- survival discussed in Chapter 3 are the preferred theoretical definitions. The length of survival of individual members of the HVCA in this research is based on the year of joining the HVCA and not necessarily the year of actual founding. Indeed firms currently need to demonstrate at least 2 years trading ‘within scope’ as a pre-requisite for joining the HVCA. The life spans of firms were assessed by taking missing data in a firm’s annual wage return series and missing years from 1981 to 1987 into account where firms straddled the gap years. Provided a firm filed wage returns under the same folio number, a change in ownership or a name change is ignored in the data.
4.3.2 Several propositions refer to ‘survival indices’. The survival index of each firm is the proportion or percentage of the maximum years possible inclusive of its first year as a member of the HVCA and 1996. A firm surviving the maximum is given a value of 100. To find the average annual survival index of new firms entering the market in each year from 1946 to 1996, the arithmetic mean of all indexed values in each year was calculated. This time series is shown in Figure 4.1.

Figure 4.1 Average annual survival index of new firms 1946-1996.

Source: HVCA wage return data

4.3.3 Figure 4.1 shows the overall stability of survival indices until 1979. Between 1946 and 1961 the annual survival rating of new firms varied far more than between 1962 and 1979, when the average annual survival rating varied in the main between 40 and 50 on the index. The volatility of the annual survival rating as measured by the ratio of variance over the mean between 1946 and 1961 was 1.73, whereas between 1962 and 1979 it was only 0.38. This appears to contradict a reasonable assumption that might be drawn from the long boom and steady growth in the period up to the late 1960s, followed by the period beginning in 1973 of volatility in construction as a whole. This assumption is that risk to and uncertainty of survival are greater, the greater the volatility of the market. However, the difference can be explained by the HVCA’s removal from their records of firms, which did not survive beyond 1961 (see Chapter 3). By removing the short lived firms from the ledgers, the survival index appears higher in a number of early years than it was in reality. The rising trend in the index after 1990 is due to the effect of right censoring which meant that as the year new firms joined the HVCA approached 1996, very low survival indices were no longer possible. For a new firm in 1992 to survive only 1 year would give it a survival index of 25 whereas a new firm surviving for 1 year in 1965 would only have a survival index value of 2.6.
4.3.4 The average index of survival of new firms between 1962 and 1979 tended to vary between 40 and 50. This result indicates that in those years new firms tended to survive on average for less than half the number of years between the year of joining the HVCA and 1996, i.e. for between 7 and 17 years.

4.3.5 The peak year in the period up to 1960 was 1951 and the peak years between 1961 and 1979 were 1970 and 1972-3. The peak years of 1970 and 1972-3 are interesting coming as they do shortly before the upper turning point in the heating and ventilating output series in 1974, but the lack of rising or falling trend in the annual survival ratings in this period may indicate a random walk. The data for the period since 1987 is influenced by the right censoring of the data, which prevents determining a meaningful peak survival rating in the years between 1988 to 1996.

4.3.6 The chances of survival of a new firm is not given by the annual survival rating which is based on the average survival index of firms in a cohort in a given year. For example, if all firms in a given year, say 1976, had a survival index of 0.75 this would not mean that the representative firm had a 75 per cent chance of survival. From such a set of data the representative firm would have ceased to exist after 15 years or 75 per cent of the 20 maximum possible years before 1996. However, having survived a number of years the proportion of firms of varying size and with different growth rates surviving to a given year, can be found using the log hazard model of the Cox regression. This is distinct from the proportion of an original population of firms surviving to a given year.

4.3.7 Everitt and Dunn (1991, p.193) suggest Cox regression, which, for example, gives the rate of failure of a population of firms in year t, given that the firms had survived up to year t. Cox regression is an example of a log hazard model used where data is censored. The particular computer package used here is SPSS. If the hazard (namely business failure) increases then declines with changes in growth rates, then the log hazard model is appropriate. In Figure 14.1, for example, the survival rate of new firms is compared to the survival rate of established firms. It appears that new firms have a lower survival rate than incumbents. This is because the early high mortality of some new firms reduces the proportion of new firms which survive. However, after the first three years, the new firms that do survive in any year have a similar chance of failure as the established firms as can be seen in the similar rate of decline. The Cox regression takes this into account. In terms of this research the hazard rate is the proportion of firms failing in any one year. According to Everitt and Dunn (1991, p.198), the simple version of this model is of the form:

\[
\log h(t) = \beta_0 + \beta_1 g
\]  

where \( h(t) \) = hazard rate, given that firms survived to year t
\[ \beta_0 = \text{constant} \]

and \( g = \text{growth rates} \)
This is derived from the hazard function (SPSS 1994a, p.294):

\[ h(t) = [h_0(t)] e^{\beta g} \]  \hspace{1cm} (4.9)

where \( h(t) \) = the hazard function
\( h_0(t) \) = the baseline hazard
\( \beta \) = regression coefficient
\( g \) = covariate such as average annual growth rate

4.3.8 However, because the spread of survival times is more like a Gaussian or normal distribution, the proportional hazards model devised by Cox is given as:

\[ \log h(t) = a(t) + \beta_0 + \beta_1 g \]  \hspace{1cm} (4.10)

where \( \log h(t) \) = log of the conditional density rate of hazard.
and \( a(t) \) = function of time

4.3.9 The conditional density rate of hazard is the rate of failure at time \( t \), given survival up to time \( t \). Using the Cox regression in SPSS enables a number of independent variables to be included in the equation. SPSS (1994a, p.295) applies the following equation to enable the modelling of a number of covariates:

\[ h(t) = [h_0(t)] e^{(\beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p)} \]  \hspace{1cm} (4.11)

\( x_1 \) to \( x_p \) are the covariates or independent variables. In the application used in this research the covariates were taken as growth rates, size and year of joining the HVCA.

4.4 Measures of concentration

4.4.1 Marsh (1988, p.90) and Barr (1998 p. 151) discuss the Gini coefficient as a measure of concentration and inequality in distributions. Barr concludes that the Gini coefficient is “in no way definitive as a measure of overall inequality” (Barr 1998, p.153), because of a number of criticisms including the arbitrary weighting of individuals based on their rank order, and the fact that it gives ambiguous results when Lorenz curves intersect.

4.4.2 Barr (1998, p.149) discusses a number of measures of inequality of income other than the Gini coefficient, including the variance and the coefficient of variation. Variance is affected by changes in absolute values, which occurs because of the growth of firms over time even after deflating the data. To overcome the increase in absolute values over time, Barr suggests using the coefficient of variation:

\[ C = \sigma / \mu \]  \hspace{1cm} (4.12)

where \( C \) = coefficient of variation
\( \sigma \) = standard deviation
\( \mu \) = mean.
4.4.3 An alternative measure of concentration is given by the Herfindahl index, \( H \), (Hay and Morris, 1991 p.210). This uses the aggregate of the sum of the squares of the market shares of the firms in an industry.

\[
H = \sum s_i^2
\]  
(4.13)

where \( s_i \) = the market share of the ith firm.

4.4.4 Again H lies between 0 and 1, 1 being monopoly. On the basis that a simpler approach should be preferred to a more complex method the Herfindahl index has been adopted here. Moreover, Hay and Morris (1991 p.211) point out that in any industry the average profit margin tends to vary directly with the Herfindahl index. This implies that changes in the Herfindahl index may be used as an indicator of changes in profit margins.

4.4.5 According to Gibrat’s law firms’ annual growth rates are not related to their size. Consequently, over time there would be a tendency for the larger firms to take a greater share of the market and concentration would therefore increase. To test Gibrat’s law Evans (1987a) suggests the use of regression. Thus;

\[
\ln X_t = \beta_1 + \beta_2 \ln X_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim N(0, \sigma^2) \forall t
\]  
(4.14)

where \( \ln X_t \) = log of market size in year \( t \)
\( \beta_2 \ln X_{t-1} \) = log of market size in year \( t-1 \)
\( \varepsilon_t \) = disturbance term in year \( t \).
\( \varepsilon_t \sim N(0, \sigma^2) \forall t \) means \( \varepsilon_t \) is distributed as normal with a mean = 0 and variance of \( \sigma^2 \).

4.4.6 If \( \beta_1 = 0, \beta_2 = 1 \), then the market would be consistent with Gibrat’s law. These conditions would then imply that concentration would increase over time. If \( \beta_1 = 0, \beta_2 < 1 \), then concentration would rise, fall or remain stable depending on the value of \( \beta_2 \). This would reflect the tendency of smaller firms to grow faster than larger firms in a contradiction of Gibrat’s law. If \( \beta_2 > 1 \), then concentration would rise rapidly over time. This would also represent a violation of Gibrat’s law.

4.5 Note on deflators used

4.5.1 The difference between price trends in repair and maintenance and new work within heating and ventilating is not as great as the differences in these price trends in the building industry as a whole. For the industry as a whole, repair and maintenance work involves the use of a different combination of technologies and resources from new build.

4.5.2 New build involves large structural elements with finishes comprising a relatively small proportion of the work, whereas work on existing buildings mainly concerns the finishing trades only. For heating and ventilating engineers, work on new build and repair and maintenance involves the installation of plant and equipment, albeit under different working conditions.
4.5.3 Cost data is available in the form of Mechanical and Electrical cost indices published by the Department of the Environment, Transport, and the Regions. Published since 1970, the main purpose of these cost indices is to adjust contract prices to take account of changes in the cost of labour and materials in heating and ventilating and electrical installations. Deflating the current heating and ventilating data by the mechanical and electrical (M and E) cost indices may thus be said to provide the most accurate time series of real output of the heating and ventilating industry. The disadvantage of using M and E indices is that these specialist series only started in 1970, whereas the cost of new construction index extends back to the 1950s and earlier.

4.5.4 The currently available cost deflator for construction industry output is the All New Construction Cost Index, (ANCI), which replaced the Cost of New Construction Index (CNC) in 1978. The ANCI can be found in Housing and Construction Statistics, which is the main source of data on the construction industry (Cannon, 1994). The ANCI as its title suggests is only concerned with new build construction. In constructing a deflator for the whole post war period it is necessary to combine the ANCI which is currently used for new construction with the Cost of New Construction (CNC) index which was only used from 1951 to 1978. Butler (1979, p97) points out a number of weaknesses in the CNC index including the assumption made that the ratio of materials to output was constant, when in fact it changed. Also, using the cost of new construction to deflate output does not take into account fluctuations in the profit margin. During the long boom this may not have been a significant problem but from the early 1970s the increased volatility of construction output and the higher rates of inflation meant that changes in contractors' costs and in the prices they received diverged, altering profit margins.

4.5.5 There is also a possible distortion in cyclical measurement if the index used to deflate the wage bill to constant prices does not fully capture the true variability of rates of pay per worker over the business cycle. This problem could arise for two reasons. First, the index may reflect nationally negotiated wage rates rather than the average rates actually paid on site. Actual rates of pay may fluctuate relative to nationally negotiated rates. Second, the index may altogether exclude from its composition the wages paid to non-directly employed labour only subcontractors (LOSC), which may also fluctuate even more than the wages of directly employed workers over the cycle.

4.5.6 According to the notes and definitions given in Housing and Construction Statistics 1987-1997, (1998, p196) a number of output price indices are used to deflate contractors' output of new work from current to constant prices in different categories of work. These are public housing, private housing, public non-housing, private industrial and private commercial. Repair and maintenance work is dealt with separately based on the costs of materials and labour.

4.5.7 Because of the above limitations, the ANCI has not been used because it is only concerned with new work. Instead, the deflator used in this research is based on the annual implied deflators calculated from the current price output series and output at 1995 prices based on a composite index including a combination of skilled and unskilled labour, and materials cost indices, used by the DETR. This deflator therefore includes both new build and repair and maintenance work on existing stock. This deflator is not published as a separate index but can be calculated from the published series of total construction output at
current prices and total construction output at constant 1995 prices in Table 1.6 in *Housing and Construction Statistics*. As this implied deflator takes both new build and repair and maintenance into account, it is referred to here as the implied Gross Construction Product Index (GCPI), although this is not its official title. The GCPI covers the period from 1955 to 1997.

4.5.8 HVCA wage return data was deflated using both the Retail Prices Index (RPI) and the Gross Construction Product Index (GCPI). The RPI related the deflated data to GDP in terms of the real purchasing power of wages paid to labour. The GCPI was used to relate HVCA wage return data to construction industry output data.

4.5.9 Wage returns are reported at current prices. Reid and Myddelton (1996 p.245) describe the loss in the value of the pound between 1945 and 1995. According to Reid and Myddelton, the rate of loss in the purchasing power of the pound accelerated between 1945 and 1980, since when the Retail Price Index (RPI) has continued to inflate but at a lower annual rate on average. As a consequence, the purchasing power of the pound in 1995 was less than 5 per cent of its purchasing power in 1945.

4.5.10 Fleming (1986 p.119) points out that one of the most important problems of interpretation of time series research results concerns the method used to convert current prices to constant prices. This especially concerns the choice of index to use for deflating the reported HVCA wage return data. In this research the GCPI was used in preference to the Cost of New Construction index (CNC)/Cost of New Output index (ANCI) to deflate current price time series such as the total output of the heating and ventilating industry within the construction industry. The GDP implied deflator (GDPI) is also used in this research when comparisons between the construction industry and the broader economy are required. From Figure 4.2 it can be seen that there are important discrepancies between the series, especially in the period between 1990 and 1993, when the decline in construction prices was not reflected in the economy at large. Deflating construction data using the GDPI therefore overstates the real decline in construction output in the recession of the early 1990s since the real decline in output was the result of lower current turnover partly caused by lower prices and only partly by lower real output.

4.5.11 In Figure 4.2, a seemingly insignificant dip in the ANCI series from 1968 to 1969 was discovered to have been an error in the DETR's published data. This decline from an index value of 17.1 to 12.6 amounting to a drop of 26 per cent, causes extreme changes when the current data for 1969 is deflated. It was consequently found that the data prior to 1968 was relatively greater than it should have been. Visually there should be hardly any difference between the three series prior to 1969.

4.5.12 When the ANCI was rebased to 1990 and five years later when it was rebased to 1995 errors were introduced into the series. The ANCI series up to 1968 used the early part of the series ANCI 1985 =100 but the years since 1969 were re-based on ANCI, 1995 = 100. For example, the Digest of Data for the Construction Industry (4th edition, 1997) contains the error in Table 2.2 on page 29, where the ANCI 1968 Q4 = 16 and 1969 Q1 = 11. No such fall in prices actually occurred. As a result of the discrepancy GCPI has been adopted as the main deflator used in this research.
Figure 4.2 The all new construction output price index 1945-1997, the gross construction product index 1955-97 and the GDP implied deflator 1948-1997

Sources: ANCI, DETR (Direct from DETR)
NWCI, MPBW, (Ref Building Research Station and DOE (1971) Collection of Construction Statistics 2nd ed., Table 6.1 Indices of Building Prices and Costs)
Notes String of new work cost index (NWCI) 1939-54 and all new construction index (ANCI) 1955-97
NWCI used as best indicator but based on different methodology to ANCI. In common years the two indices do not correlate.
GDP Index 1995 = 100 from Table 1.1 National Accounts, Economic Trends Annual Supplement 1997, No 23, ONS, p.7 and Table 2.1, Economic Trends Annual Supplement 1998, No 24, ONS, p.135
The Gross Construction Price Index (GCPI) is based on the implied deflator used by the DETR to determine total construction output at constant prices.

4.5.13 Further problems arise with the use of index numbers. For example, the Cost of New Construction Index (CNC) was used from 1949 to 1978 to deflate current construction output data and investment in new buildings for official statistics. However, inaccuracies in the index arose for a variety of reasons, such as the exclusion of some payments to self employed workers (Fleming 1980 p.268-9). Fleming (1980 p.270) refers to the report by Reddaway (1973) on Selective Employment Tax, in which Reddaway suggested that the CNC Index may have underestimated the value of the index in 1969 by between 6 and 7 per cent.

4.5.14 The size of these errors and adjustments together with the problems of measurement already discussed by Fleming leads one to conclude that official data must be prone to inaccuracy and requires great caution and doubt (Fleming, 1980 p.270). A similar conclusion was drawn by Bowley and Corlett (1970 p.208). Fleming himself thought that cost and price indices far from being tools of economic analysis should themselves be the subject of analysis (Fleming 1980 p.279). While he charged that their known deficiencies and inconsistencies seriously weakened any conclusions to be drawn from the use of these indices, he recognised that they were the only ones available.
4.6 Research methods

4.6.1 In order to observe the growth and survival of firms over a large number of years, longitudinal studies of firms in trade in a number of given years were undertaken. The firms in trade in a particular year are comprised of incumbents and entrants, which separately or together form cohorts. These cohorts of firms form panels and repeated annual measures of size, annual growth rates and survival of individual panel members can be taken. Everitt and Dunn (1991, p.206) suggest a number of approaches to panel studies, including studies in which changes over time are monitored and studies in which intervention takes place. In this research the cohorts are often divided into incumbents and entrants for the purpose of comparing the performance of established firms with new firms. In any panel data study several problems can be anticipated. The non-response of firms (assessed or incomplete data) or the effect on the panel of firms dropping out (firms leaving the HVCA) will affect the panel increasingly the longer the period of the study. Incidents occur, such as the merging of the Refrigeration Association with the HVCA, and conditions change as the business cycle continually raises or lowers demand in the heating and ventilating market, encouraging the entry of new firms or bringing about the demise of others. As a result new representative panels need to be composed periodically.

4.6.2 In this research the long run average annual growth rate of firms depends on the period selected. As the industry grew until the mid 1970s, the average aggregate annual growth rates of the cohorts of firms before 1973 from the year of entry to 1996 tended to be greater than the growth rates of cohorts for years after 1973. Nevertheless in order to conduct a long run study of the heating and ventilating industry it is necessary to use cohorts from the late 1950s and 1960s, especially as wage return data is missing for the years 1980 to 1986.

4.6.3 The cohorts of new firms between 1947 and 1993 were also studied in terms of their survival ratings. However, in order to cover each cohort of firms in terms of their growth rates, size and survival would have required much more space with little addition to the principles governing the relationships between these variables. It was therefore decided to study one cohort in particular and the cohort of firms already in or joining the HVCA in 1963 is used as an example of a set of firms whose behaviour, growth and survival can be traced in the data. A stratified panel study is composed of the same firms for a given number of years and is used as a sample to reflect a population. The cohort of firms used here is the population of the cohort of firms, which were in the HVCA in 1963 and for which data has been found. Annual wage returns are compared to a number of particular variables such as employment, output and number of firms of the heating and ventilating engineering sector since 1957, when the currently used industry series in Housing and Construction Statistics began.

4.6.4 For the purposes of this research the focus of interest is the relationship between growth and survival of individual firms rather than the long run aggregate patterns of growth of the heating and ventilating industry as a whole. Nevertheless, the wage return data gathered for this research are compared to the output of the heating and ventilating industry,

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1 Only in 1957 were heating and ventilating contractors included in data as a separate category in the Ministry of Works Annual Return of Labour and Output for Building, Electric Wiring and Contracting, and Civil Engineering Contracting (Fleming 1980 p.539).
construction industry and the Gross Domestic Product. To this end multiple regression and correlation will be used to test time lags and consistency.

4.7 Limitations of research methods

4.7.1 One major limitation of the wage return data used in this study is that it has been necessary to use only declared wage returns. Throughout the period studied all members of the HVCA were obliged to submit their wage bills. This research is specifically concerned only with the population of member firms, who actually filed returns with the Heating and Ventilating Contractors Association in any given year. However, any firm failing to send in a wage return was assessed for the purpose of calculating its membership fees. As assessments were used to deter firms from late or non-submission, they often included an implied penalty in the form of an assumed increase over the previous year's return. From the point of view of giving a measure of actual wages paid or a measure of output, these assessments would be misleading, as they were usually calculated when firms were in difficulties and unable or unwilling to send their wage returns in on time. Assessed returns were therefore excluded. However, the declared wage returns used in this research therefore tend to bias the results in favour of the more successful firms in any one year.

4.7.2 Moreover, it should be noted that wage returns refer to the wages paid to heating and ventilating employees regardless of the nature of the work undertaken. It therefore included work outside the heating and ventilating industry carried out by members. This also applies to turnover figures until 1995, when the definition of turnover was altered to include only the value of work within the scope of the HVCA (HVCA, 1995 p.18).

4.7.3 Only a proportion of firms in the heating and ventilating industry are members of the HVCA in any one year. Thus in interpreting aggregate wage returns, not only do they only represent a proportion of firms in the industry, but a proportion of these wage returns represents HVCA member firms' work outside the field of heating and ventilating, air conditioning and refrigeration.

4.7.4 In the period covered by this research, much of the official construction data is based on a sample of firms in the official register of construction companies. Not since 1952 has registration been compulsory. As a result the register of construction firms became increasingly unrepresentative until the early 1970s. As registration was voluntary the rate of increase in the size of the register did not necessarily reflect the rate of increase in the population of firms in the industry as a whole. Similarly, membership of the Heating and Ventilating Contractors' Association is also voluntary and membership growth cannot be used to confirm or deny changes in numbers of firms in the whole heating and ventilating industry. Instead, HVCA membership must be compared with the number of heating and ventilating industry firms on the official register.

4.7.5 The notes published in *Housing and Construction Statistics* (1998 p.197) repeat and update the notes of earlier editions. According to these notes the DETR conducts regular surveys of private contracting firms based on a register of 'reporting units', which may be firms reporting as a whole including subsidiaries, or may be separate parts of one firm operating in different regions. In 1973 the official register was revised, adding 25,000 firms to the existing 70,000 firms which could be sampled. In 1982 a further 45,000 firms were
added to the register (Fleming 1986 p.221). The register has thus varied in size rising to 195,000 in 1993. In 1996 there were 163,000 firms on the register, all of which were sent questionnaires.

4.7.6 However, firms with fewer than 8 people are classed as 'small firms' and only need to supply a minimum of information. Another problem with official data, to which Fleming refers, is the systematic omission of small enterprises although they comprised the vast majority of firms and a sizeable proportion of output. The register omitted many small firms because voluntary registration since 1953 had meant that these firms tended not to register, while the Census of Production only sent out returns to the larger firms (Fleming 1980 p.159).

4.7.7 In October of each year only the larger firms are asked to provide data on third quarter output and employment levels for the Private Contractors' Census. This data forms the basis of annual output estimates of the heating and ventilating industry used in this thesis, although, of course, the majority of firms employ fewer than 8 people. Adjustments are made (formerly by the DoE or latterly by the DETR) to take account of the omission of smaller firms. However, because no allowance is made for firms not on the register, annual changes do not necessarily reflect structural changes but may only reflect changes in the register (Housing and Construction Statistics, 1998, p199).

4.7.8 Moreover, the reporting of subcontract work may be under-reported because main contractors on the register may have correctly deducted the value of subcontracts to firms which were omitted from the register. Meanwhile, in other cases double-counting of subcontracted work may have occurred when main contractors included subcontracts in the value of their output and subcontractors again reported, (as they were supposed to), the same work as their own contribution (Fleming, 1986, p.120).

4.7.9 There is a relevant discussion in Fleming (1980, p.46) concerning the official accounting of subcontracted work in the construction industry. Different methods were adopted by the Department of the Environment (DoE) and the Census of Production (COP). The DoE only asked firms to report work for which the contractors themselves were physically responsible. The COP asked firms to provide the value of work carried out by them and by their subcontractors. Both methods are liable to double counting. Double counting of the number of firms also occurs because some firms with branches in different regions would have submitted multiple returns and each one would have counted as a separate reporting unit or firm (Fleming 1980 p.65). Moreover, the timing of payments to subcontractors depended on when they were paid by main contractors and long delays would have caused time lags in the data between when the subcontracted work was carried out and when it was recorded in the data (Fleming 1980 p.50).

4.7.10 The accuracy of the data actually gathered especially up until 1968 also raises serious doubt (Fleming, 1980, p.47). In a report by Sugden and Reddaway (1973, pp.263-6) a survey of 50 contractors found that, while some contractors based their returns on valuation certificates (which included materials not necessarily worked on yet), others used costing systems and still others multiplied a typical output per head by the number of people employed. If contractors based their returns on cash received, as some did, this would have included retention monies for work carried out in an earlier period.
4.7.11 In the early post war period only firms who responded to the questionnaire were recorded in the COP. Apparently the sample results did not attempt to take non-respondents into account (Fleming 1980 p.63). Fleming (1980 p.162) also points out that in the four censuses conducted between 1954 and 1968, work done was divided between main and subcontractors, but only according to the type of work undertaken in the main by each firm. An accurate assessment of the total work done under subcontract or as a main contractor cannot be deduced from the data.

4.7.12 In 1955, after war time building controls were ended in 1953 and 1954, changes were introduced to data collection methods (Fleming, 1980, p.97). During the Second World War and until 1953, compulsory registration of firms had meant a ready source of information was available. When registration became voluntary, the register became less reliable and in 1955, the Ministry of Works used the SIC 48 to select a sample of firms and reduced the number of firms in its list (Fleming 1980 p.98). This method was used until 1977, by which time discrepancies in the register of firms had led from an under-recording of 7.5 per cent in 1963 to an under recording of 13.5 per cent in 1972. Because of the under-recording of data, revisions were carried out in 1973, which had the effect of increasing the 1972 construction output by 8.5 per cent (Fleming, 1980, p.151).

4.7.13 Fleming (1986 p.223) also points out the difficulties of classifying firms within construction. Specifically he refers to the mis-allocation of firms by trade. Before 1971, firms were classified periodically, and if a firm switched from 'Plumber' to 'Heating and Ventilating Engineer', the change would not have been recorded for several years.

4.7.14 Another important factor to bear in mind is the time lag between activities and reporting results, especially as projects could run over a number of years (Fleming, 1986, p.120). This is apparent in all the accounting and wage return data in this research. For this reason an attempt has been made to build-in time lags into the annual data to account for the fact that the data is end of year. It has been assumed that the wage returns are filed with the HVCA on average several months after the accounts are completed. For this reason the wage return data in year $t$ is assumed to refer to wages paid in year $t-1$.

4.7.15 Cannon (1994, p.308) asserts that there had been a decline in the quality of data concerned with the construction industry, partly because the basic framework of the data had not altered in spite of major changes which had taken place over the last twenty years. The Statistics of Trade Act 1947 had required monthly returns concerning contracts and orders for new construction, quarterly returns on construction activity and annual returns of small firms. Only in 1991 was a review of construction statistics undertaken by government. An infrastructure series was introduced in 1993 and several minor changes were made in Housing and Construction Statistics, which contains several references to heating and ventilating contractors, together with the introduction of the complementary Digest of Data for the Construction Industry, which contains little data directly related to the heating and ventilating industry.

4.7.16 Cannon (1994, p.311) also points out that building services as a proportion of total construction output can only be obtained by estimating their share of construction costs in different building types. Thus there is no industry wide statistical basis directly supporting
the generally held view, that building services including heating and ventilating have been increasing as a proportion of the output of the construction industry. The only data supporting this received wisdom is that derived from mechanical and electrical subcontractors' output figures given in the private contractors' census. For example, since 1971 the increase in electrical contracting as a proportion of construction output is clearly shown in Figure 4.3. However, heating and ventilating engineers only increased as a proportion of construction up to 1983.

Figure 4.3 Electrical contracting and heating and ventilating as percentages of construction industry output 1971-1997

Sources: Construction output series supplied by DETR
Electrical contractors work done, Private Contractors Census.
Note: All data deflated using GCPI

4.8 The exploratory study

4.8.1 Apart from data provided in official publications such as Housing and Construction Statistics and data supplied by the HVCA, companies registered at Companies House also provide data in the form of their annual accounts. It would in theory be possible to use company accounts to investigate the performance of firms, as this is common research practice, but as many of the firms engaged in heating and ventilating are very small, the interpretation of their accounting data can be open to misinterpretation. Moreover, the wage return data extends back to the Second World War, whereas company accounts only became mandatory after the 1967 Companies Act. Indeed, small firms were still given reporting exemptions after 1967.
4.8.2 A separate exploratory study was therefore conducted between February and April 1998, to find out the degree of accessibility of company accounts data and the problems involved in interpreting these accounts. See Appendix 2 for details of the exploratory study.

4.9 Concluding remarks

4.9.1 This chapter has discussed a number of methods of calculating the long run annual growth rates. The main features of the statistical methods used are:

- the two preferred methods are the geometric mean of annual growth rates and the log transformed regression coefficient of size.
- In order to measure survival an index of survival was used. This index is based on the percentage of the maximum possible survival period firms survived from the year of joining the HVCA to 1996.
- In the main the deflator used in this research is the implied deflator used by the DETR to calculate constant total construction output from current total construction output data. This implied deflator is referred to in this research as the Gross Construction Price index (GCPI).
- This research is a study of a population of firms rather than a sample. All firms which were identified as having been members of the HVCA, and for which annual wage return data was available, have been included in the analysis. No wage return data for the period from 1980 to 1986 is available.

4.9.2 Before dealing with the data analysis of the heating and ventilating industry a number of contextual and theoretical issues are discussed. Because of the contingent nature of many of the changes which have taken place in the heating and ventilating industry the following chapters in Part 3 provide the historical context. In Part 3 changes in the heating and ventilating industry are seen inter alia as responses to changes taking place in the wider economy. Part 3 deals with the political, social and economic events in the post Second World War period making use of the perceptions and perspectives given by the Annual Reports of the HVCA.
Part 3  Contextual issues

*The History of the Heating and Ventilating Industry since the Second World War.*
Chapter 5 The heating and ventilating industry within the construction industry

5.1 Introduction

5.1.1 Part 3 of the thesis deals with the historical context of the heating and ventilating industry from 1945 to 1996. This chapter is concerned in particular with long run economic structural changes in the construction industry in general and considers the outside influences on the heating and ventilating industry in particular, such as changes in construction industry output. The next chapter discusses attempts by government to regulate the economy in general and the construction industry in particular. The events and issues raised in this and the next chapter are then developed in Chapter 7 which discusses the response by contractors in the heating and ventilating industry to changes in the economy and changes brought on by shifts in government policy. Chapter 8 discusses the effect of these responses on employment relationships in the heating and ventilating industry and changes in the composition of firms in the heating and ventilating market.

5.1.2 The aim of this part of the thesis is to give an account of the behaviour of firms in the heating and ventilating industry in terms of their responses to changes in their business environment. The heating and ventilating engineering firms who survived, did so partly because they adapted their business model to changes taking place outside their control in the wider economy and the construction industry. These changes may also have favoured some firms and not others.

5.2 The heating and ventilating industry, the construction industry and GDP

5.2.1 To study the effect on the heating and ventilating industry of changes in the construction industry this chapter begins by looking at construction industry output data. As

Figure 5.1 Construction output 1948 to 1996 at current prices as measured by the construction component of GDFCF and total construction output.

Sources: GDFCF, ONS, Economic Trends Annual Supplement 1997, No 23, HMSO, Table 1.8 Dwellings and new building and works only. Housing and Construction Statistics, Table 4.2 Construction output (GB)
contractors only supply to contract, output can be used as a proxy for demand. This can be seen in Figures 5.1 and 5.2. Figure 5.1 illustrates two definitions of construction output at current prices for the period 1948 to 1996, the construction component of gross domestic fixed capital formation and construction industry output. Both time series show slow but steady growth, with the annual rate of change rising from 1971. From 1971 to 1990 output appears to rise rapidly, fall rapidly between 1991 and 1993, and almost regain its 1990 level of output by 1996.

**Figure 5.2 Construction output 1955 to 1996 at current and 1995 prices.**

Sources: GDFCF, Tables 1.3 and 1.8, Economic Trends Annual Supplement 1997 edition No 23, ONS, HMSO and GDP implied deflator at market prices, Table 1.1 Prices, Economic Trends Annual Supplement 1997 edition No 23, ONS, p 7 DETR, (Unpublished, 1999), Table 1.6, HCS, Output at 1995 prices

5.2.2 Although the two construction output series are similar, the use of official data is an inexact science, the choice of time series used depending on the context. Differences occur because of changes in definitions, such as changes in the Standard Industrial Classification (SIC), methods of collecting data, and the changes in technology over time, which lead to qualitative changes omitted from the data. As a result it can always be argued that the statistical data is not consistent over the very long run, for example, as in this research. The problem is of course further compounded by the need to deflate the data, introducing more statistical noise into the equation. Nevertheless deflating the data provides a picture of the 'real' changes in output, which took place

5.2.3 Figure 5.2 shows the time series of total construction output at current and constant 1995 prices, using the Gross Domestic Product (GDP) implied deflator to deflate Office for National Statistics (ONS) construction output data. The Department of the Environment, Transport and the Regions (DETR) data is deflated using DETR construction cost indices.
The deflated data shows relatively slow growth between 1967 and 1981 followed by a rapid expansion from 1981 to 1989. The volatility of construction output especially after 1973 noted by Ball (1996) is confirmed in this graph in both constant price series. Variance of annual real output from 1948 to 1971 was significantly lower in the years before 1971 compared to the following period in both the ONS and DETR series.

5.2.3 Figure 5.3 uses the DETR series of total construction output in Housing and Construction Statistics to breakdown construction output into new work and repair and maintenance from 1955 to 1997.

**Figure 5.3 Total construction industry output, new work and repair and maintenance 1955-1997 at 1995 prices**

Source: Data provided by DETR, 16th April 1999.

5.2.4 Although the demand, costs and output of the construction industry as a whole clearly encounter variations, according to Ball (1988 p.98), the size of these variations at the aggregate level are not 'peculiarly volatile'. Ball distinguishes between the aggregate changes in output of new build, and repair and maintenance between 1955 and 1985. Figure 5.3 shows new work and repair and maintenance from 1955 to 1997. Real annual new work at 1995 prices rose steadily from £13,800m in 1955 to £31,200m in 1968. Repair and maintenance rose from £9,900m to just over £15,700m in the same period. However, from 1968 to 1981 new work declined while repair and maintenance work continued to increase albeit with increased volatility. Between 1955 and 1997, 1968 was the year of greatest new build output in real terms. Thereafter, new work declined until 1981 although it exceeded repair and maintenance every year until 1980.

5.2.5 Ball accounts for the variations in repair and maintenance in terms of the 'squeezed incomes' of firms and the public sector during recessions, when they cut back on building maintenance. As construction firms’ incomes depend on profit margins calculated as a
percentage of turnover, over which they have little control, any reduction of turnover leads to a reduction in income. As this occurs during recessions, this in turn can be taken as a squeeze on the profits of contractors.

5.2.6 These changes in demand for construction according to the model proposed in Chapter 1 are dependent on the rest of the economy. Since 1945 the composition of GDP altered due to a number of recognised long term economic structural changes which took place in manufacturing and service industries. From 1981 to 1991, for example, the share of GDP at factor cost of manufacturing industry declined from 25.1 per cent to 21 per cent, whereas banking, finance, insurance, business services and leasing increased from 11.4 to 17.7 per cent in the same period (Economic Trends, 1997). The relative position of construction in the economy from 1955 to 1997 can be seen in Figure 5.4, as the growth in the rest of the economy was not matched by the growth in construction.

Figure 5.4 Construction and GDP 1955-1997 at 1995 prices

![Graph showing construction and GDP 1955-1997 at 1995 prices](image)

Source: Construction output data at 1995 prices provided by the DETR (unpublished)
Note: GDP deflated using 1985 weightings

5.2.7 Figure 5.5 shows construction output (right hand axis) and GDP (left hand axis) at current prices. Growth in construction output appears to have been similar to growth in GDP until 1986 after which construction grew more rapidly than GDP until 1990. The readjustment in construction output between 1990 and 1993 allowed GDP to absorb the spare built capacity created in the late 1980s. After 1993 the construction industry grew much in line with GDP once more.
Figure 5.5 Time series of construction and GDP at current market prices

Construction output measured on the secondary y axis.

5.2.8 The official series of GDP and construction industry output illustrated in Figure 5.5 show that construction output grew faster than GDP between 1957 and 1979. Nevertheless, Cable (1980, p. 184) argues that between 1957 and 1979 the contribution of construction to GDP grew at an annual rate of only 1.35 per cent per annum compared to GDP at 2.1 per cent. Indeed, the rate of expansion of the construction industry during those 22 years, according to Cable, was one of the lowest along with vehicles at 0.8 per cent per annum, textiles and leather clothing 0.73 per cent per annum and metal manufacture, which actually declined at the rate of 0.26 per cent per annum. In fact, according to the data, the long term decline in the construction share of GDP is more apparent over the long period from 1955 to 1995.

Figure 5.6 Construction as a percentage of GDP 1955-1996

5.2.9 In spite of the annual growth in construction, a clearer picture of the relationship between construction and GDP therefore emerges from Figure 5.6, which illustrates the time series of construction as a proportion of GDP. Having increased its share of GDP from 9 per cent in 1955 to 11.5 per cent in 1973, construction output fell to around 7.5 per cent of GDP in 1991 and remained at that level until 1996. The long run trend since 1973 shows that the building industry has contributed a declining share of GDP.

5.3. The relationship between heating and ventilating and construction industry output 1955 to 1997

5.3.1 Just as structural change has taken place between the construction industry and the GDP, structural change has also taken place within the construction industry itself, which has altered the relationship between the other firms in the construction process and heating and ventilating contractors. This is because the heating and ventilating industry tended to contribute an increasing proportion of the value of output until 1972. Since 1972 its long run share of output did not increase. Figure 5.7 shows real output of the heating and ventilating industry compared to construction industry output from 1957 to 1997.

5.3.2 This post war increase in the share of construction industry output occurred for a number of reasons. Firstly, there has been a shift in the composition of demand towards building types which require high mechanical and electrical specifications and heating and ventilating services form an important element of such work. Thus the growth in demand for hospitals, offices and other high quality buildings has favoured the heating and ventilating industry. Secondly, heating and ventilating technology has been used to replace other

Figure 5.7 Output of the heating and ventilating industry and the construction industry 1955 to 1997

Sources: DETR and Housing and Construction Statistics
Heating and ventilating industry to be read off secondary y axis; Construction industry to be read off primary y axis.
Data deflated using GCPI, 1995 = 100
technologies such as coal heating, partly because of pollution and partly because of operating cost considerations. In economic terminology there has been a substitution effect, as developers and building owners have moved to cheaper energy sources. This was particularly the case when oil prices rose in the mid 1970s and building owners reacted to save energy. Thirdly, building design has altered in response to new requirements and expectations demanded by clients and building users. Controlled environments in buildings and rising expectations of environmental comfort together with larger more complex buildings led to the increased use of technology within buildings. At the same time that these developments increased demand for heating and ventilating contractors, the share of building costs attributable to heating and ventilating rose because other trades and technologies were either no longer required or because new techniques reduced other costs in the construction process.

5.3.3 The pattern of growth of output of the heating and ventilating industry relative to the construction industry since 1957 is shown again in Figure 5.8, but this time both series are based on an index of 1957 =100. As can be seen in Figure 5.8 heating and ventilating output grew more rapidly than construction output especially from 1968 to 1971. There was an almost equally rapid decline in heating and ventilating output from 1972 to 1976 until output returned to its long run trend path. These shifts in output of heating and ventilating systems reflect the increasing share of construction work carried out by heating and ventilating contractors until 1986. In 1986 the rate of expansion in heating and ventilating began to fall below the rate of increase in construction as a whole, slightly increasing as a share of total construction output only during and after the recession of the early 1990s.

**Figure 5.8 Indices of annual real output of the construction and heating and ventilating industries 1955 to 1997, 1957=100**

Source: Heating and ventilating industry, HCS; Construction industry output data supplied direct by DETR HVI data deflated using the GCPI Cl data at 1995 prices

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5.3.4 The pattern of growth in the share of construction work carried out by the heating and ventilating industry is confirmed in Figure 5.9. This shows that the heating and ventilating industry increased its share of construction output from 3.5 per cent in 1957 to just under 4.5 per cent by 1996. Indeed it rose to over 5.5 per cent between 1982 and 1984 and again in 1986. Although it is often asserted that the mechanical and electrical aspects of construction have increased as a proportion of total construction costs in recent years, it does not however appear to have been the case for the heating and ventilating industry since 1983, since when its share declined to between 4 and 4.5 per cent up to 1996.

Figure 5.9 Heating and ventilating output as a percentage of construction output 1957-1997

Sources: Housing and Construction Statistics, Annual, DETR

5.3.5 Although the heating and ventilating industry fulfils an important role in the construction process as building clients become more demanding of heating and ventilating systems, the pattern of growth of heating and ventilating output is very different from that of the rest of the construction industry. The annual changes in the heating and ventilating industry do not appear to be synchronous with the rest of the industry as illustrated in Figure 5.10. The graph shows that the output of the heating and ventilating industry was often to be found accelerating in periods when the rest of construction was decelerating. Nevertheless between 1975 and 1986 both sectors appear to be following a similar pattern, but it is noticeable that heating and ventilating was far more volatile than construction as a whole.
5.3.6 If the heating and ventilating industry follows a completely different cycle from that of the construction industry, then the heating and ventilating industry is not a wholly dependent part of construction. Other factors may also be responsible for the variation in demand for heating and ventilating contractors apart from demand for construction. Based on the DETR series of annual real construction output and heating and ventilating output deflated by the GCPI all at 1995 prices, the degree of dependence of the variation of heating and ventilating output on the variation of construction output between 1957 and 1996 can be found. Using regression analysis, the value of the coefficient of determination, $R^2$, is only 0.71. This may be interpreted as 71 per cent of the variation of heating and ventilating output can be accounted for by variations in construction (Bryman and Cramer 1997, p260). This makes heating and ventilating contractors highly dependent on construction industry conditions but by no means exclusively so.

5.4 Concluding remarks

5.4.1 This chapter has shown that taking the period as a whole both total construction and heating and ventilating output increased. The analysis of the time series of construction output since 1955 shows that for construction industry new build output peaked in the 1960s but repair and maintenance work continued to grow. However, between the early 1970s and 1996 just as the share of GDP produced by the construction industry declined, the proportion

Sources: DETR (not published) Housing and Construction Statistics, Table 1.6 Output at 1995 prices
DETR, HVI output at 1995 prices using GCPI
of total construction output produced by the heating and ventilating industry also diminished in spite of a period of expansion in the 1980s.

5.4.2 This chapter has also shown that although heating and ventilating contractors belong to the construction sector, a large part of their work lies outside new build or building repair and maintenance work carried out in conjunction with other building firms. Heating and ventilating firms also repair and replace heating, ventilating and refrigeration systems, which are essentially mechanical and relate to industrial and domestic engineering activities, comparable to the supply and repair of domestic fridges, television sets and computer systems.

5.4.3 Having discussed changes in the output of the heating and ventilating industry and the construction industry, the next chapter discusses the effect of different government economic policies on heating and ventilating firms. Chapter 6 discusses both the long and short term impacts on the heating and ventilating market as governments undertook strategies designed to deal with economic difficulties as and when they arose.
6.1 Introduction

6.1.1 Government macro-economic policy is understood to be concerned *inter alia* with controlling inflationary pressures, overall levels of employment, and the pursuit of economic growth. While economic policy may be seen to succeed or fail to a greater or lesser extent in terms of its grand macro-economic objectives, the effect of such policies on individual sectors (and sub-sectors) of the economy can often be very different from those intended for the economy as a whole. This chapter examines the effect of government economic policy on one such sub-sector of the economy, the heating and ventilating industry. This historical context from 1945 to 1997 is given largely from the perspective provided in the Year Books and Annual Reports of the Association of Heating, Ventilating and Domestic Engineering Employers (AHVDEE), which became the Heating and ventilating Contractors Association (HVCA) in 1963. These annual reports reflected the response of the HVCA to economic developments. What matters here is not to give a full historical account of what took place but to provide the basis of some of the reasoning behind actions taken by firms in the heating and ventilating industry.

6.1.2 Over the period of this study, the two most significant sets of external economic factors influencing the behaviour of heating and ventilating contractors appear, from the annual reports of the HVCA, to have been the construction business cycle and government economic policies. The two sets of factors are linked. Since the Second World War the construction business cycle has been influenced by changes in government policy. These government economic policies have at times been in reaction to balance of payments crises under a fixed exchange system, and at other times, they have been aimed at counter-acting inflationary pressures. Economic policies have also been used to promote wider government economic and social policy objectives, including maintaining employment levels, industrial relations reforms, regional policies, social services, education and health. If these policies have not always been helpful to heating and ventilating contractors nor have they specifically adversely affected the heating and ventilating industry more than construction in general.

6.1.3 Both Powell (1996) and Smyth (1985) describe the post war era of government intervention in terms of *a period of reconstruction and deregulation*. From 1945 to 1954 the regulations which had been seen as necessary for the war effort were progressively eased. Having dismantled much of the regulation, government still felt a responsibility to intervene in the running of the economy. The years from 1954 to 1979 may be called *the period of the managed economy*. For these 25 years a consensus in politics and economics led both Labour and Conservative governments to attempt intervention in the economy. This intervention took the form of *demand management* from 1954 to 1966, a period Powell and Smyth refer to as ‘the long boom.’ When demand management became difficult to achieve because of wider international and domestic economic considerations, *prices and incomes policies* were adopted from 1966 to 1979 in attempts to control inflation. Prices and incomes policies regulated costs, prices and income shares, but with increasing difficulties, disappointing results and ultimately disillusionment with this approach to the management of the economy. Other government economic intervention concerned industrial relations and
the distribution of income. Geroski and Gregg (1997, p3) attribute the supply-side revolution and the monetarist policies of the Thatcher governments in the 1980s at least partly to the ‘apparent malaise of the period and general disenchantment with conventional methods of demand management’.

6.1.4 Hence, a third era began in 1979, when the approach to government economic policy emphasised deregulation on the basis of a form of global neo-classical economics. This policy favoured the role of market forces rather than direct government intervention. Consequently since 1979 intervention by government has been largely indirect through the use of interest rates and measures to deregulate markets. In the main governments no longer intervened in private sector industrial disputes except to ensure a greater flexibility on the part of firms to enable them to respond more easily to changes in demand. Nevertheless, it may be argued that government intervention in the miners’ strike during the early 1980s showed that government industrial policy was concerned with shifting the relative bargaining strengths of the participants in the labour market, not only away from miners but also other groups of workers, a process already begun in construction. This led to a greater degree of job insecurity and a deterioration in terms of employment compared to the previous era of the managed economy. The emphasis on supply side economics also increased the volatility of demand as governments avoided adopting counter-cyclical policies.

6.1.5 To some extent any division of time is bound to be arbitrary, and different researchers choose periods which fit the context of their argument. For example, the three periods chosen for analysis here, 1945 to 1954, 1955 to 1979 and 1980 onwards are slightly different from Lansley’s (1987, p.142) division of the post war era into three distinct periods, namely 1950 to 1973, 1974 to 1980 and 1980 onwards.

6.2 Period 1: 1945 to 1954 - the period of reconstruction and deregulation

6.2.1 Many authorities, including Smyth (1985) and Powell (1996), consider the post war period of reconstruction to be best understood by first considering the circumstances of the 1939-45 War. Although this research is only concerned with the period following 1945, the restrictive economic conditions, which existed for a period after the war, did have their origins in measures taken by government in the name of defence during the period of the conflict. These restrictions took three forms: the registration of firms, the licensing of building work and the control of supplies.

6.2.2 In 1941 Defence Regulation 56AB was introduced. This regulation restricted entry into the construction industry to those firms which had already undertaken building work. In June 1944 this barrier to entry was lowered and in March 1946 entry into the industry was unrestricted by government although firms still needed to register. Mandatory registration was only completely removed in 1953 (Fleming, 1980 p.54).

6.2.3 Another building regulation arising from the need to allocate resources to the war effort was Defence Regulation 56A. This regulation concerned the licensing of construction work, which continued until the end of 1954 (Smyth 1985, p.122). Following the Second World War the Report of the Council of the Association of Heating and Ventilating Domestic Engineering Employers, (which became the Heating and Ventilating Contractors'
Association in 1963), remarked that there had been slow progress, and the industry had been held back because of the priorities in the building programme set by government (AHVDEE, 1947 p.58). Although this may have been the case as far as heating and ventilating engineers were concerned, there was little evidence in fact that the licensing system held back construction work as a whole.

6.2.4 Smyth (1985, p.118) maintains that the number of licences would have allowed for a potential output for the industry of £1,175m in 1947 and £1,264m in 1948, compared to the official value of output of £1,047 in 1947, which included repair and maintenance. However the official value of work was almost certainly an under-valuation of the total of work undertaken. As Smyth points out work valued at less than £1,000 did not need to apply for a licence and, in any case, much work may not have been recorded at all.

6.2.5 This does not mean to say that construction was not held back by other regulations and controls, especially concerning the supply of materials (Smyth 1985, p.121). Smyth (1985, p.113) points out that following the war, government attempted to prioritise reconstruction and the distribution of materials in short supply. Indeed this policy was a continuation of wartime regulation begun in 1940 when the Works and Building Priority Committee created a list of Government projects, which were to be given high priority. This list was called the WBA list. A second list of projects were designated WBZ jobs, which were liable to have their labour and materials diverted to other uses. Other building work was given a “neutral” category, if their priority was not as critical to the war effort as those projects on the WBA list (Kohan, 1952, pp83-4). In response to increasing shortages of materials, further restrictions on civil building work were introduced in 1941. A procedure called the ‘nil certificate’ was set up, which attempted to limit the building of new factories and warehouses to those where no existing alternative could be found (Hargreaves and Gowing, 1952, pp.248).

6.2.6 After the war, contracts given a WBA/MAT designation, permitted contractors access to the materials they required, but from the evidence of the existence of ‘materials chasers’, this did not always mean the materials were readily available. The need to obtain ‘M’ forms disrupted material supplies and WBA priority became meaningless (AHVDEE, 1948 p.65). Materials-chasers were employed to locate supplies in order to meet requirements. Firms in the heating and ventilating industry were busy, and their labour costs rose, not least because of delays caused by shortages of components. Many jobs remained incomplete, tying up the capital of heating and ventilating firms (AHVDEE, 1948 p.66).

6.2.7 Concern was expressed throughout the late 1940s that government intervention in international trade was depriving the heating and ventilating industry of essential material and was reducing employment and labour productivity in the heating and ventilating industry (AHVDEE, 1947 p.59). Government controls were seen as preventing firms from ‘getting on with the job’ (AHVDEE, 1948 p.99). According to the report of the Council of the Association of Heating, Ventilating and Domestic Engineering Employers in March 1950, capital investment policies in the form of licence procedures and incentives to export in the form of restrictions on the supplies of materials in the UK affected the heating and ventilating industry far more than rising labour and material costs (AHVDEE, 1950 p.104). The government wanted to increase exports to acquire foreign currency and pay for the most
essential imports. Indeed in 1948 import restrictions had also impacted on the performance of firms, as they were unable to obtain tools from the US and spare parts for US machinery, and manufacturers of heating and ventilating equipment in the UK were unable to make up the short fall (AHVDEE, 1948 p.66).

6.2.8 This view expressed by the trade association has some resonance in a paper originally published in 1958 by Shonfield (1995, p.36), who argued, that Government regarded industrial investment as an expendable item in view of a weak balance of payments. He saw such an approach as partly responsible for the long term decline of British manufacturing in general. Notwithstanding Shonfield, this assessment by the AHVDEE that government controls were the sole cause of delays to projects and problems facing the industry may not necessarily have been entirely accurate. It is true the delays and the continuous need to move operatives from one site to another depending on where materials were available and therefore where work could proceed undoubtedly had the effect of reducing productivity. It may also have been the case, as Powell (1996, p.167) points out, that productivity in the construction industry as a whole actually fell between 1937 and 1951 by 2.5 per cent per annum. However, the poor performance of contractors in general in carrying out their work following the war may have been due more to delays caused by shortages of materials as a result of skill shortages in manufacturing lost in the war and disruption to production as the economy returned to civilian output. The decline in performance was also caused by the poor quality of labour who were able to find work in construction because of labour shortages caused by the war and because there was full employment immediately after it. Indeed, Smyth notes that shortages of labour after the war were so acute in the housing sector that on average there was only one worker per house under construction in 1946 (Smyth 1985, p.112-3). In any case, Powell (1996, p.167) states that construction output only actually declined as a direct result of government ‘stop-go’ policy much later in 1969.

6.2.9 The nationalisation of coal and the impending nationalisations of electricity, gas and transport were seen by the AHVDEE as further threats to the ‘individual enterprise’ of firms in the heating and ventilating industry in 1947 (AHVDEE, 1947 p.59). If 1947 had been viewed as one of “disappointed hopes,” 1948 saw the return of optimism according to the anonymous contractor contributor to the Year Book of 1949. However, this optimism was clouded by the prospect of steel nationalisation, the main material used by the heating and ventilating industry (AHVDEE, 1949 p.87). The aim of steel nationalisation was to restore steel production following a lack of investment and problems in the steel industry, which were causing shortages.

6.2.10 One can expect the cost of steel per unit of heating and ventilating contractors’ output to be a smaller percentage than the cost of steel per unit of structural steel industry output, due to the added value by the application of technology in heating and ventilating systems compared to structural steel. It is therefore possible to exaggerate the significance of steel prices in heating and ventilating compared to structural steel. On the other hand, while buildings could substitute steel frames with concrete and other structural elements, substitution of steel by heating and ventilating contractors was more difficult. Nevertheless, the impact of steel shortages was far greater on, for example, specialist steel erectors than heating and ventilating contractors, because of the actual quantities of steel involved.
6.2.11 If nationalisation of steel was seen not as a solution to the problem of under-investment but as a threat by individual contractors in the heating and ventilating industry opposed to centralisation, 1948 was also the year of the ‘bonfire of controls’, with the easing of post war restrictions. However, before plans to generate economic and industrial recovery could be put into place balance of payments problems emerged (Smyth 1985 p.122). Because of the lowering of rationing and other controls the government was forced to devalue the pound in 1949. With devaluation came cuts in government spending, rising material prices and other inflationary pressures. These were then exacerbated by the economic effects of the Korean war, pushing inflation up to a rate of 20 per cent per annum, according to Smyth (1985 p.123). However, in Figure 6.2 inflation rose to just over 10 per cent in 1952.

6.2.12 In 1953, the remainder of the post war government controls were lifted and materials became increasingly available, with the result that prices became more stabilised. According to one heating and ventilating contractor at the time, the increase in availability of materials allowed heating contractors to save on their own need to hold stock (AHVDEE, 1954 p.43). At the same time he noted that, “more projects were afoot than for many years previously.” (AHVDEE, 1954 p.41). This was later confirmed in the Report of the Council of the AHVDEE (AHVDEE, 1956 p.148), which stated that the record high levels of work reached during the year ending 31st March 1956 had been due to the lifting of licensing restrictions in September 1954.

6.2.13 If this were the case then it could indeed be concluded that post-war government restrictions had been effective in controlling the output of heating and ventilating engineers. It appears from the point of view of heating and ventilating contractors, the restrictions were no longer needed and did indeed form a bureaucratic barrier to expansion. At any rate, the lifting of these restrictions may be said to have marked the end of the post war reconstruction phase. However, if Shonfield was right, these restrictions had done little to rebuild Britain’s industrial base but had, on the contrary, been the cause of lost output instead.

6.3 Period 2: 1954 to 1979 - the period of the managed economy

6.3.1 This period can be further subdivided into: (a) 1954 to 1966 - the era of demand management and (b) 1966 to 1979 - the era of prices and incomes policies.

a: The long boom: 1954 to 1966 - the era of demand management

6.3.2 The last of the war time restrictions were ended towards the end of 1954, although the remaining level of government intervention in the construction industry continued for the following 25 years (Smyth 1985, p.109). According to Smyth (1985 p.124), this gave the industry a quarter of a century of relative stability and growth, but not before further balance of payments difficulties arose in 1955, as a direct result of the increase in the consumption of imports, given that exchange rates were fixed. In fact, as noted above the relative stability of the industry lasted only until 1974, approximately only 20 years. However, market conditions tightened before then, as growth in construction appeared to slow down from 1968 until the 1980s (see Figure 5.3).
6.3.3 The title of the contractor's review of the year for 1955 may have summarised the perceived economic conditions facing heating and ventilating contractors at the time, ‘Costs Rising - Credit Squeezed - But Business Growing’ (AHVDEE, 1956 p.61). In fact, during 1955 and the early part of 1956 until April, wages were reported to have risen by 12.5%. This was against a rise of under 4.5 per cent in the retail price index. Material costs were also rising. However, “work was very plentiful and there were little signs of the effect of the credit squeezes” with order books fuller than ever (AHVDEE, 1956 p.61).

6.3.4 Full employment and improving the standard of living, based on economic growth and price stability were the stated aims of government according to the first report of the Council on Prices, Productivity and Incomes, which had been set up in 1957. The report summarised the post war period as one of success in achieving high employment and increased annual output but conceded that government had failed to secure price stability (Ministry of Labour Gazette, 1958).

6.3.5 By March 1961, the Council of the AHVDEE could report that the heating and ventilating industry was fully occupied, with large building programmes for hospitals, universities and industry (AHVDEE, 1962 p.98). In fact, the hospital rebuilding programme still appeared to be only in its early stages of planning, with only a few contracts being let by as late as April 1964 (HVCA, 1964 p.4). However, the optimistic view of construction in 1961 did not extend to the economy, which was beginning to face another balance of payments crisis, which was met with a pay pause introduced in July 1961. The Chancellor of the Exchequer deliberately targeted the construction industry as it was not directly linked to exports and production. He raised interest rates from 4 per cent in 1959 to 7 per cent by 1961 in order to discourage speculative investment in buildings (Smyth 1985 p.155).

6.3.6 The year 1965 saw the arrival of a new Government, together with yet another balance of payments crisis. One measure adopted by government to counter the outflow of funds was to raise interest rates again. In spite of this measure, there was no shortage of work for heating and ventilating engineers though “competition remained extremely keen,” (HVCA 1965 p.7). This implied a squeeze on profits was occurring in 1965 as costs (especially interest rates) increased but could not be passed on easily. It emerged later that in 1965, 392 builders had gone to the wall owing a total of £900,000, which at the time was the highest deficiency on record, and it was feared that the trend in these figures over the following years would be upward (HVCA, 1967, p.29)

6.3.7 According to Coates and Hillard (1995, p.9), the net effect of government economic policy throughout the 1960s was to raise GDP per head by 24.4 per cent between 1960 and 1970. While this can be seen as a real achievement in absolute terms, it compares with 38.7 per cent for West Germany, 54.6 per cent in France, and 58.2 per cent in Italy. Japan achieved an increase of 159.2 per cent during the same period.

b: The period of the managed economy: 1966-79 - the era of prices and incomes policies

6.3.8 It appeared that confidence in demand management was beginning to crack by the mid 1960s. Government began to rely increasingly on interest rates to control various aspects
of the economy at large (for example, the exchange rate), in spite of adverse effects such policies might have on specific industrial sectors such as construction. This shift in government economic policy away from demand management may therefore also have influenced attitudes and culture in construction in response.

6.3.9 Steady growth in construction output came to an end in the late 1960s and output became increasingly volatile partly as a result of government economic strategies to control the economy as a whole. The stop-go policies of the government continued when in 1966 another balance of payments problem confronted the economy. This time, not only were interest rates increased, but other measures were also introduced, including a freeze on wages and cuts in public spending (Smyth 1985, p.145). Because of the continuing threat of a sterling crisis, Government also adopted a prices and incomes policy. Again the interests of industry, including heating and ventilating firms, were not necessarily seen as immediately important as the maintenance of the balance of payments and support for an over valued fixed exchange rate.

6.3.10 In spite of these efforts by government to restrain demand at home and combat inflation, in mid November 1967 sterling was devalued by 40 cents to $2.40 to the pound. Following devaluation, further cuts were made in public sector spending at the beginning of 1968 and on September 2nd, 1968, Selective Employment Tax (SET), which had been introduced in 1966, was increased by 50 per cent, the increase having been announced in the Budget earlier in the year (HVCA 1968, p.35). The impact of these cuts on the construction industry was, however, expected by government to be minimal, with construction output expected to rise by between 3 and 4 per cent in that year (HVCA 1968, p.27). In 1969 increases in incomes were subject to a 3.5 per cent ceiling unless productivity agreements could be shown to justify a higher pay rise (HVCA 1969, p.7). In the event these policies had the effect of slowing down the economy, though inflation continued on a rising trend. For construction as a whole, it was the start of a period of volatility in output as illustrated in Figure 5.3. It was the start of a long downward trend in new construction work until 1981.

6.3.11 Following the General Election of 1970, the new government still faced the same economic problem which had confronted the previous administration, namely inflation. Because of rising costs, heating and ventilating contractors faced a particular difficulty as did other contractors in the construction industry. This concerned firm price tenders, which the government insisted on using on public sector projects, in spite of representations by construction organisations such as the HVCA. As public sector construction contracts comprised a sizeable proportion of all construction work, the government saw firm price tendering as a means of putting pressure on the construction industry to combat rising costs. The government, however, contradicted itself somewhat, arguing that firms should be advised to allow for cost increases when tendering for work. The HVCA's response was to suggest to its members that tender prices in 1970 should allow at least 6-10 per cent, or more than double the percentage on contract prices it had recommended in 1966 in order to account for rising labour and material prices (HVCA 1971 p.7, p.21 and p.22). In spite of inflation, or perhaps because of it, construction output fell a further 3 per cent in 1970 (HVCA 1971 p.7). This is also confirmed in Figure 5.3. The drop in demand led heating and ventilating contractors to cut their prices although they faced rising costs. The pressure to find work thus squeezed profit margins and profits further.
6.3.12 Inflation remained one of the main concerns of economic policy. Under Stage Two of the Government’s counter-inflation policy, a 50 percent productivity deduction on allowable labour cost increases was imposed. Pay increases were allowable if they could be shown to reflect productivity increases, but only half of the increase in wages could be passed on in the form of higher prices. Pay increases therefore squeezed profits. The HVCA noted that:

“The stated objective of the productivity deduction [was] to ensure that the benefits of increased productivity [were] passed on to the consumer. In the case of the construction industry, of course, the benefits are passed on to the building owner who is by no means always the consumer,” (HVCA, 1973 pp.26-7).

Indeed the Price Codes and the general principles of prices and incomes policy were geared to manufacturing industry rather than construction and the differences between manufacturing and construction were not always appreciated by Government.

6.3.13 Representations were made on behalf of the construction industry pointing out the causes of some of the difficulties of implementing anti-inflationary policies in construction. Construction firms, they argued, carried out work on one-off projects, each with its own associated level of technical difficulty and unpredictability. This made it difficult to set comparable prices for different projects. Further difficulties were caused by the fragmented nature of subcontracting work in the construction process, which made the administration and monitoring of pricing policies complicated and expensive. Moreover, wage rates were largely decided locally on site to reflect local labour market conditions. Payments to contractors were frequently delayed and spread over long periods of time. As a result Prices and Incomes Policies, according to the HVCA, were not seen as practical in the construction industry (HVCA, 1974 p.25).

6.3.14 Whether or not these arguments had any influence on government policy is beyond the terms of this research, but in Stage Three of the government’s counter inflation strategy the productivity deduction was modified so as not to erode profit margins by more than 10 per cent or return on capital employed to less than 8 per cent or alternatively net profit margins to below 1.5 per cent (HVCA, 1974 pp.24-5). Stage Three ended on December 19, 1974 and was replaced by Stage Four the following day. In Stage Four productivity deductions were used for the last time. This time productivity deductions were not intended to reduce the return on capital below 10 per cent or net profit margins to below 2 per cent (HVCA, 1975 p.25). This therefore increased the incentive for firms to raise their productivity (HVCA, 1975 p.25). From August 1976 no more deductions were required (HVCA, 1977 p.31). This more relaxed incomes policy continued to form a central part of the government’s counter inflation strategy in 1976 but the net effect was that incomes rose by 11-12 per cent (HVCA, 1977 p.8).

6.3.15 Inflation was not the only problem facing government. Because of the need to satisfy conditions laid down by the International Monetary Fund in 1976 in order to obtain a $3,900m standby credit, the government was forced to cut public spending by a further £2,500m (HVCA 1977 p.8). The Public Sector Borrowing Requirement (PSBR), which had been as high as £10,480m in 1975 was also to be reduced. By 1977 the PSBR had been
halved to £5,993m only to more than double again to £12,244m by 1980 (Smyth 1985, p.192). Such dramatic shifts in spending inevitably caused disruption in public sector construction demand with a knock-on effect on heating and ventilating contractors especially those working on hospital and university building. Nevertheless, during the 1970s the higher technology based sectors of the construction industry were better able to maintain output levels than general building firms. According to Smyth (1985 pp.198-9) mechanical, electrical and process engineering gained from increasing building requirements.

6.3.16 Although unemployment in the economy remained at 1.5m people in 1977, a degree of optimism returned to the heating and ventilating industry with the prospect of increased public sector spending on construction. The rate of inflation declined from 16 to 8 per cent as can be seen in Figure 6.2. Nevertheless the rise in earnings approached 14 per cent, which was 4 per cent above the voluntary 10 per cent pay guidelines set in Stage 3 of the pay policy, in spite of the threat of discretionary government sanctions. These sanctions nevertheless particularly affected contractors and subcontractors working on public sector contracts as building firms working on government funded projects were more directly controlled by (and dependent on) the public sector than other firms providing consumer goods. Under Stage 6 of the prices policy, the prices charged by heating and ventilating firms were controlled by the government, who replaced price rises based on allowable cost increases, with a system of upper limits on profits, of 12.5 per cent and 3 per cent based on either capital or sales respectively (HVCA 1978 p.8, p.26 and p.27).

Figure 6.1 Retail price index 1948-1996 and the index of materials and fuel purchased by manufacturing industry 1963 to 1996.

Source Economic Trends Annual supplement 1997 edition No 23 ONS, General Index of Retail Prices (All items) (RPI) 1990 = 100 using 1985 weightings, and materials and fuel purchased by manufacturing industry, (MFPI) 1990 = 100, Table 2.1 Prices p. 161
6.3.17 Figure 6.1 shows clearly how inflation in retail prices began to accelerate in the early 1970s and from 1972 materials and fuel purchased by industry also rose rapidly until 1984. Even before 1972 materials and fuel had been rising at a faster rate than retail prices. However, improvements in productivity, labour substitution and material saving innovations compensated for higher relative input prices to some extent. After 1972 the differences in price increases became even more pronounced squeezing manufacturing firms in particular in the process as they found it increasingly difficult to pass on higher costs in the form of higher prices, partly because of competition from abroad. It was this competition from abroad in the form of manufactured imports, which also led to the balance of payments crises during the 1970s. A clearer indicator than Figure 6.1 of annual changes in prices both to consumers and to industry is given in Figure 6.2 which shows the annual changes in the indices.

6.3.18 In Figure 6.2 manufacturing input prices can be seen as far more volatile than the retail price index, with materials and fuel rising by almost 50 per cent in 1974 and falling by over 15 per cent in 1986. The highest annual rise in the retail price index occurred in 1975 at just under 25 per cent and in no year did deflation occur. Between 1963 and 1975 the annual rate of price increases followed a rising trend. Since 1975 the trend has been downward albeit with several reversals in particular in 1980 and again in 1990. In 1973, 1974 and 1976 fuel prices rose significantly and this cost increase was used by firms as an excuse to raise their prices under the guise of passing on input cost rises. These price increases became self-fulfilling (and self-defeating) as manufacturing outputs were then used as inputs further down the chain of production and higher prices then became the norm. In 1990 the reasons for the peak in inflation was due at least in part to housing market activity and consumer spending.

**Figure 6.2 Annual percentage price changes in the retail price index and the index of material and fuel prices purchased by manufacturing industry 1949-1996.**

Source: Economic Trends Annual supplement 1997 edition No 23 ONS, General index of Retail Prices (All items), and Materials and fuel purchased by manufacturing industry Table 2.1, p 161
6.3.19 Prices and incomes policies had led to inconsistencies in labour markets and product markets, which required re-adjustment. These re-adjustments inevitably meant a catching up process took place and in 1975 the rate of inflation accelerated towards its peak of around 25 per cent per annum. As a result, these Prices and Incomes Policies which had long been the mainstay of the government’s counter-inflationary measures began to disintegrate rapidly from 1978 onwards, especially in the light of declining rates of inflation, which removed the imperative of counter-inflationary measures. Increasing disillusionment caused by the anomalies and examples of unfair discrimination against certain groups of workers, especially in the public sector led to widespread industrial action, such as industrial action by transport workers and in copper tube manufacturing plants, which directly affected the heating and ventilating industry.

6.3.20 Unemployment reached 1.25 million people in 1975 (HVCA, 1976 p.8 and p.18). However the unemployment situation was not uniform throughout the country. Differences in unemployment in different regions may account for contradictory statements published in the HVCA Annual Report. On page 15 of its 1976 Annual Report the HVCA reported a significant rise in the number of operatives being made redundant, although skilled workers, such as welders and advanced fitters, were still in “short supply” in many areas (HVCA, 1976 p.15). Later in the same report on page 28, the HVCA reported that the volume of work had not yet declined since 1973, and contractors in the heating and ventilating industry were still “reasonably fully employed” (HVCA 1976 p.28). Nevertheless, it was felt that harder times were about to begin with regions such as Yorkshire, Eastern Counties, Scotland, South Wales and the West of England showing the first indications of a downturn in demand. Clearly anti-inflationary policies were having an adverse impact on the heating and ventilating industry.

6.3.21 Nevertheless, towards the end of 1975, the government introduced a voluntary pay policy, publishing a white paper entitled *Attack on Inflation*. The “voluntary” maximum increase in weekly pay of £6 for those earning £8,500 or less was backed by a mandatory price code if pay settlements breached the upper limit (HVCA, 1976 p.8). However, the increasing unpopularity of incomes policy was reflected in the heating and ventilating industry, where the HVCA blamed pay restraint as well as the state of the industry for the rise in the number of disputes requiring resolution under the terms of the conciliation machinery in the National Agreement (HVCA, 1977 p.13).

6.3.22 In 1978 in Stage 4 of its incomes policy in response to inflationary pressures the government not only cut public sector capital spending but also sought to restrict pay increases to 5 per cent per annum. This pay policy failed, according to the HVCA, due to strike action by unions and pay comparability criteria used to overcome the anomalies created by pay restraint. (HVCA, 1979 p.8). This implied criticism of the unions illustrates a hardening in attitudes towards industrial relations in response to increased pressures on firms faced with rising costs and declining demand. This was in contrast to the generally collaborative approach of the 1950s and 1960s. In the late 1970s strikes had a direct impact on the heating and ventilating industry. A transport drivers’ strike and strikes at manufacturers, especially copper tubing supplies, caused delays and cost increases which
created sourcing difficulties for heating and ventilating firms who found it difficult, according to the HVCA, to recover their unexpected increased costs and to complete contracts on time (HVCA, 1979 p.42).

6.3.23 The 1978 Stage 4 of incomes policy and Stage 7 of prices policy were the last to be introduced before the change of Government in 1979. Stage 7 prices policy consisted mainly of reports by the Price Commission on specific price increases. The more government attempted to control prices, incomes and conditions, the more employers in collusion with a large element of the workforce found ways of avoiding the regulations. The interventions may have reduced the rate of inflation below what it otherwise might have been but reductions in the rate of inflation were bought at the cost of increased uncertainty caused by ‘stop-go’ policies, the casualisation of labour, a hardening in industrial relations, reduced public sector demand and low levels of investment. The heating and ventilating industry appears to have followed a similar pattern.

6.4 Period 3: 1979 to 1997 and beyond - the era of global neoclassical economic policies

6.4.1 In 1979 the change in government signalled a further shift in approach to economic policy. The new government abandoned prices and incomes policies in favour of interest rate centred monetary policy aimed at restricting money supply (HVCA 1979 p.8). The Price Commission itself was abolished in the 1980 Competition Act (HVCA 1981 p.31). Nevertheless, from Figure 6.2 both the annual rate of retail price inflation, which rose from under 10 per cent and materials and fuel inflation, which rose from virtually zero in 1978, increased to over 15 per cent per annum in November 1979 with interest rates rising to 17 per cent, a combination of events which produced a loss of business confidence. These factors together with cuts in public spending of almost £1.5bn, including cuts in capital projects, deepened the recession in construction, which had begun in 1979 and reached its lower turning point in 1981, according to Figure 5.3. Indeed, these public sector cuts of £1,468m came on top of reductions planned by the previous government, which were themselves criticised by a construction lobby, the Group of Eight, as too little to maintain employment levels in construction.

6.4.2 In fact, although further public sector cuts over the coming years were planned, construction output grew after 1981 until 1990, due largely to private sector demand, especially commercial developments in the second half of the decade. At the same time government gave some encouragement to private sector construction demand by introducing additional allowances for work on industrial buildings. Unfortunately due to the uncertainty caused by the 1980 recession generally, these allowances had little compensatory effect on construction demand in the short term. The Government also announced plans to create Enterprise Zones with capital allowances and exemptions from Development Land Tax, (HVCA 1980 p.31). These zones did succeed in stimulating construction but only in certain targeted areas.

6.4.3 With the ending of prices and incomes policy and the abolition of the Price Commission in 1980, an era of fine-tuning economic policy came to an end. As Lansley (1987, p.148) points out, with the decline in public sector demand for construction, government was no longer as concerned as it had been to use the building industry as a
counter cyclical tool, to create employment. In any case, since 1972 this policy had not prevented the decline in real output of the construction industry. Stop-go prices and incomes policies had been discredited, seen at worst as the cause of the problem rather than as government attempts to lessen the impact of global and national economic difficulties and at best seen as attempts which only made matters worse. General monetarist policies aimed at reducing the rate of inflation came to be seen by the government, but not by all, as offering greater long run economic stability.

6.4.4 Coates and Hillard (1995, pp7-8) chart the decline in the UK economy between 1970 and 1995. They state that manufacturing declined as a proportion of GDP from over 30 per cent in 1970 to 22 per cent by the mid 1990s. Employment in manufacturing fell from 8.5 million people in 1966 to just over 4 million in the 1990s. The relative decline of manufacturing meant that in 1983 the UK changed from being a net exporter of manufactured goods to being a net importer in spite of the prominence given to balance of payments problems. Indeed the relative decline of British manufacturing must have contributed to the international payments problem. Coates and Hillard (1995, p 8) also point out that Britain's relative decline can be seen in the fact that its international ranking in terms of GDP per head fell from second place in 1960 to 18th out of 24 OECD members by the mid 1990s.

6.4.5 By 1980 the recession was beginning to cause large numbers of redundancies of operatives and even some of staff as heating and ventilating firms responded to lower levels of demand, although some firms were able to take advantage of a temporary employment scheme introduced to mitigate the effects of the lack of an adequate workload. The Temporary Short Time Working Compensation Scheme (TSTWCS) applied only to the larger heating and ventilating firms employing 10 or more workers. The Department of Employment were prepared to pay half the daily wage costs of employees, who would have been laid off, for a period of up to 9 months if they were kept on on a part time basis (HVCA 1981 p.13).

6.4.6 In the meantime the government began to open up the public sector to increased competition. The Local Government, Planning and Land Act 1980 became effective in April 1981. This piece of legislation forced the Direct Labour Organisations (DLO) of Local Authorities to compete with private sector firms for work. Although the nature of DLOs meant that they trained and employed people on terms more onerous for the employers than firms in the private sector, the HVCA felt that the 5 per cent rate of return on a current cost accounting basis required of DLOs still gave them an unfair advantage over private firms in tendering competitively for local authority work (HVCA 1981 p.42). If they did indeed have an advantage over private sector competitors, it did not prevent DLOs from declining in size and importance throughout the 1980s, as a result of Compulsory Competitive Tendering.

6.4.7 Although not intended as a make work scheme the Energy Conservation Act (1981) indirectly gave a temporary boost to demand for heating and ventilating contractors, by setting energy efficiency standards for heating, hot water, cooking and refrigeration. In the short term it may have stimulated demand for upgrading works for heating and ventilating contractors but in the longer term it may have also reduced demand for heating and ventilating services by reducing energy wastage and the need to replace equipment as
frequently as might otherwise have been the case. At the same time government set up an energy saving scheme, backed with £50m of public funding, for the conversion of boilers from oil to coal fired systems (HVCA 1982 p.51). It is not known here how much of the £50m available funding was actually taken up. The main point here is that the prominence and priority given to heating, ventilation and refrigeration by government meant that provided firms in the industry were sufficiently flexible different kinds of specialist work were available in different niche markets. Though £50m was hardly a large proportion of the total output of the heating and ventilating industry it must have contributed even in a small way towards maintaining a level of demand between 1981 and 1983 for heating and ventilating contractors above what it otherwise would have been, when other types of specialist contractors were experiencing difficulties in the market in the recession of the early 1980s. According to Figure 5.7, in 1980-81 heating and ventilating hardly declined while construction output dropped by almost 10 per cent.

6.4.8 Apart from the miners' strike of 1984, which caused inconvenience to many heating and ventilating contractors, another external economic factor to impinge on the heating and ventilating industry in this period was the attempt to defend the value of the pound by raising interest rates from 9 per cent to 12.75 per cent as the rate of exchange of the pound against the dollar fell to its lowest point at the beginning of 1985 to $1.03. This fall in the exchange rate of sterling served to stimulate the economy, which grew at 3 per cent, and construction also saw an increase in output (HVCA, 1985 p.8).

6.4.9 One of the consequences of the recovery in the economy was an increase in the rate of inflation rising from an annual rate of 5.2 per cent in March 1984 to 6.9 per cent by March 1985 (HVCA 1985 p.8). Nevertheless in 1985 private sector demand for construction continued to increase, and the economy experienced a general recovery on several fronts. Inflation fell to 3 per cent during 1986 (HVCA, 1986 p.8), only to rise slightly the following year with interest rates fluctuating around 9 per cent. As the pound continued to rise against the dollar to $1.68, government felt able to relax its monetary policy in favour of monitoring exchange rates. Moreover, it felt able to increase public sector spending on construction, encouraging construction output to continue on its upward trend. The recovery in the economy was reflected in the reduction of 300,000 people in the official number of people registered as unemployed.

6.4.10 This economic recovery continued and in 1988 the numbers of unemployed declined to below 2 million people. Consequently, there was an increased demand for loanable funds and consumer goods, which led to an increase in interest rates to 14 per cent, increases in wage rates and ultimately an increase in the rate of inflation to 8 per cent. Unfortunately, because of the high level of demand in the domestic market and the rising exchange rate of the pound, the trade deficit widened and began to cause concern once again.

6.4.11 One explanation of the downturn in the business cycle beginning at the end of the 1980s is based on the economic policies followed at the time, including the failure of monetary policy. Another factor, which contributed instability to the housing market, as Hillebrandt, Cannon and Lansley (1995 p.14) point out, was the long warning by Nigel Lawson in the Budget of March, 1988. He announced in March the abolition of multiple mortgage tax relief for people, such as unmarried couples, living in the same property but this
measure was only implemented in August of that year. This delay of several months only
served to increase the speculative demand for housing in the late 1980s. Annual private
sector housing starts reached a peak in 1988 at 221,744 only to fall to 120,190 by 1992
(Housing and Construction Statistics, 1998a). Similarly the value of housing output for both
the public and private sectors at constant 1995 prices fell from £10.0bn in 1988 to £5.9bn in
1991, but by 1997 it had recovered somewhat to £7.5bn (Housing and Construction Statistics,
1998b).

6.4.12 A similar collapse of the industrial and commercial property sectors also caused a
major decline in construction and heating and ventilating. In 1989 new industrial
construction work peaked at £3.2bn and fell to £2.4bn by 1993. The new build commercial
property output of the construction industry peaked in 1990 at £10.0bn falling to £5.8bn by
1993, all at constant 1995 prices. Only infrastructure building output increased at the time
from £3.9bn in 1989 to £6.7bn in 1993 but this type of work had minimal impact on the
heating and ventilating industry (apart from the Channel tunnel project) and in any case the
increase was not sufficient to compensate for the decline in the rest of construction.

6.4.13 Housing output was predominantly based on private sector finance. Since
privatisation a high proportion of work on infrastructure has been in the private sector. The
other major change introduced by government in the 1990s was the introduction of the
Private Finance Initiative (PFI), which has obliged contractors and specialist firms to
consider long term life cycle costs in addition to construction costs. This placed further
emphasis on the maintenance and repair of systems and greater weight on mechanical and
electrical engineers than before.

6.4.14 When the Private Finance Initiative was introduced in 1992 government used it in an
attempt to further replace construction industry dependence on public sector funding (and
funding constraints) of public sector projects with private sector funding by relaxing one of
the Ryrie rules that private finance for public sector projects should count as public sector
debt (Winch, 2000, p.149). However, delays in implementing projects meant that PFI projects
failed to stimulate demand for construction in the period before 1996.

6.4.15 Because of growing concern about the state of the construction industry (its volatility,
lack of investment in training, and its fragmentation) the quality of its output and the number
of inter-firm construction disputes, the Latham Report was commissioned by government and
published in 1994. One of the main outcomes of the Latham Report was the debate which
followed culminating in the Housing Grants, Construction and Regeneration Act 1996. This
act recognised the need to mediate in disputes between main and subcontractors and sought
to bolster the position of subcontractors if they were abused by main contractors, a major
cconcern expressed by the HVCA.

6.5 Concluding remarks

6.5.1 The previous paragraph describes the current dilemma facing the construction
industry arising out of its post war experience and responses. It has continued to under-invest
and failed to develop sufficient improvements in its own management and skills, which has
left it in difficulties when faced with increasing demands for ever more complex building

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projects, technology and above all participation in the provision of the built environment after the construction phase.

6.5.2 It would be wrong to blame government for all the economic ills and consequential decline in the UK economy. For Geroski and Gregg (1997, p.3) the stagflation of the 1970s was also due to a number of commodity price rises, (including oil), poor industrial relations and the ‘cumulative effect of under-investment in training, research and development and basic infrastructure’. However, if one views Geroski and Gregg’s list of causes of stagflation as market responses to the economic effects of Government policy then Governments may still be held to be directly and indirectly responsible for the direction or lack of direction of economic performance. If one characterises the UK economy in general as Coates and Hillard (1995) do as ‘UK economic decline’ the performance of the UK construction industry as a whole and the heating and ventilating industry in particular has been far more robust than many other industries. While construction survives, the same cannot be said of all other industries. And that is an achievement.

6.5.3 Having discussed changes in the output of the heating and ventilating industry in the previous chapter and the perception of government policies from the point of view of heating and ventilating firms in this chapter, the next chapter deals with the response of the industry to its economic environment.
Chapter 7  The response of contractors in the heating and ventilating industry to changes in the economy

7.1  Introduction to heating and ventilating demand and the survival of firms

7.1.1  In Chapter 6 three distinct phases in government policy since the Second World War were discussed. In this chapter construction demand trend characteristics are also divided into three periods. The first was the period of immediate post-war reconstruction, which lasted until approximately 1950. The second was the long boom from circa 1950 to circa 1968, as measured by output as a proxy for demand. The third period lasted from 1968 and can be characterised as a long period of instability.

7.1.2  The third period of instability itself can be divided into three shorter phases (see Figure 5.3). The first phase from 1968 to the early 1980s was a period of declining output in construction. From 1981 until 1990 construction witnessed expansion. In 1991 the construction industry experienced the start of a recession with recovery only beginning to appear by 1994. Changes in the level of output in construction reflect changes in demand for construction and as such affect demand and output in the heating and ventilating industry. However, heating and ventilating is only one of several trades within the construction industry and it is unlikely that all trades were equally affected by changes in overall demand, especially as different trades feature prominently in different types of building work, which themselves follow different patterns of expansion.

7.1.3  Figure 7.1 shows the value of work done by a number of different specialisms within construction. In particular the graph especially highlights the performance of heating and ventilating contractors and electrical engineers. Both of these specialisms increased relative to the other trades, which appear to grow at a much slower rate. However, heating and ventilating can be seen to increase rapidly in the period up to 1972. Since 1972 while the value of electrical engineering work done continued on a long run upward trend, heating and ventilating work done remained more or less at a similar level of output as that first reached in 1972 following a major recession and recovery between 1973 and 1983. Always the largest two specialisms, by 1983 electrical engineers and heating and ventilating contractors were both much larger than the other trades.

7.1.4  Figure 7.1 confirms the received wisdom that mechanical and electrical contractors increased their relative share of construction output. However, Figure 7.2 shows that between 1959 and 1997 changes in the value of output of different trades were greatest in the glazing trade, scaffolding and plant hire. Long run trends in output of electrical and heating and ventilating engineering were similar to the changes in most other trades. A second feature of both Figures 7.1 and 7.2 is that the value of work done by plant hirers reached a peak as early as 1979 and then declined rapidly until 1983, only recovering to the levels first achieved in 1967 and 1968. The following sections trace the particular circumstances of the heating and ventilating industry.
Figure 7.1 Work done by a number of specialisms in the construction industry
1959 to 1997 at 1995 prices

Source: Private Contractors Census, Table 3.3, Housing and Construction Statistics, Annual
Notes: Carptrs = Carpenters and joiners; Demo contrs = Demolition contractors; Scaffolders = Scaffolding specialists; C’rete specs = Reinforced concrete specialists; H and V engrs = Heating and ventilating engineers; Elect contrs = Electrical contractors; Asphalters = Asphalt and tar sprayers; Flooring contrs = Flooring contractors.
Omitted from the graph: Construction engineers, Insulating specialists, Suspended ceiling specialists, Floor and wall tiling specialists and Miscellaneous.
Data deflated using the GCPI 1995 = 100.

7.1.5 By its nature much of what occurs in construction occurs in response to changes in demand for its services. The same is true of heating and ventilating contractors. Changes in demand are examined in Section 7.2. The effect of these changes on heating and ventilating contractors is discussed in Section 7.3, which deals with increases in the capacity of heating and ventilating firms and improvements in productivity. Increases in capacity to meet increased demand do not disappear when demand declines and the increases in capacity combined with increased productivity led to frequent periods of over-capacity in the heating and ventilating industry in many years especially after 1973. The consequences of over-capacity in relation to demand for heating and ventilating services is discussed in Sections 7.4 and 7.5.
Figure 7.2  Index of work done by a number of specialisms in the construction industry
1959-1997 at 1995 prices, 1959 = 100

Source: Private Contractors Census, Table 3.3, Housing and Construction Statistics, Annual
Notes  Carptrs = Carpenters and joiners, Demo contrs = Demolition contractors, Scaffolders = Scaffolding specialists, C’rete specs = Reinforced concrete specialists, H and V engrs = Heating and ventilating engineers; Elect contrs = Electrical contractors Asphalters = Asphalt and tar sprayers, Flooring contrs = Flooring contractors.
Omitted from the graph Construction engineers, Insulating specialists, Suspended ceiling specialists, Floor and wall tiling specialists and Miscellaneous.
Data deflated using the GCPI 1995 = 100.

7.2  Changes in demand for heating and ventilating

7.2.1  In the late 1940s the heating and ventilating sector was cushioned to some extent by the need to save fuel as coal prices were tending to rise. There appears to have been a rather chaotic switch from coal to oil fired installations and back again to coal. In themselves these shifts by no means harmed heating and ventilating contractors. Conversion work meant full order books for contractors and full employment in the trade. Moreover, the level of demand for installing ever more efficient heating systems was expected to remain strong (AHVDEE, 1948, p.99).

7.2.2  Thus the heating and ventilating industry may not have followed the same cyclical pattern as the rest of the building industry in the years immediately after the war. After the immediate post war expansion in building work, the government cut spending on construction and without an increase in private sector demand to compensate, construction
output actually fell in real terms, from 1948 to 1951 (Smyth, 1985, p.124). This was followed by a period of growth in construction output which began in 1951, and continued steadily though slowly until the end of the 1960s.

7.2.3 Throughout the 1950s demand for heating and ventilating also remained relatively steady and growing. This expansion continued into the 1960s and beyond reaching a peak in 1972, (see Figure 5.8). The comments in the Council’s 1962 Annual Report were characteristic of the optimism in construction at this period. According to the Annual Report total output of construction had increased by 5% in 1961, with heating and ventilating work probably increasing more, in spite of periods of slack due to declining industrial orders (AHVDEE, 1962, p.13).

7.2.4 As the expansion continued both 1962 and 1963 were also recorded as busy years for heating and ventilating contractors. The Annual Report of the Council for the year ending 31st March 1964 stated that the construction industries had been “at full stretch,” with the heating and ventilating industry “for the most part fully occupied,” (HVCA, 1964 p.7). Indeed, optimism was expressed due to the increasing content of mechanical services in buildings. As the turnover of the heating and ventilating industry expanded, an above average number of new firms entered the market in 1965, according to the HVCA. This growth had been mainly in the domestic heating sector, while demand for heating and ventilating systems in new office developments at the time declined.

7.2.5 According to the HVCA, the increase in domestic work was largely a result of advertising campaigns by the oil, coal and gas industries, rather than any specific marketing activity on the part of the heating and ventilating industry itself. In any case, overall, the effect on total demand for the sector, according to the contractor’s review of the year, was to expand it significantly, with further increases in demand expected (HVCA, 1965 pp.5-6). Although materials were still readily available and apparently giving no cause for concern, worries about skill shortages on and off site were beginning to be expressed (HVCA, 1965 p.7).

7.2.6 Skill shortages are a sign that an industry is approaching full capacity, affecting its ability to maintain its rate of growth. This is confirmed by the HVCA, who reported a slackening in the rate of growth of total construction industry output while claiming that heating and ventilating contractors continued to be very busy. In spite of being very busy, the HVCA also reported that competition between heating and ventilating contractors had become extremely keen, (HVCA, 1966, p.7). Although the perennial complaint of contractors is that competition is keen and profit margins are low, it is likely that on this occasion this comment by the trade association was a further indication that profits were being squeezed. This was perhaps because growth in construction in general was slowing down at the same time as costs were rising as full resource capacities were being approached.

7.2.7 Because of the limited capacity of the construction industry, it became clear that the National Plan proposed by government had set targets that were not going to be met. At any rate towards the end of the 1960s the rate of growth in new building work slowed down (Smyth, 1985, p.178). Nevertheless, in 1968 alone new construction work continued to increase by 3.5 per cent according to the HVCA, a rate far greater than the average rate of
growth for the economy as a whole (HVCA, 1969, p.7). But this increase in output could not be sustained, partly perhaps because of capacity constraints.

7.2.8 Construction demand declined in 1969, but the HVCA maintained that total demand for the heating and ventilating industry had been comparatively unaffected (HVCA, 1970 p.7). Indeed, Figure 5.8 shows that while construction output fell slightly between 1968 and 1970, heating and ventilating industry output actually rose by around 15 per cent per annum in the same period. From Figure 5.3, all new build construction had declined slightly from its peak in 1968 and then recovered to its 1968 level in 1972, only to enter a period of major recession starting in 1973. Increases in oil prices in the early 1970s may have caused problems in terms of inflation and the balance of payments. However, for firms in the heating and ventilating industry it meant they were employed to adapt buildings in response to the changed relative energy prices. This provided a slight respite for heating and ventilating firms during one of the worst declines in output since the Second World War, although the domestic consumer market was constrained to some extent by government credit restrictions in force at the time.

7.2.9 Construction demand declined further between 1974 and 1977, partly in response to the measures taken by government. Although there was a drop in both private and public sector housing demand, and investment output, the HVCA reported that demand for heating and ventilating continued at a high level in 1974. This was mainly due to the time lag between projects starting and heating and ventilating systems being installed at a late stage in construction. It may also have been related to additional work caused by the sudden rise in oil prices in 1973, stimulating demand for non-oil heating systems after a time lag of a year. In the end by 1976 the heating and ventilating industry reflected the decline in construction output, as can be seen in Figure 5.7. However, because of the sustained decline in expected output, the HVCA warned of a future lack of work for heating and ventilating specialists. The HVCA guessed that the output of the heating and ventilating industry had dropped by 5-10 per cent between 1976 and 1977 and was on a downward trend (HVCA, 1977 p.31).

7.2.10 In the event 1976 marked the lower turning point in the heating and ventilating business cycle and demand began once more to increase. Indeed, 1976 was the lowest level of demand in the last quarter of the twentieth century and by 1977 the economic situation had improved. The number of people out of work declined and output and workloads throughout industry increased. Of those heating and ventilating firms which had survived the recession, many firms were once more working at or near capacity.

7.2.11 Although the long run trend in demand for heating and ventilating systems was upward, it was more volatile than it had been prior to 1970. In 1980, for example, the recession deepened as anticipated by the HVCA, with unemployment rising to 2.5m people and construction output fell by 5 per cent. The HVCA reported that in 1981 the 12 per cent drop in the output of the construction industry was so great that it was down at the level last seen twenty years earlier (HVCA 1982 p.8 and p.9). While this can be seen in Figure 5.7, the drop in heating and ventilating output or demand was not of the same magnitude by any means, only dropping to the level first reached 12 years earlier in 1969.
This recession had been so severe in construction as a whole that Lansley (1987, p. 154) argued the industry required restructuring and rationalisation to prepare for the upturn in demand. This appears to have occurred in heating and ventilating. From 1978 to 1992 the number of firms in the heating and ventilating industry expanded from just under 3,000 firms to over 9,700, the majority of these employing only one person. Although the total number of firms increased after 1977, the number of firms employing just 4 or more employees continued on a long run downward trend. Figure 7.3 shows the decline in the number of firms employing 4 or more people, which, of course, includes those employing 8 or more, also shown in the graph.

Figure 7.3 Number of firms in the heating and ventilating industry by number employed 1973 - 1998

In 1982 the decline in construction output halted, but demand for construction remained at low levels throughout the year. In 1982 a record number of HVCA members went out of business because of the level of competition, and continuing over-capacity combined with cash flow problems (HVCA, 1984, p.8). Those heating and ventilating contractors who had survived the recession, like other firms in the construction industry, were prepared to tender at extremely low prices for the limited opportunities available. However, the HVCA reported that towards the end of the year demand began to increase and by early 1983 construction orders were over 15 per cent above the level of a year before (HVCA, 1984, p.8). Recovery of demand for heating and ventilating was far more rapid than for construction as a whole (see Figure 5.7).
7.2.14 Optimism in the industry was widespread. Building Material Producers predicted growth of 4 per cent in construction output in 1983, while the Economic Development Committee for Building predicted a 6 per cent increase (HVCA, 1983, p.27). Although government spending on construction remained low, total construction demand did begin to rise, with growth taking place in repair and maintenance and services in particular. However, the HVCA feared the increase in demand for repair and maintenance would be short lived, because VAT was imposed on alteration work in the 1984 Budget (HVCA, 1984, p.8). In the event repair and maintenance continued to grow as a proportion of total construction output. From Figure 5.4 it would appear that demand for repair and maintenance was not significantly affected by the introduction of VAT. From the mid 1980s construction output and property investment were boosted by support from the financial institutions. So great was the enthusiasm for lending on construction and property from the housing market to speculative office developments that it led to instability in these markets between 1985 and 1993.

7.2.15 As Hillebrandt, Cannon and Lansley (1995, p.11) point out, bank lending to construction companies increased threefold and credit to property companies increased five times between 1985 and 1990. However, this increase in private funding did not necessarily support additional demand because as Lansley (1987 p.149) noted, private funding of projects previously carried out by the public sector had been replacing public sector spending on construction in the 1980s, as a consequence of the government’s privatisation programme.

7.2.16 Towards the end of the 1980s a number of comments by the HVCA marked an increasing pessimism regarding continued growth in demand. The HVCA reported a reduction of 3 to 4 per cent in real terms in public sector demand for construction in 1988 (HVCA 1989 p.23). Later, fears were expressed that increases in interest and mortgage rates were damaging to private sector new housing demand and would adversely affect domestic heating contractors (HVCA 1990 p.33). These fears expressed an awareness that the expansion in construction demand could not be sustained. However, the increase in interest rates were not seen as a response of financial markets to excessive demand for loanable funds but rather as a threat. By the end of the decade, the HVCA announced that its State of Trade Surveys showed a drop in new orders in the second half of 1989 though actual workloads were still rising as a result of past orders (HVCA 1990 p.22). Inevitably the upper turning point in the cycle approached, as it became increasingly difficult to sustain growth in demand.

7.2.17 As the recession deepened in 1990 both construction orders and output declined rapidly. According to the HVCA, orders declined by 8 per cent in the first six months of 1990 while output dropped by 2.5 per cent (HVCA 1991 p.6). This trend continued into 1991 with a further decline of 10 per cent in less than a year (HVCA 1992 p.9). The drop in demand for both construction as a whole and heating and ventilating in particular between 1990 and 1992 was approximately 12 per cent, as shown in Figure 5.7.

7.3 The growth in the capacity of the heating and ventilating industry

7.3.1 Underpinning the post war history of the heating and ventilating industry has been its capacity to meet changes in demand. In some years demand exceeded capacity, whereas in
others the reverse was the case. In some years \textit{changes} in demand were greater than \textit{changes} in capacity, and in other years the reverse was the case. In principle the relationship between demand and capacity can be measured using annual changes in input prices compared to annual changes in output prices. In those years when input prices rose faster than output prices, profit margins were squeezed. Years in which output prices rose faster than input prices imply that capacity was available and firms were able to respond to increases in demand by raising prices to increase their profit margins. Rising profit margins may be taken as a sign of spare capacity and growth within the sector, whereas declining profit margins imply near capacity levels of output for the industry. Unfortunately profit margins for all firms over the whole period are not available. This section nevertheless examines the relationship between the capacity of the heating and ventilating industry and demand from an historical perspective.

7.3.2 The capacity of an industry depends on the labour, capital stock and technology used. Firstly, as far as labour is concerned, changes in industrial capacity are a function of a number of factors, including changes in the size, composition, skills and motivation of, and effective hours worked by, the workforce. Secondly, changes in the quantity of capital stock and hence changes in labour productivity also affect capacity. Thirdly, increases in capacity are implicit benefits of changes in the technology, new materials used and methods used by firms. This section considers changes in productivity and the relationship between demand and capacity and the consequences of differences between them.

\textbf{Figure 7.4 Time series of the indices of heating and ventilating industry output, total employment and aggregate wage returns 1961 to 1997}

<table>
<thead>
<tr>
<th>Year</th>
<th>Total employment</th>
<th>Work done</th>
<th>Annual wage returns</th>
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<tbody>
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<td>1961</td>
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<td>1997</td>
<td>460</td>
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Sources: Housing and Construction Statistics Table 3.1 (Private contractors: work done) Table 3.4 (employment) HVCA annual wage returns.
Notes: Output data deflated using GCI 1995 =100.
7.3.3 Throughout the second half of the twentieth century improvements in labour productivity in the heating and ventilating industry implied that fewer operatives did not necessarily mean the industry's capacity was reduced. After 1951 construction industry productivity grew at a rate, albeit below the national average, of 1.8 per cent per annum until 1964. Productivity growth in the heating and ventilating industry in the immediate post war period is difficult to estimate. This is partly because the published data was based on the Censuses of Production which were not annual, partly because the definitions used changed and partly because of omissions in the data due to the data gathering techniques. From 1964, however, it rose at a rate of only 1.6 per cent per annum until the early 1970s (Powell 1996, p.167).

7.3.4 If productivity per person were constant over time, employment trends would reflect output. Figure 7.4 shows heating and ventilating industry employment and work done plotted alongside aggregate wage returns of HVCA firms between 1961 and 1997. In fact, Figure 7.4 demonstrates a wide disparity and trend differences between these three variables. The heating and ventilating industry work done series shows a long run increase until 1972. In the period between 1972 and 1997 the output of the industry did not show any signs of sustained growth. Wage returns though volatile throughout the period peaked in 1990, following a long run growth trend up to that point. Meanwhile, since 1973, total employment in the heating and ventilating industry declined in general in spite of short periods of increased employment.

7.3.5 Figure 7.5 indicates changes in gross output per worker used as a measure of productivity. However, because of the rise of labour only subcontracting reported employment in official data tends to understate the size of the total workforce by an increasing amount until the mid 1980s, by which time much of the switch to casual employment from direct employment had taken place. As a result the estimates of annual productivity changes after 1986 are more likely to be correct. The changes in productivity prior to 1986 reflect diminishing numbers of directly employed labour and ignore the increasing proportion of labour only subcontracted operatives used.

7.3.6 Clearly other factors apart from output (or demand) and productivity determine direct employment levels. Most notably the growth of self-employment or labour only subcontracting partly accounts for the divergence in employment and output trends in Figure 7.4. A simplified model of direct employment in heating and ventilating might be suggested combining output, subcontracted employment and productivity as follows:

\[ e_{dt} = f(q_t, e_{st}, e_{dt-1}, \Delta p_t) \]  

(7.1)

where  
\[ e_{dt} = \text{direct employment in year } t \]  
\[ q_t = \text{output in year } t \]  
\[ e_{st} = \text{subcontract labour in year } t \]  
\[ e_{dt-1} = \text{direct employment in year } t-1 \]  
and  
\[ \Delta p_t = \text{change in productivity in year } t \]
7.3.7 This simple model omits technological change, though it may be assumed to be embodied as part of the productivity variable. Hence,

\[ e_{it} = \alpha + \beta_1 q_t + \beta_2 e_x + \beta_3 \Delta p_t + \varepsilon \]  

(7.2)

where \( \alpha = \text{constant} \)

and \( \varepsilon = \text{error factor} \)

7.3.8 The error factor accounts for all other random exogenous variables not included under output, subcontract labour and changes in productivity and technology. However, taking official statistics at face value and assuming the labour and output variables are completely accounted for, then total productivity per person would be represented by

\[ TP_t = \frac{O_t}{L_t} \]  

(7.3)

where \( TP_t = \text{total productivity in year } t \)

\( O_t = \text{heating and ventilating output in year } t, \text{ and} \)

\( L_t = \text{total heating and ventilating employment in year } t. \)

7.3.9 This annual productivity per person is shown as a rising trend in Figure 7.5. Based on the same data the average annual increase in productivity was 2.21 per cent per annum. This continuing increase in annual output per person during and after the peak year of 1990 may

**Figure 7.5 Index of heating and ventilating labour productivity 1961-1997**

Sources: Housing and Construction Statistics Table 3.1 (Private contractors: work done) Table 3.11 (operatives) and Table 3.12 (APTC)

Notes: Output data deflated using GCPI 1995 = 100

Productivity = work done/total employment
be accounted for by the continued level of output, combined with the decline in the numbers employed as reported in the published data of the industry. In addition it may have been due to the increasing use of casual labour to replace directly employed workers. As a result measured employment may have declined more rapidly than can be accounted for by any change in production methods or any introduction of new technology at the time.

7.4 Implications of long term industrial over-capacity in the heating and ventilating industry

7.4.1 From time to time the issue of the capacity of the heating and ventilating industry to meet demand is raised within the HVCA. For example at the end of March 1967, the HVCA saw heating and ventilating contractors operating at or near full capacity in a construction industry whose total output, (according to their report) had risen marginally for the third year in spite of an economy in crisis (HVCA, 1967 p.7). In the event, according to the Annual Report, in the following year new construction output was 5 per cent greater in 1967 than it had been a year earlier (HVCA, 1968, p.27).

7.4.2 Again in the late 1970s full capacity was approached. Many heating and ventilating contractors reported relatively full order books to the HVCA, and a bottleneck in the form of a technical constraint began to appear. This technical constraint was caused by limitations on the potential number of new gas connections that could be made, held up by the rate of exploitation of gas reserves in the North Sea (HVCA, 1980, p.8).

7.4.3 During the recession of the early 1980s many contractors ceased trading while others reduced their capacity and workforces. While individual contractors may have reduced their capacity, the capacity of the industry remained relatively intact with redundant skilled workers able to set up and operate small firms (see Figure 7.3) or act as labour only subcontractors. When demand increased (from 1983 on) the HVCA found that competition for work nevertheless remained intense (HVCA, 1985, p.8).

7.4.4 In spite of the stock market crash in October 1987, the economy continued to expand. The HVCA noted that the construction industry began to show signs of overheating in the South East and London, especially with the start of the Channel Tunnel project (HVCA, 1988, p.8). The housing market was boosted by changes to Mortgage Interest Relief at Source (MIRAS) announced by the government, as many couples purchased properties before the changes took effect, (HVCA, 1988, p.29). By the end of the decade, 72 per cent of firms in the HVCA survey said they were working at full capacity compared to 67 per cent a year earlier (HVCA, 1990, p.22).

7.4.5 In contrast to the industry operating at or near full capacity, payment difficulties may be symptomatic of a buyers' market in the construction industry, which in turn is a sign of industrial over-capacity. The issue of late payment has indeed been a recurring theme in the heating and ventilating industry. In 1966, for example, heating and ventilating contractors reported that they were encountering increasing difficulties in being paid on time. The problem was blamed on architects for not giving subcontractors notification of amounts owed to them in certificates issued to main contractors. Without notification the subcontractors did
not know when to press for payment (HVCA, 1966, p.34). However, the main beneficiaries of payment delays were not the architects but the main contractors. Delays in payments to subcontractors improved the cash flows of main contractors when growth of construction output as a whole was decelerating causing the profit margins of main contractors to narrow. Main contractors were able to do this because they knew they would be able to source heating and ventilating services from alternative heating and ventilating specialist firms keen to win new orders.

7.4.6 In fact these problems were arising in 1965 and 1966 when heating and ventilating output was increasing rapidly (Figure 5.8). Indeed, the industry was able to achieve increases in its output precisely because it had the capacity to do so. If actual capacity is measured by the highest output achieved, the upper turning point in 1972 as the year of the highest output in the period between 1945 and 1985 demonstrated the maximum output the industry was capable of producing. If capacity is measured in terms of potential output then if heating and ventilating engineers had the capacity to produce more they were not given the opportunity to do so until 1985, by which time productivity improvements would have raised potential full capacity still further.

7.4.7 By 1973 in response to excess industrial capacity caused by the recession some members of the HVCA diversified into thermal insulation. Though inflation was still seen as the major cause of the deterioration in profits, late payments allegedly caused this time by quantity surveyors slowing down interim payments were also causing concern because of the effect on cash flow and working capital (HVCA, 1975, p.44 and p.53). Again during 1990 high interest rates together with adverse trading conditions led main contractors to withhold or delay payments to subcontractors often leading to their insolvency (HVCA, 1991, p.6). The poor treatment of heating and ventilating contractors reflected their weak bargaining position caused by over-capacity in the recession. During periods of growth the issue of payment delays did not appear as frequently in the Annual Reports.

7.4.8 Over-capacity was also reflected in the negotiations with public sector clients. Delays in payments to heating and ventilating contractors were not confined to their private sector clients or main contractors. The HVCA carried out a survey of payments owed to its members by public sector departments. The survey published in 1993 showed that the 129 respondents were owed an aggregate of £21,914,689 of which PSA Management owed £4,101,187 to members, taking on average 93 days to pay, while PSA Services owed £3,329,310 and took 91 days to pay on average. Local authorities took 65 days on average to pay and owed £3,134,721. The Ministry of Defence and the Home Office owed £5,441,466 and £2,176,805 respectively and took on average 42 and 41 days to pay. Other government departments generally paid within a month (HVCA, 1993, p.8). Such delays to payment added greatly to the cash flow difficulties of firms especially at a time of recession and severe over-capacity.

7.4.9 Again in 1995 the HVCA still saw their industry in a state of crisis with commercial conditions facing members as ‘difficult’ at best and ‘downright impossible’ at worst (HVCA, 1996, p.3). In the following year the HVCA saw the introduction of the 1996 Housing Grants, Construction and Regeneration Act as potentially helpful, with the hope of improving the cash flow position of subcontractors and inter-firm dispute handling (HVCA, 1997, p.10).
In 1998 Part 2 of the Housing, Construction and Regeneration Act enacted legislation concerning abuse of pay when paid clauses. The HVCA’s long campaign on the issue had at last borne legislative fruit for their members. However, neither the HVCA nor the industry itself confronted the issue of endemic over-capacity, perhaps for the simple reason that neither could do anything about it in any case, because of restrictive trade practices legislation preventing them from so doing. As has been noted barriers to entry into the heating and ventilating industry are low and when firms lay off workers many of these workers may remain in the heating and ventilating industry as labour only subcontractors even if some laid-off workers exit.

7.5 Cost, price and profit changes: an HVCA perspective

7.5.1 This section deals with the relationship between demand and the capacity of the heating and ventilating industry to meet that demand from 1945 to 1996. The interface between demand and capacity can be seen in terms of the costs of inputs, the prices of outputs and the resulting changes in profits of firms in the industry.

7.5.2 The benefits and problems of prolonged excess demand in the heating and ventilating industry were reflected across the whole construction industry in most years in the period from the beginning of the Second World War until 1973. The issue became one of finding sufficient resources to meet demand rather than the more usual concern of over-capacity in the construction industry chasing too little work (Powell, 1996, p.166).

7.5.3 At the beginning of the 1950s supplies to the heating and ventilating industry were still causing difficulties. For example, steel was in short supply and prices of heating installations and mechanical ventilation systems were rising (AHVDEE, 1952 p.30). Nevertheless new jobs continued to be commissioned. Increased costs of raw materials, labour, and transport were blamed for the price increases of the components used by heating and ventilating contractors but they were nevertheless able to pass on these higher costs to their customers.

7.5.4 Firms often received only partial deliveries of materials instead of the bulk orders they required. These partial deliveries were often spread over a number of months causing delays and further inefficiencies (AHVDEE, 1952 p.32). For example partial delivery of materials and components would impact on labour and administration costs for the contractor as labour was moved from site to site depending on the availability of materials and components. This disruption to work would have also raised costs and squeezed profits, even without a rise in the unit price of material inputs. Labour costs are a function of rates per hour, number of hours worked and the porosity of the working day\(^1\), and it is the porosity of the working day which is most affected by late or incomplete deliveries.

7.5.5 Apart from direct costs, overhead costs also apparently rose by more than 10 per cent in real terms in 1951, according to the Council’s report in 1952. The reasons for the rise in overhead costs were given as ‘very heavy increases in [the] cost of office materials, certain

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\(^1\) The porosity of the working day refers to the proportion of non-productive time to productive time per day.
transport and postal increases, etc.’ (AHVDEE, 1952, p.121). It is, nevertheless, quite likely that material shortages led to increased administration costs as more effort and time were required to organise work over and above normal practices. It is also worth noting that the Council recognised that there had *not* been a particular pressure from the unions, who had ‘not been unreasonable in their demands’ (AHVDEE, 1952, p.121). This indicates that there may have been little wage pressure on profits in 1951, as wages would undoubtedly have been the major cost item (within the cost of sales) in the profit and loss accounts. Thus, in spite of shortages of skilled labour, the heating and ventilating labour market remained steady.

7.5.6 Nevertheless, by 1952 the President of the Association highlighted the manpower problem as the greatest issue facing heating and ventilating contractors, due to the demand put to the industry (AHVDEE, 1952, p.xxxiii). The lack of wage pressure may have been more of a reflection of depression in other parts of the economy and the construction industry other than heating and ventilating. Thus, it would appear that the rise in costs could well have been largely due to the high levels of demand for heating and ventilating systems, which in turn caused disruption to supplies of materials, as sites competed for available resources. Such disruption to work also adversely affected labour productivity, which would have raised the cost of labour even without any increase in wage rates.

7.5.7 Indeed, the AHVDEE President later wrote that many considered that if the rise in prices had continued, central heating and mechanical ventilation would have priced themselves out of the market (AHVDEE, 1952, p.30). These high prices did, however, appear to generate a healthy level of profits for the contractors themselves. This conclusion appears to be supported by the implication unwittingly admitted in the same commentary that few would have wanted to return to cut price competition brought on by a trading slump (AHVDEE, 1952 p.31). In fact price became secondary to obtaining delivery of components in the first place (AHVDEE, 1952, p.31). Presumably even if the cost of heating and ventilating systems rose greatly in 1952, they would still have constituted a relatively minor proportion of the total cost of construction, and therefore added relatively little to the final building costs. More significant would have been the cost increases caused by the prolongation of and delays to construction work due to late delivery of materials.

7.5.8 On the other hand, in many cases, it was reported that heating and ventilating contractors were squeezed by rising costs and a contractual obligation to absorb the increased costs in the original tender price (AHVDEE, 1952, p.32). In those cases where contractors were able to pass on their increased charges there would not necessarily have been a particular problem, except perhaps in their cash flows. However, if contractors were unable in some cases to pass on their higher costs, this may have reflected a relative weakening in their bargaining position in the recession of 1951.

7.5.9 By the end of the 1950s it was reported that “competition became noticeably keener,” especially for contracts in the upper price brackets. This statement appears to imply that profit margins were being reduced in order to win these contracts, since the reviewer at the time felt that “commitments entered into might yet prove to be an embarrassment to the contractors concerned,” (AHVDEE, 1960, p.46). At the same time it was noted that, variations in the cost of materials had been in an upward direction. However, manufacturers
did not always pass on their cost increases (AHVDEE, 1960, p.46). This would indicate that manufacturers too were facing increasing difficulties in maintaining their sales growth, and were accepting lower profit margins. Increasing competition from abroad as well as productivity increases, which enabled them to increase output at a rate greater than the growth in the market also placed downward pressures on manufactures’ profit margins.

7.5.10 The changing trends in trading conditions were reflected in the comments of the Council Report for the year ending March 31st 1959, which also suggested that profits could be squeezed at the upper turning point of the business cycle.

"As our Industry, (sic) in the main, supplies services for other Industries, its trading activities follow the trend in industry in general... In this our Industry followed the general pattern of the trade of the country which, although in many spheres registering an increase in turnover, showed net profits smaller than those of the previous year." (AHVDEE, 1960, p.111).

7.5.11 Thus, although Figure 5.7 shows the recession of 1960 in the heating and ventilating industry was relatively minor, a steady increase in capacity was not matched by demand. This ultimately led to a profit squeeze, especially in an industry such as heating and ventilating, where demand is not price sensitive and lower prices and profit margins do not necessarily lead to increased demand and output.

7.5.12 The Annual Report for the year ending 31st March 1965, noted a confidential analysis prepared for the National Incomes Commission on profit margins in various trades between 1956/57 and 1960/61. This report showed a downward trend in the profit margins of heating and ventilating contractors, which the HVCA considered serious. Figures from the Inland Revenue showed that profit margins relating to the construction industry were as low as 5 per cent (HVCA, 1965, p.32-3). It is, however, not clear whether the profit margins referred to were gross or net. In any case at 5 per cent they appear high by the standards of the 1990s, though the difference in profit margin compared to the 1990s may have been due to the greater use of fixed assets by contractors in the 1960s compared to the 1990s. The higher the proportion of fixed assets to total assets the greater the profit margin tends to be.

7.5.13 In the Contractor’s Review of the year to mid 1963, competition in the heating industry remained intense (AHVDEE, 1963 p.37). This level of competition led to price-cutting, which eroded the “very small margin of net profit,” and trading profits began to fall as a result. The reviewer at the time pointed out that there seemed to be an inability to restore prices to a level at which they showed a reasonable return on capital employed. According to the reviewer this was due to two sets of causes. Firstly, due to the lack of confidence on the part of heating contractors, they apparently lowered their prices whenever there was a lack of inquiries, but they delayed raising them again when the number of enquiries increased. Perhaps a more likely explanation is that contractors sensed a lower level of enquiries, greater uncertainty and lower levels of business confidence, especially during the periods of slack referred to above, and priced more keenly as a consequence. The observation that contractors did not raise prices in response to an increase in enquiries implies that prices respond more to actual workload factors than mere speculative enquiries, which may or may not lead to work.
7.5.14 In other words, in general, price increases when the increase in real demand (as measured by output in construction industries) is greater than the increase in capacity. But this does not necessarily imply that profit margins or total profits also increase. Profit depends on the volume of sales and the difference between prices and costs. Profit margins may be low either because there is spare capacity causing firms to compete intensively or because industrial capacity is being fully exploited and input costs are rising at a faster rate than output prices.

7.5.15 However, other factors including contingencies, which do not readily fit into any deterministic model still need to be taken into account. For example, the purported reluctance of heating and ventilating contractors to raise prices referred to above, may have been due to the "credit squeeze" policies adopted by government at the time and rising interest rates. According to the reviewer in 1963, these credit squeeze monetary policies tended to restrain manufacturers from raising their prices to heating and ventilating contractors, with the exception of certain steel tube manufacturers, who did increase their prices (AHVDEE, 1963, p.38).

7.5.16 Similarly, the prices of inputs may be seen as exogenous contingent determinants of the costs of heating and ventilating contractors. In 1966 high interest rates, balance of payments problems and inflation formed the economic conditions perceived to be having adverse effects on the construction industry. In the same year the contract copper price, which is the price paid by manufacturers continued to rise. The increases in price were partly blamed on a number of political events taking place including the Vietnam war and the unilateral declaration of independence by Rhodesia, a major copper producer, which had prompted United Nations' sanctions which reduced the availability of the metal. Moreover, industrial unrest in other copper producing countries was also reported. The contract price of Chilean copper rose from £336 to £496 per ton. The price of Zambian copper also rose on the London Metal Exchange, selling there on the open market instead of at the arranged contract prices, which had been used earlier. As a result the Ministry of Public Building and Works index for copper tube, (1952 =100), rose from 149 in November 1965 to 180 in March 1966 (HVCA 1966, p.28). Fortunately, by the following year the market for copper had regained some degree of price stability, but in the meantime the rapid increase in price had acted as a stimulus for technical change, in the search for a replacement of the material and a reduction in its use. A reminder, if one were needed, that firms like any economic agent can respond in many different ways to price changes and do not just accept prices as a given, ceteris paribus.

7.5.17 At the beginning of 1970 wages and materials rose sharply, partly as a result of a catching up exercise following the break down of the government's prices and incomes policy at the end of 1969. The HVCA reported that the rate of wage increases doubled to 11-12 per cent per annum in 1970. In spite of the continuing demand for heating and ventilating systems, very low profit margins in the sector were admitted by the HVCA. These low profit margins were an indication that firms were maintaining their output by reducing their mark ups. Indeed, in 1970 the HVCA described the situation as one of 'cut throat' competition, which the HVCA could do nothing to prevent as any measures it could take would run counter to the Restrictive Trade Practices Acts of 1956 and 1968 (HVCA, 1971, p.7 and p.22). Intervention in the market by the HVCA had become a particularly sensitive issue.
The Registrar of Restrictive Trade Practices was investigating collusive tendering in the construction industry at that time, and having uncovered anti-competitive practices amongst electrical contractors was about to probe the heating and ventilating market (HVCA, 1971, p.24).

7.5.18 In 1971 market pressures on heating and ventilating contractors remained, with firms willing to charge extremely low prices in order to gain work (HVCA, 1972, p.8). In spite of attempts to combat rising prices, the rate of inflation continued to increase in the early 1970s. Oil prices rose four hundred per cent paving the way for other price increases. As industrial and commercial consumers switched to alternative sources of energy in the early 1970s, demand for heating and ventilating contractors remained high, although the HVCA still reported low profit margins in the sector (HVCA, 1974, p.9). These low profit margins provide evidence of a profit squeeze caused by input costs rising as full industrial capacity was approached. However, this is not to say that other factors were not also responsible for the squeeze on profits or indeed their complete erosion.

7.5.19 In 1974 the HVCA pointed out that the rise in costs due to inflation had eroded much of the profitability of many of the existing contracts. According to their costing survey firms were operating on a 2.5 per cent profit margin or mark-up in 1974, which meant that heating and ventilating contractors were often in effect trading at a loss with inflation running at over 20 per cent per annum (HVCA, 1975, p.7 and p.24). For example, any delays in payment would have eroded any real profit based on such low margins.

7.5.20 The general economic situation in 1974 declined further according to the HVCA in the aftermath of the 1973 energy crisis. A balance of payments deficit of over 6 per cent of GDP added to the gloom and lack of economic confidence. In 1974 firms were trading on low profit margins at a time of relatively high inflation and credit restrictions, which constrained demand. These conditions were seen as responsible for some of the liquidity problems faced by contractors at the time (HVCA, 1975, pp.25-6).

7.5.21 The HVCA also saw the removal of statutory prices and wage controls in July 1974 as a threat. To a large extent they were justified as basic wages rose by over 30 per cent per annum (HVCA, 1975, p.7 and p.24). The resulting economic uncertainty led to a decline in demand for construction, which also adversely affected demand for heating and ventilating. Capacity exceeded demand as firms experienced difficulties in maintaining both real prices and output. There followed efforts by government to reduce inflation, but with the upturn in demand in 1977 the rate of inflation began to rise again, with interest rates at 14 per cent and wage increases averaging 15 per cent per annum.

7.5.22 In 1980 the rate of inflation, which had been as high as 21 per cent was reduced to 14 per cent per annum. The Bank of England responded by cutting in stages the Minimum Lending Rate from 17 per cent to 12 per cent. This had the effect of reducing the exchange rate of the pound from $2.40 to $2.00, with the lagged effect of raising material prices such as copper, essential for heating and ventilating contractors (HVCA, 1981, p.8). Given the state of the construction market, higher material costs were to a great extent absorbed by heating and ventilating firms keen to obtain work in a recession. Some areas such as the South East continued to demand the services of heating and ventilating contractors, although
the HVCA again reported a squeeze on profit margins, this time caused by over-capacity in
the market (HVCA, 1981 p.8 and p.26).

7.5.23 Following the recession in the early 1980s improvements in the construction market
began to gather momentum as output recovered. Demand and tender prices increased but so
did the building costs of materials and labour. As a result profit margins in construction
remained relatively low throughout the 1980s (HVCA, 1989, p.8).

7.5.24 By 1991 many heating and ventilating contractors were reduced to finding work at
almost any price in order to survive. Like many specialists in the construction industry,
competition between them led many heating and ventilating engineers to tender at
unprofitable prices. According to the HVCA’s own state of trade survey, only 13 per cent of
respondents claimed that tender prices were viable (HVCA, 1992, p.9). Low profit margins
were sustainable only as long as output increased. If the output of contractors declined even
slightly, many firms would have found they had few cash reserves available.

Concluding remarks

7.6.1 It can be seen from the above that many factors other than cost affect the profitability
of firms in the heating and ventilating industry. Clearly the cost of labour and materials are
central in the pricing of work. However, prices in the heating and ventilating industry do not
necessarily greatly influence the aggregate level of output of this relatively small sub-sector
of the building industry. It is difficult to see what alternatives to the expertise of heating and
ventilating engineers clients could use. Plumbing firms offer a similar but more limited
service. Therefore clients would require heating and ventilating engineers regardless of
expense, provided the price was determined in a competitive environment.

7.6.2 At the same time, because heating and ventilating only represents one element of a
building, any reduction in price would not significantly increase the quantity of heating and
ventilating services used. The quantity is determined by predetermined specifications and
general construction demand, over which heating and ventilating firms have little control.
Therefore it may be assumed that the price elasticity of demand for heating and ventilating
engineering taken as a whole would tend to be relatively inelastic, though of course the price
elasticity of demand facing individual firms in competition with others is a different matter.
This implies that firms sought advantage over their competitors through price competition
but the downward pressure on prices which competition achieved did not necessarily increase
the total size of the market in real terms.

7.6.3 This chapter has thus shown that in the heating and ventilating industry:
• labour productivity increased over time,
• output grew annually until the early 1970s,
• between the early 1970s and 1996 output did not increase in real terms.
• Consequently in any given year there was a downward pressure on prices as firms
  competed to use their spare capacity.

7.6.4 The following chapter looks at the impact of over-capacity on both labour relations
and the population of firms in the heating and ventilating industry.
Chapter 8 Changes in the heating and ventilating industry labour market and the population of firms.

8.1 Introduction

8.1.1 The relationship between demand and capacity discussed in Chapter 7 manifests itself in the labour market in terms of the number of people employed, wage rates and conditions of employment. This chapter concludes the discussion of the historical context of the changes taking place in the heating and ventilating industry and considers the impact of business cycles on the heating and ventilating labour market and industrial relations. It also discusses the consequences of the business cycle on the population of firms and the implications of these changes in the population on the penetration of the heating and ventilating industry by the HVCA.

8.2 Employment relations and employment policy: an HVCA perspective

8.2.1 One sign that the business cycle was on an expansion path in 1953, was that “towards the end of the year labour conditions... became unsettled” (AHVDEE, 1954 p.42). In fact there appear to have been substantial claims for wage increases in several industries including heating and ventilating contracting and heating and ventilating component manufacturing, which were threatening to raise the costs of installing heating and ventilating systems. The rise in wages was a construction market response to an increase in the demand for technical staff which exceeded its supply. Shortages of skilled heating and ventilating draughts people also caused cost increases in terms of the delays in getting final drawings on to jobs (AHVDEE, 1954 p.44). Even at the end of the 1950s this demand for competent office personnel showed “no sign of diminishing,” (AHVDEE, 1960 p.48). The level of employment in the heating and ventilating industry remained high until the early 1970s. Thus trading conditions were becoming increasingly difficult for firms, because materials and labour costs were rising but firms were not always able to pass increases on in higher prices.

8.2.2 A number of political and economic changes around 1972 altered the economy’s relationship with the rest of the world and increased uncertainty for firms wishing to undertake investment projects, partly contributing to lower demand for construction. On January 1, 1972 Britain joined the Common Market and in June the government decided to abandon fixed exchange rates. In the same year, there were also two major strikes affecting the heating and ventilating industry. The first was the miners’ strike, which caused disruption to heating and ventilating contractors due to the three day week and power cuts. As a consequence, according to the HVCA, some firms in the heating and ventilating industry laid off workers (HVCA, 1972 p.9 and p.12).

8.2.3 The second strike was in the construction industry itself, lasting 11 weeks. This strike was blamed for a 2 per cent decline in construction output. Although the strike did not involve heating and ventilating contractors, it caused disruption to their work on those sites where strike action was taking place. However, the HVCA was able to gain the co-operation of the union in permitting heating and ventilating work to continue, provided it could be carried out without endangering lives. Low profitability of firms continued although,
according to the HVCA, orders began to increase dramatically in 1973, leading to a minor upturn in heating and ventilating output in 1974. This in turn led to severe labour shortages for heating and ventilating contractors (HVCA 1973 p.3, p.9, p.13), who employed more people in 1973 than in any other year before or after, as shown in Figure 7.4.

8.2.4 The decline in output between 1976 and 1977 led to redundancies at both operative and staff levels within firms (HVCA, 1977 p. 17). By the late 1970s and early 1980s the labour market in heating and ventilating reflected the increasing volatility of demand. This pattern continued. According to an HVCA survey 8.1 per cent of employees in the heating and ventilating industry had lost their jobs in the year up to October 1983, with further redundancies expected (HVCA, 1984 p.14).

8.2.5 By 1983 total unemployment in the UK had reached almost 3.2m people, (though the definition of unemployment had been altered with the effect of reducing the number registered as unemployed, which was the measurement then used). This high level of unemployment was one of the costs (in human terms) of the reduction in the rate of inflation from 10 down to 4 per cent per annum. At the same time annual nominal base rates were reduced to 10 per cent (HVCA 1983 p.8). In this climate of increasing unemployment in the economy as a whole, redundancies in heating and ventilating firms may have reflected the shift away from direct employment towards casual employment and labour only subcontracting rather than a drop in workload, especially as heating and ventilating output was increasing at the time.

8.2.6 Despite increased business confidence and predictions of growth in the construction industry in 1983, the survey of redundancies carried out by the HVCA (referred to above) showed that unemployment in heating and ventilating was still increasing (HVCA 1984 p.14). These redundancies did not, however, significantly reduce the capacity of the industry. As in earlier years labour shifted from direct to indirect employment. When demand increased (from 1983 onwards) the HVCA found that competition for work remained intense. This was partly due to competition from small firms and the increased use of casual labour (HVCA 1985 p.8). In order to survive firms reduced the terms and conditions of employment they offered.

8.2.7 However, total demand put to the construction industry in 1984 was rising. Demand for skilled labour increased, raising wage rates in the process as more people found work either as directly employed or self-employed labour. The proportion of labour only subcontractors compared to the total workforce continued to rise. Total unemployment in the country as a whole, however, remained stubbornly high in 1985 at 3.3 m, while those in work were able to secure pay increases above the rate of inflation. This was also the case in construction and the heating and ventilating industry for both directly and indirectly employed labour.

8.2.8 On the issue of labour only subcontracting the HVCA and the Union both still argued in 1985 that so called ‘self employment’ was a threat to themselves and their members (HVCA 1986 p.8). The HVCA argued that members had to pay increased rates making them less competitive while other firms were seen as evading tax and avoiding benefits due to employees. It is doubtful that these differences between members and non-members were in
8.2.9 Shortages of skilled operatives and staff were experienced especially in the South East, though the HVCA claimed that the heating, ventilating and refrigeration industries were less affected by shortages than were other sectors of the construction industry (HVCA 1989 p.13). Indeed this demand for labour in the South East reflected the growing divide in the labour market between the South East and the rest of the country, especially the Midlands and the North. The City of London was in the process of developing further its role as a global financial market following the ‘Big Bang’ of changes in the Stock Exchange and its methods of trading. As a result building work in the City to accommodate new information technology and new methods of dealing had expanded office construction.

8.2.10 By 1990 the upper turning point in the business cycle had been reached. Interest rates rose to over 15 per cent by the middle of 1990 and skill shortages led to high wage rates. The annual reductions in unemployment, which had been a feature of the second half of the 1980s were reversed in 1990. Nevertheless, skill shortages in industry remained a problem, causing wage rates to rise as firms competed for available skilled labour. Although the rate of growth of construction output began to slow down in 1989 and fell in 1990, it still remained at a relatively high level (HVCA 1990 p.8). Only in 1991 did total real output actually fall.

8.2.11 It is therefore not altogether surprising that the HVCA expressed concern on behalf of its members at the rise in average earnings. With labour wage rates rising but aggregate output in decline, profits were once again squeezed, as firms had to price keenly in order to compete for work.

8.2.12 Although by 1994 the industry had shown some signs of recovery, (see Figure 5.7), the HVCA was still reporting that the recession showed no signs of coming to an end. Firms were able to survive in spite of low profit margins and delayed receipts, often by resorting to redundancies, short time working and reductions in overtime (HVCA 1994 pp.3 and 4). As if to add to their trading difficulties, new health and safety regulations were introduced in March 1995, (HVCA 1995 p.11), though the additional costs of the new Construction (Design and Management) Regulations (CDM) regulations applied to all firms and could therefore more easily be passed on to clients. Although these regulations may have been perceived of as a threat to the firms, these changes represented improvements in the conditions of employment for heating and ventilating site labour.

8.3 Subcontractor relations with their workforce

8.3.1 From the 1st July 1946 entry to the industry as a craftsman required a mandatory apprenticeship. A skilled labour shortage was anticipated because of the restricted entry and because, as the Annual Report optimistically suggested, future demands on the industry would be expanding for many years (AHVDEE, 1947, p.58). The shortage of trained and skilled people, both in the office and on site remained a major problem for the heating and ventilating contractor throughout the 1950s.
8.3.2 The Council Report for 1956 noted that the permanent employment of operatives from a fixed base, entailing moving from site to site, was still far more prevalent in heating and ventilating contracting than in the rest of the building industry (AHVDEE, 1956 p.151). However, as a result one portent of changing conditions of employment emerges in the comments of one contractor in 1956, who found it was distressing to see so many of those whom he had carefully trained lured away by other firms. It did not help in the efficient execution of work when staff and work-people changed so often (AHVDEE, 1956 p.64). It would appear that there was an active labour market for skilled and qualified heating and ventilating engineers. At the same time loyalty to the firm was beginning to break down and family owned businesses were no longer able to ensure that their staffs would remain if they received better offers from competing firms.

8.3.3 Industrial relations during the period of the long boom underwent a transition from concern and co-operation to detachment and confrontation. For example, the responsibility, long accepted by employers to be in their own interests, for the training of labour began to alter. With an increasingly active heating and ventilating labour market, there existed serious disincentives for employers to train new entrants. At the end of the 1950s one contractor wrote that, the apparent reluctance of employers to safeguard their own future labour requirements by training apprentices was difficult to understand (AHVDEE, 1960 p.48). Lower levels of training imply poorer quality of work at a later date. This may have been a pattern across construction as a whole. Lansley (1987 p.149) notes that during the 1960s there was a fall in the quality of workmanship in construction which he attributes to the use of poorly understood new materials and design rigidities which permitted little scope for modification on site. However, if training was in decline at a time when construction was approaching full capacity, then it was inevitable that complaints about quality would follow.

8.3.4 While industrial relations in the heating and ventilating sector had been relatively trouble free, in 1961 and 1962 there had been an increasing number of difficulties in construction as a whole, particularly on large sites. At the time the causes of labour difficulties had been attributed by the Ministers of Labour and Public Building and Works, to the multiplicity of contractors on these large sites. The Minister of Labour favoured giving as much authority as possible for labour relations to the main contractor. In fact no analysis of the root causes of industrial unrest in the construction industry had been undertaken by government, and, according to the Annual Report, statements to the effect that labour difficulties had been due to the number of contractors and sub-contractors on many sites were apparently based on opinion and not upon fact (AHVDEE, 1963, pp.9-10)

8.3.5 The credit squeeze of the early 1960s may have lowered confidence and expectations and may have partly led to changing attitudes towards the direct employment of operatives. Contractors had tended to increase their permanent staff even if only marginally, when workloads increased, which then placed an added burden of overheads, according to one heating and ventilating contractor writing in the 1963 edition of the AHVDEE Year Book. The cost of these greater overheads could only be met with an increase in turnover. In order to obtain the necessary increase in turnover, so the argument went, profit margins needed to be cut. The conclusion drawn by the contractor was that firms needed to halt, if only temporarily, the steady rise in overheads (AHVDEE, 1963, p.37). Again in the Year Book of the following year overheads of all kinds were seen as threatening improved profitability in
spite of increased turnover (HVCA, 1964, p. 7). Thus many costs associated with labour were beginning to be seen as avoidable overheads.

8.3.6 While firms began to move from direct employment towards casualisation and wages reflecting local labour market conditions, the AHVDEE in its role as an employers' association was concerned to present an ordered agreement between employers and the unions. In a labour market completely governed by local conditions, the industrial relations role of the AHVDEE would have been much diminished. Therefore it is not surprising that according to the AHVDEE in the Annual Report for the year ending 31st March, 1963, it reported that, "the most important event of the year for the industry was the conclusion of the three year wages and hours settlement." (AHVDEE 1963, p.3). This agreement was referred to the National Incomes Commission, where it was later criticised. The Commission saw no justification for making a pay award greater than the 3-3.5% per annum counter-inflationary norm set in the Government White Paper (Cmnd 2639). The AHVDEE successfully defended the agreement on the grounds that it was necessary to attract men (sic) of the right calibre to carry out skilled work unsupervised (HVCA 1964, p.10). The agreement set a precedent for three-year wage agreements, which was to be repeated three years later in 1966.

8.3.7 Nevertheless, a new, but not unprecedented, industrial relations strategy was beginning to emerge. A split between practice by firms and HVCA policy developed. As pointed out above, directly employed operatives and staff were increasingly seen as overheads which could instead be treated as a cost of sales if they were employed on a temporary basis. Similar practices were taking place across the whole construction industry. This is not to imply that directly employed labour had always necessarily enjoyed continuity of employment. According to Somers (1995) during the 1950s and 1960s workers, including those with skills, were regularly released at the end of every job.

8.3.8 The trend towards increased casualisation may also have been reinforced by the introduction of a number of measures by government, as firms took evasive action in order to minimise the adverse impact of the legislation on their activities and profitability. The Contracts of Employment Act (1964), for example, affected employees with a minimum of 26 weeks continuous employment, working a minimum of 21 hours per week. The Act conferred a minimum period of notice and rights to minimum pay during that notice (HVCA 1964, p.16). In a further effort to improve statutory terms of employment new legislation was introduced in December 1965. The Redundancy Payments Act gave employees, who were made redundant, entitlement to compensation, if they had had at least two years of continuous employment.

8.3.9 Selective employment tax (SET) was announced in the 1966 budget, with a view to encouraging employment in export orientated industries such as manufacturing, by increasing the cost of employment in service industries and construction. The HVCA expressed serious concern that SET of 25s per week for men, 12s 6d for women and boys under 18, and 8s for girls under 18 was greater than the net profit margins, which the industry earned, according to the costing survey carried out by Tansley, Witt and Company for the Association. In the following year the Government responded by permitting price adjustments to certain public sector contracts in order to recover at least a proportion of SET levied on building contractors
Nevertheless, the HVCA saw both the Redundancy Payments Act and SET as adding to commercial pressures on heating and ventilating contractors. Coming at a time when contractors were expressing an interest in casualising labour in order to remain competitive and flexible in response to changing market conditions, both these statutes served to accelerate the move towards increased labour only subcontracting.

8.3.10 Because of the government's prices and incomes policy in 1966, the Ministry of Labour intervened in the second three-year wages agreement which had been negotiated between the employers and the unions in the heating and ventilating industry. While the first phase of this three-year agreement had been implemented as planned in 1966, the start of the second phase was deferred from February to July 1967 (HVCA 1967, p. 10). The third phase later proceeded as planned. In fact, despite the prices and incomes policy, this three year wages agreement had run so smoothly that at the end of the three year period another three year wages agreement was signed in 1969 (HVCA 1969, p. 14). The 1969 agreement introduced three new grades into the wages structure (assistant, fitter and welder) perhaps in response to the restraints of the incomes policy. Nevertheless, as the economic climate grew more uncertain with rising inflation, balance of payments difficulties, government intervention and doubts concerning future demand, the consensus and co-operation between employers and unions, which had been possible for the previous two decades was beginning to show signs of wearing thin as employers sought alternative conditions of employment.

8.3.11 Following the publication of the Phelps-Brown Report in 1968 there was an attempt to control labour only subcontracting by legislation (HVCA 1970 p. 13). In the event, the legislation was not forthcoming because of a general election and the defeat of the government. Nevertheless, the introduction of new rigidities in the general labour market particularly affected the flexibility of firms in the project orientated construction sector, including heating and ventilating contractors, with the counter-productive effect of increasing casualisation rather than diminishing it. As these measures and responses predated the recession of the early 1970s by several years, it can be argued that casualisation of the labour force in construction and heating and ventilating was further encouraged by the increased volatility of the market after 1973 but was not caused by it.

8.3.12 Indeed, these attempts to introduce greater rigidity in the formal arrangements of the heating and ventilating industry labour market may have been part of a much larger global trend, the result of a prolonged period of economic growth in most of the major economies of the world. It may be argued that pressure on profits may have restricted the ability and willingness of firms to invest and this in turn may have led to the downturn in the world economy. However, Brenner (1998 p. iii) argues against this view. He argues that this was not the cause of the ensuing global recession starting in the early 1970s, which was more to do with competition between different economies and firms and problems of international adjustment. At any rate it can be seen that these global trends were reflected even within the minute workings of the heating and ventilating industry in the UK. As the labour market in construction became more casualised, greater counter-effort was made to institutionalise the market with agreements between unions and trade associations and with government legislation until the change in government in 1979.
8.3.13 Following the Winter of Discontent from 1978 to 1979, the new government was determined to prevent a repetition. It introduced the 1980 Employment Act, which required unions to carry out secret postal ballots before taking strike action, and picketing was restricted to those employed in the work place itself. Individuals were given the right not to join a union, thus abolishing the closed shop. Finally, and most relevant for firms in the construction industry, employee protection against unfair dismissal within the first 2 years of employment was abolished in firms with fewer than 20 employees (HVCA 1981 p.14). This legislation weakened labour representation and reduced security of employment for a large percentage of the construction industry work force working in small firms on projects for short periods.

8.3.14 In 1981 unemployment rose to over 3 million, with predictable consequences in the labour market in terms of wage settlements, which declined in real terms, i.e. settling below the rate of inflation. The government’s preferred target figure of 5 to 6 per cent for wage settlements was nevertheless not achieved, although the drop in wage pressure helped to reduce the rate of inflation from 14 per cent to 10 per cent. However, international lack of confidence in the pound meant that sterling declined against the dollar from $2.00 to $1.75, although interest rates had been raised from 12 to 15 per cent (HVCA 1982 p.8). The economic crisis affecting the country was further exacerbated by the Falklands War placing further strain on financial resources.

8.3.15 Indeed, the HVCA carried out a survey of redundancies and according to that survey, 17 per cent of operatives had been laid off in 1981 (HVCA 1984 p.14). However, turnover of labour is the norm in construction industries especially in any downturn in demand. In itself this may have been a bad year in terms of redundancies and output but not as bad as implied by the survey of operatives. Output declined by only approximately 9.5 per cent in 1979 and 2.5 per cent in 1981. The HVCA also went on to report that only 2 per cent of staff (APTCs) had been made redundant since the end of 1980, which implied relative stability in output and orders (HVCA 1982 p.12). Moreover, it is not stated how many operatives were subsequently taken on as labour only subcontractors, (which was an accelerating trend in construction), or who subsequently went on to work in other firms.

8.3.16 Taking employment trends in the construction industry between 1985 and 1995, Hillebrandt et al. (1995 p.14) state that in 1985 the workforce was approximately 1.5m, rising at the end of the 1980s to 1.8m, since when the figures working in construction fell to 1.4m by 1993. It was the persistence of high levels of unemployment, which lay behind the deterioration in conditions of employment and remuneration during the 1980s only to be reinforced by the market conditions of the recession in the early 1990s.

8.3.17 This trend towards casualisation of construction labour was a reflection of employment trends in the wider economy. Coates and Hillard (1995, p7) show that casualisation and part-time work increased between 1971 and 1993 at the expense of full-time employment. In 1971, 18.3m out of a total 21.6m people (84.7 per cent) were in full time work. By 1993 these figures were reduced to 15.0m out of 20.8m people (72.1 per cent).
8.4 Changes in the organisational population of the heating and ventilating industry

8.4.1 The rise in labour only subcontracting and casualisation of the workforce was accompanied by an increase in the number of firms employing only 1 to 3 persons as was illustrated in Figure 7.3. This showed a threefold increase in the number of heating and ventilating firms from 2,900 in 1977 to 9,600 in 1990 due almost entirely to the increase in the number of firms in the smallest categories. This pattern of company formation was reflected in construction as a whole, which also showed a threefold increase from 78,000 firms in 1977 to 210,000 in 1990. In spite of the expansion in the number of firms after 1977, the increase in the number of insolvencies per year in construction did not begin until 1981, reaching a peak in 1990, as shown in Figure 8.1.

Table 8.1 Personal bankruptcies and company liquidations in construction 1968-1997

<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>1972</td>
<td>1091</td>
<td>1987</td>
<td>1123</td>
<td>1972</td>
<td>518</td>
<td>1987</td>
<td>1490</td>
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<td>1975</td>
<td>1543</td>
<td>1990</td>
<td>2347</td>
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<td>956</td>
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<td>1979</td>
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<td>3362</td>
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<td>1994</td>
<td>2401</td>
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<tr>
<td>1982</td>
<td>968</td>
<td>1997</td>
<td>2182</td>
<td>1982</td>
<td>1422</td>
<td>1997</td>
<td>1419</td>
</tr>
</tbody>
</table>

Source: Department of Trade and Industry.
8.4.2 Gray and Flanagan (1989 p.19) show the number of self employed bankruptcies in construction as a whole in England and Wales for the period from 1977 to 1987. Table 8.1 and Figure 8.1 show an extended version of the same series from 1968 to 1997. It appears from Figures 8.1 that the annual number of bankruptcies of self-employed rose steadily from 1986 to 1992 whereas company liquidations declined between 1986 and 1988 before rising to a peak in 1992. In the 1990s both liquidations and bankruptcies show a downward trend. The peak years for construction company insolvencies were 1970, 1977, 1985 and 1992.

8.4.3 In order to relate annual bankruptcies and insolvencies to the level of output of the construction industry all three series were indexed in Figure 8.1. In general there appears to be a time lag between the peak years of construction output and the peak years of bankruptcies and insolvencies, the time lag being in the region of two to four years. This could be explained in terms of Sherman’s nutcracker theory (see Chapter 10). The peak years of construction output are, according to Sherman (1991) crisis years in which profits are squeezed. Following the crisis firms and self employed individuals manage to survive a number of months or years before finally being declared insolvent or bankrupt respectively.

8.4.4 Table 8.1 records the number of firms leaving the construction industry due to bankruptcy or liquidation. It does not give the inward flow of new entrants. Although there is no official annual record of new firms entering the heating and ventilating industry, a record of firms entering and leaving the HVCA is given in Figure 8.2. In the ‘crisis’ years (by number of liquidations) of 1970 and 1977 the number of new members exceeded the number of losses and output in the industry actually increased. In 1985 new members and losses were almost balanced while heating and ventilating output increased. In 1992 the recession in heating and ventilating output caused losses in membership which exceeded the number of new members joining the HVCA.

**Figure 8.1 Indices of construction output, bankruptcies and insolvencies 1969-1997, 1995 = 100**

![Figure 8.1 Indices of construction output, bankruptcies and insolvencies 1969-1997, 1995 = 100](image-url)

Source: Department of Trade and Industry.
8.4.5 Figure 8.2 shows that annual new members outnumbered membership losses until 1982, with the result that until 1982 the HVCA was able to expand every year. Since 1983 the position became less predictable, with the largest downturn in membership occurring between 1991 and 1994. Membership reached a peak of 1,211 in 1981 and then declined to 1,155 in 1987 (a drop of 5 per cent) before recovering. Again in the recession of the early 1990s, membership peaked at 1,285 members in 1991 and declined to 1,087 in 1994 (a drop of 15 per cent).

8.4.6 Several new firms joining the HVCA in 1963 were supply and fix contracting subsidiaries owned by manufacturers (HVCA, 1965 p.4). This example of vertically integrated firms joining the heating and ventilating market formed part of the transition from an industry dominated by family run firms with roots in heating and ventilating to an industry whose largest firms were mostly subsidiaries, a transition completed by the end of the 1990s.

8.4.7 In the early 1970s, the combination of relatively low prices and rising costs made it almost inevitable that there would be a cluster of business failures in the heating and ventilating industry. In the event, the collapse of many firms was delayed until 1973 and 1974, when the HVCA declared that the year was “one of the most difficult ever encountered.” (HVCA, 1974, p.3).

*Figure 8.2 Annual HVCA membership, gains and losses 1962-1997*

Sources: Reports of the Council of the HVCA, Annual.

8.4.8 The drop in demand in the recession at the beginning of the 1980s led to company failures especially amongst specialist engineering contractors, who the HVCA claimed suffered more than general builders (HVCA 1982 p.28). However, firms which experience
trading difficulties do not necessarily cease trading immediately but instead attempt to keep afloat by using a number of delaying tactics in the belief they may weather the financial storm. Hence, although demand increased in 1982, a record number of HVCA members were forced into bankruptcy or ceased trading, because of cash flow difficulties first incurred in earlier years (HVCA 1984 p.8).

8.4.9 The HVCA referred to the number of insolvencies of main contractors in 1990, which had a domino effect on many subcontractors, when payments for work done were not forthcoming. Indeed by 1991 the situation facing members of the HVCA had become so serious that the President of the Association wrote in the 1992 Annual Report;

"I do not wish to dwell on the bad news... but it has been tragic to see so many previously successful and long established companies being driven out of business during the present recession. Now, more than ever the name of the game is 'survival'." (Heating and Ventilating Contractors’ Association Annual Report, 1992 p.2).

8.4.10 Indeed, there had been a decline in the number of members of the HVCA since 1991 when the Association had reported a membership of 1,285 firms. By 1993 membership numbers had dropped to 1,116, a reduction of 13 per cent over two years. Even this rate of decline understated the problems facing members of the HVCA. The drop in membership measures the net effect on membership after new members joining had replaced some of those leaving. In fact in 1993 alone, 224 firms (or 18 per cent of the existing membership) had ceased to be members of the HVCA for one reason or another. 99 had ceased to exist, 9 had left the industry and 116 had left the HVCA but not the industry, having merged or been taken over (HVCA 1993 p.15). However, from Table 8.2, membership numbers recovered between 1994 and 1997, from a low point of 1,087 membership grew to 1,222 by 1997. Nevertheless, between 1994 and 1997, the HVCA lost 304 members or 28 per cent of the 1994 membership.

Table 8.2 Annual HVCA membership, gains and losses 1990-1997

<table>
<thead>
<tr>
<th>Year</th>
<th>Membership</th>
<th>New members</th>
<th>Total losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>1277</td>
<td>118</td>
<td>80</td>
</tr>
<tr>
<td>1991</td>
<td>1285</td>
<td>120</td>
<td>112</td>
</tr>
<tr>
<td>1992</td>
<td>1237</td>
<td>142</td>
<td>190</td>
</tr>
<tr>
<td>1993</td>
<td>1116</td>
<td>103</td>
<td>224</td>
</tr>
<tr>
<td>1994</td>
<td>1087</td>
<td>111</td>
<td>140</td>
</tr>
<tr>
<td>1995</td>
<td>1167</td>
<td>168</td>
<td>88</td>
</tr>
<tr>
<td>1996</td>
<td>1160</td>
<td>108</td>
<td>115</td>
</tr>
<tr>
<td>1997</td>
<td>1222</td>
<td>162</td>
<td>101</td>
</tr>
</tbody>
</table>

8.4.11 While the number of firms continued to increase in the heating and ventilating industry, they tended to be much smaller (according to Figure 7.3) and presumably less concerned with formal membership of establishment organisations, such as the HVCA, reflecting the increased casualisation of the construction process since the late 1970s. Thus in spite of the increase in the number of firms in the heating and ventilating industry as illustrated in Figure 8.3, the trend of the actual number of new members electing to join the HVCA each year remained approximately the same. Although the HVCA represented a diminishing proportion of all heating and ventilating firms it remained representative of the firms which produced the bulk of its output, those firms employing 4 or more people.

Figure 8.3 Heating and ventilating contractors and HVCA membership 1948-1998

Sources: Reports of the Council of the HVCA, Annual.
Private Contractors Construction Census, Annual

8.4.12 The penetration of the population of these larger firms by the HVCA is given in Figure 8.4, which shows the annual membership of the HVCA as a percentage of firms employing 4 or more people and 8 or more people. This shows an increasing penetration over time of the population of heating and ventilating firms employing 4 or more people. Indeed by the late 1990s the number of firms who were members of the HVCA exceeded the number of firms employing 8 or more people by a factor of almost 2.

8.4.13 Although aggregate turnover data is not available for the period prior to 1987, it is clear from Figure 8.5 that although the proportion of heating and ventilating firms represented by the HVCA fell from just over 65 per cent in 1960 to around 13 per cent in 1984, the share of output between 1987 and 1996 varied between just over 70 per cent and almost 95 per cent. This reflects the fact that the great majority of new firms only employed one person, many of whom would have perceived little advantage in joining the HVCA.
Figure 8.4 Ratios of HVCA members to all heating and ventilating firms with 4 or more employees and 8 or more employees 1973 to 1997

Sources: Private Contractors Census, Table 3.6, Housing and Construction Statistics, Annual HVCA Annual Reports

Figure 8.5 HVCA members as a percentage of all heating and ventilating firms 1948-1996 and aggregate HVCA members’ output as a percentage of all heating and ventilating output 1987-1996

8.5 Concluding remarks

8.5.1 There is understandably and almost inevitably a degree of partisan analysis on the part of the HVCA given in their Annual Reports. They clearly favoured policies they saw as benefitting their members and the HVCA. Such policies called for fewer restrictions and regulations on working practices, less interference in the economy in general, but more intervention to maintain steady demand for construction and more protection of the subcontractors in their conflicts with main contractors. There was a period in the 1960s when co-operation with the union side appeared genuine and the perception of the HVCA towards industrial relations was that it was important to value the contribution of the workforce, their welfare and training. With the changes in the market in the 1970s the HVCA attitude to industrial relations appeared to harden as firms responded to increased market volatility by increasing the amount of casual employment. However, the move towards increased casualisation had already begun in the 1960s as a result of both a shift in attitudes towards the indirect employment of labour and in response to government intervention in the labour market.

8.5.2 While profit margins frequently came under pressure according to the HVCA, the options available to firms as far as material and component inputs were concerned were very limited and to a large extent outside the control of individual firms, who were not themselves manufacturers. These options consisted of changes in materials, technological innovations, and changes in standard specifications. However, even most of these developments were outside the direct control of individual firms. The other option open to firms was to control their labour costs and this was achieved in a number of ways with short term advantages but with lasting implications for the skill level of the workforce and the development of the industry.

8.5.3 Another consequence of the increase in casualisation and subcontracting was the increase in the number of very small firms in the heating and ventilating industry after 1977. This reduced the crude percentage of all firms, which were members of the HVCA. Compared to the relatively small number of larger firms in the industry, the number of HVCA members appears to represent the majority of firms employing 4 or more people. However, it does not follow that a high proportion of the larger firms are necessarily members of the HVCA, in view of the predominance of very small firms, many of whom are also members. Nevertheless, because a high proportion of turnover is attributable to members of the HVCA, making the HVCA representative of a significant proportion of the largest firms in the heating and ventilating industry.

8.5.4 In considering industrial relations in the heating and ventilating industry a number of propositions formed the underlying economic framework of this chapter. These propositions were:

- just as it was in the rest of the construction sector after the 1970s, labour was increasingly casualised in the heating and ventilating industry. However, the degree of casualisation in the heating and ventilating industry was not necessarily adopted to the same extent as in other parts of the construction industry because of the cost of training and output quality required (HVCA interview).
since the end of the Long Boom, firms responded to pressure by passing risks due to low profit margins on to labour in order to survive
heating and ventilating wages and conditions are influenced by construction industry wages and conditions though not necessarily in all respects. For example, while the construction industry adopts a low wage rate with high bonuses, the heating and ventilating industry has tended to follow a high basic wage rate with relatively low bonuses (HVCA interview).
heating and ventilating wages are also determined by the labour market at large, heating and ventilating being only a small sector of the labour market, with skilled labour able to migrate out of building services into many other engineering and non-engineering markets
heating and ventilating firms have tended to resist improvements in relative pay and conditions especially since the late 1970s. Nevertheless, one example of an improvement in working conditions was the increase in sick pay. However, the funding for this improvement was obtained by transfers from the industry wide contributory holiday pay fund (HVCA interview). Although the transfers reduced the net gain of increased sick pay to employees when the increase in sick pay was introduced, the introduction of working time regulations in the late 1990s increased employers' contributions to the holiday pay fund as fewer hours are permitted by the new regulations (HVCA interview). Such improvements only benefitted directly employed workers.
industrial relations became more confrontational since the volatility in the heating and ventilating market increased after the early 1970s
unions' ability to act effectively in the heating and ventilating industry on behalf of their members as a whole but not necessarily on behalf of individual members has been eroded since the early 1980s. However, (according to the HVCA interview) in the late 1990s there was a noticeable change in the balance of the weightings or representation in employment relations negotiations in favour of the union side.

8.5.5 The historical factors which have been discussed in Part 3 of this thesis have illustrated many of the contingent causes of the development of the heating and ventilating industry in the latter half of the twentieth century. Part 4 considers some of the theoretical elements which have also contributed to the process of change which has taken place.
Part 4  Literature review

The theoretical issues
Chapter 9 The strategic options of heating and ventilating engineers.

9.1 Introduction

9.1.1 Having discussed in previous chapters various aspects of the business environment in which heating and ventilating contractors operate, this chapter looks at the range of responses to the conditions they face in terms of their strategic planning. It has long been argued that the ability of firms to respond to their environment is critically important for their survival (Burns and Stalker, 1961, Sadler and Barry, 1970, Lansley, 1987, p.142).

9.1.2 Hannan and Carroll (1992, p.13) observe that in many markets the number of firms grows rapidly, then slowly and peaks. The population density then declines but eventually stabilises. This general pattern of growth and decline is caused by the introduction and then aging of technologies. At first new firms enter to take advantage of the new techniques but as the technology ages some firms are forced out of the market and the mortality rate increases. They suggest that as organisational populations grow, the level of competitiveness grows even faster (Hannan and Carroll, 1992, p.16). As more firms join a market, eventually competition between firms intensifies as the addition of each new firm adversely affects the sales of one or more incumbent firms. Consequently they suggest a number of propositions, including:

- the founding rate of an organisational population in any year is inversely proportional to the intensity of competition (Hannan and Carroll, 1992, p.31). Thus, some potential new entrants may be deterred from entering the market by raised levels of competition. Consequently the proportion of new entrants to existing firms declines during periods of competition when profitability is reduced.
- the mortality rate of firms in any given year is directly proportional to the intensity of competition (Hannan and Carroll, 1992, p.31)
- the mortality rate of firms founded in any given year is directly proportional to the intensity of competition in the year of founding.

9.1.3 They argue in line with Stinchcombe (1965) that firms founded during periods of intense competition tend to perform less well than firms formed at other times, because the staff of these firms have little incentive to develop skills needed for long term survival (Hannan and Carroll, 1992 p32). The main concern of firms is surviving in the short term and their ability to compete in the long run is impaired through a lack of organisational routines such as planning, marketing policies and approaches to innovation.

9.1.4 In Chapter 1 heating and ventilating contractors, were seen as specialist or subcontractors to the main contractors of the building industry. Their capital asset structures and employment policies together with their perceived opportunities for marketing, investment and growth are all constrained by their business environment and their need to be competitive. This chapter considers how firms in heating and ventilating may respond to these competitive pressures and which strategies they adopt.

9.1.5 The purpose of this chapter is to demonstrate that a number of strategic options are open to heating and ventilating firms as specialist engineers and subcontractors in the construction industry. However, these strategies are basically concerned with growth and
survival of the firm. This chapter therefore places growth and survival strategies in the context of the wider variety of strategies open to firms.

9.1.6 Lansley (1987, pp.142-3) argues that firms' responses may be operational, competitive or strategic. Which response is most appropriate depends on the business environment at the time. Under conditions of relative stability, operational changes are appropriate when firms concentrate on procedures without affecting the relationship between the firm and its environment. At other times competitive changes, which do alter the relationship between the firm and its environment, may be appropriate and in aggregate such changes affect the structure of the industry. Firms need to respond to changed market conditions, if they are to remain competitive and survive. They have to adopt new practices (such as labour only subcontracting) or technologies (such as the Internet). Finally Lansley defines strategic changes as those changes which are not gradual but involve changes in direction such as new products, services or markets which move the firm into new areas of activity.

9.1.7 Consistent with the heating and ventilating and the construction industry output data discussed in Chapter 5, in the period between 1950 and 1973, Lansley argues (from the perspective of main contractors) that firms faced a long relatively steady period of growth. In that period firms could concentrate on their efficiency by reviewing their internal procedures and could introduce strategic changes in a controlled and planned manner. When the construction market became more volatile in the period after 1974 firms needed to adopt more flexible approaches in order to survive. This led them to increase their use of plant hire, subcontracting and labour only subcontractors. Lansley (1987, p.147) states that a people-orientated approach (including training) might be needed to replace a task-orientated approach under conditions of uncertainty in order to retain and motivate individuals. However, he does not comment on the extent to which this occurred after 1974. Indeed, given the evidence of the HVCA Annual Reports discussed in Chapter 8, with the rise in subcontracted labour, if anything there was less emphasis on the development of the workforce in construction in the period after 1974 than in the period before.

9.1.8 Given that the appropriateness of particular strategies varies over time, there is a problem of defining the term, 'strategy'. Although Glueck (1980 p.9) saw firms' 'strategies' in terms of co-ordinated plans related to their aims, the problem with any discussion on strategic planning concerns the difficulty of defining the term 'strategy' itself, when conditions are continually changing. To Mintzberg and Quinn (1991, p.4) 'strategy' may refer to plans, patterns, positions or perspectives, which may be deliberate and ex ante, or may emerge with the passage of time ex post, without being formulated as such. Indeed they argue that in order to study firms' actual emergent strategies one must study their patterns of aims and operant policies over time (ibid. p.6). As patterns or plans, strategies integrate aims with actions necessary for their achievement, by taking available resources into account. To Mintzberg and Quinn strategies direct the firm given that it operates in an uncertain and changing environment. Decisions are strategic where they relate to longer term plans, which state aims or objectives, rather than simply responding to current events in order to survive.

9.1.9 Some of the implications of the business cycle for firms engaged in strategic planning involve the need for a sensitive approach to planning which takes the particular phase of the
business cycle at any time into account. Different strategic options are required in response to different phases of the cycle. Indeed, Lansley (1987, p. 144) asserts that the three broad periods since 1950 (see Paragraph 4.1.5) each had distinct environments, (what Gruneberg and Ive (2000) refer to as social structures of accumulation) which had different implications for firms’ strategies and survival. This chapter seeks to provide the theoretical framework firms in heating and ventilating engineering require in order to plan their growth and survival. By adopting a behaviouralist approach to decision making, similar to Cyert and March (1992) which recognises the firm as a coalition of interests, this chapter shows that firms are propelled into a growth strategy in order to survive.

9.2 The strategic decision making process

9.2.1 Cyert and March (1992, p.118) characterise the firm as a coalition of diverse subgroups, in which decisions are taken by various people, representing different functions and responsibilities, and at different levels within the firm. While this may very well describe the structure of large firms, the majority of heating and ventilating contractors are small and medium sized enterprises in which one or two individuals undertake all the management responsibilities, employing a small number of operatives either directly or on a casual basis.

9.2.2 Cyert and March go on to describe their decision model in terms of a system involving the firm and its interaction with its business environment. States of the system in one period of time then move to a new state in the next period as a result of external shocks and decisions taken by the firm. Periods are thus seen as discrete rather than continuous, static rather than dynamic. This over-simplifies the ever changing nature of all the variables in the business environment. Changes in technology, the entry of new firms, and changes in the level of demand all affect decisions and occur at different times. However, Cyert and March emphasise the unpredictable instability of the system and therefore focus on the short term reactions of firms as they adapt from one period to the next. The long run implications of their decision making model, which assumes stable conditions, is relevant only in terms of logical general concepts discussed below, rather than describing the actual behaviour of firms.

9.2.3 Similarly, in their systems approach to construction firms, Newcombe, Langford and Fellows (1990, p.8) describe construction firms as “open systems” interacting with their environment. As long as the outputs are greater than the inputs into the system, firms create reserves of excess resources, which enable them to survive crises. They argue that by investing in capital and resources, construction firms actively aim to increase their spare capacity in order to avoid organisational entropy, the process of disintegration and the eventual ceasing of trade. While Newcombe et al. describe the aims of firms in management terms, a similar argument (discussed below) is developed in economic terms by Penrose (1959) and Wood (1975).

9.2.4 However, while Newcombe et al. describe a pro-active approach, the behavioural approach to decision making of Cyert and March (1992, p.121) assumes that firms attempt to deal with uncertainty by reacting to feedback rather than by forecasting changes in the
market. Moreover, they assume that firms use rules of thumb to make decisions. These heuristic decision rules are of course used against the background of the economy, and take into account sociological, technological, and political factors as well as economic conditions.

9.2.5 For instance demographic changes and the rate of household formation combined with rising incomes have increased demand for housing. This increase in the demand for housing may induce some heating and ventilating firms to increase their marketing effort in terms of domestic home heating and/or increase their margins on domestic heating systems and installations as soon as they see opportunities to do so. Other factors influence the production, pricing and employment decisions of firms. Such factors include health and safety, income tax, and employment legislation emanating from both Westminster and the European Union in Brussels. In the main this thesis views such changes as exogenous economic shocks. Instead, this chapter looks at the aims and strategies of firms based on the combined theoretical approaches given by Cyert and March (1992), Penrose (1959) and Wood (1975).

9.2.6 The behaviour of firms can be characterised as having passive as well as active features depending on circumstances. Hay and Morris (1991, p.21) describe the passive and active behaviour of firms. Passive behaviour denotes a firm setting its price in the pursuit of maximum profits given the constraints set by the market. Eventually, if profits decline the passive firm would accept its position and leave the market. In contrast, active behaviour leads firms to try to shape their own future, removing constraints where possible, through, for example, diversification, merger and take-over.

9.2.7 Because of the need for survival in the short term in a hostile construction industry environment, where contractors view each other as protagonists, firms tend to behave passively in the short run as in the Hay and Morris model. However, because of the difficulty of removing uncertainty even in the long run in the construction market an active strategy of planned investment, technical development and acquisition, as in Hay and Morris, assumes a greater degree of forethought and control over operations than is usual in construction. Rather, one would expect the strategies of firms in construction to emerge as a pattern of unplanned diversification and merger activity ex post as described by Mintzberg and Quinn above.

9.3 The strategic aims of firms

9.3.1 The particular aims and strategies of firms depend on the time frame being considered. In the long run it may be possible to say what the aims of the firm are and the decisions needed to meet these objectives. The long term here may be assumed to be anything from three years and over. In the shorter term especially one year or less, the aims of firms and their decisions are determined more by events. Longer term objectives may be concerned with size and growth, areas of activity, new markets and technological developments, and such aims require strategic decisions to be made, including investment decisions involving planning and setting targets. Indeed it may be that strategic decisions may on occasion need to be made that involve disinvestment and negative growth. In the shorter term firms may be more concerned with current cash flows, completing projects on time and to budget, finding new work and managing the workforce. These aims require
operational decisions, which tend to be responsive to current trading conditions, and may be concerned with the survival of the firm.

9.3.2 Kast and Rosenzweig (1985, p.179) use the term ‘the goals of a firm’ as an inclusive label to describe aims, objectives and targets. Indeed the overall purpose of a firm may be defined by its goals such as the production of cars. For heating and ventilating contractors the overall purpose is to provide and install heating, cooling or refrigeration equipment and ventilating plant in existing buildings or ones under construction. Indeed the formal goals of heating and ventilating firms may be taken as the terms stated in their Memoranda of Association which limited companies are obliged to provide and register in Companies House.

9.3.3 However, to understand why firms operate and take decisions, broadly defined (though functionally specific) goals can be divided into not-necessarily measurable aims and narrow measurable objectives. Although this distinction is not drawn by Drucker (1954, p.63), for example, he refers to management by objectives in terms of productivity (measurable), physical and financial resources (measurable), profitability (measurable) and in terms of public responsibility (not measurable), manager performance and development (measurable and not measurable respectively) and worker performance and attitude (measurable and not measurable respectively). Nevertheless for the purpose of clarity of exposition a distinction between aims and measurable objectives will be used here. Thus while aims may include objectives, not all aims are objectives, only those that are measurable.

9.3.4 In Newcombe, Langford and Fellows (1990, pp.62-3), Grinyer (1972) identifies a number of the aims of construction firms. These aims are both economic and non-economic in nature. The non-economic objectives of construction firms according to Grinyer are:
• internal political (referring to the continuing control by the existing owners or board)
• the avoidance of governmental intervention
• meeting the aspirations of employees and developing them
• serving clients, and
• gaining a good reputation for the firm.

9.3.5 These non-economic aims may have been stated in response to a questionnaire but that does not mean they are necessarily consistent. For example, the gaining of a good reputation may be desirable for those who identify themselves with the firm. It may also confer on them a certain status. However, for the firm to seek a good reputation at the expense of profitability could spell the end of its survival as an independent entity. Such was the fate of Rolls Royce and indeed (as will be shown in Chapter 15) the majority of large firms in the heating and ventilating industry, although the causes of failure vary from firm to firm. It should also be noted in the list above, the relatively low priority given to serving clients. If firms fail to be seen as serving their clients, marketing difficulties must ensue as well as payment difficulties if clients feel their interests or expectations have not been fully met. Finally, the stated aim of meeting the aspirations of employees and developing them would hardly be borne out by the growth of labour only subcontracting. The casualisation of the work force was necessitated by the need to be flexible in response to changing market conditions in construction after the 1973 crisis. According to Grinyer, firms also seek
flexibility in order to be able to respond to unforeseen circumstances. For example, they may aim to have sufficient management available to respond to unexpected opportunities, which arise. Moreover to meet the need to cope with unexpected orders they may also aim to hold sufficient current assets in reserve.

9.3.6 Grinyer relates the economic aims of a firm to its market strength, financial efficiency and ability to respond to uncertainty. In terms of competitive strength Grinyer points out that firms seek growth of turnover, earnings and market share. These may be defined as objectives. Certain accounting ratios may be used to measure financial efficiency including profit margins, the asset utilisation ratio and the return on capital employed. Presumably, one of the implicit (if not explicit) objectives of firms is to improve these ratios or to maintain them at or above the sector average. Firms then choose strategic options as a means of achieving these objectives.

9.3.7 While Grinyer’s aims may appear to be the aims of the managers of firms, they appear to be concerned with the strategies and criteria used rather than with the primary task, which is the functional purpose of any organisation. It could be suggested that the primary task for heating and ventilating firms is the provision of the heating and ventilating systems and their technically successful installation and functioning in situ at a price and volume which enables the firm to survive by satisfying its clients.

9.4 Growth as a strategic option

9.4.1 In Penrose (1959) and Wood (1975) the main aim of most firms is to cause their sales to grow. According to Penrose, firms need to expand in order to survive, survival being defined as the continued employment of resources at or above the current level. When firms fail to expand they may enter crises, resulting in a contraction of the scale of production and redundancies. Penrose (1959, p.38) sees the growth of firms as a function of entrepreneurial management. A shortage of capital is seen as a sign of poor management and a failure to ‘keep up the rate of net investment required’ to enable the firm to grow.

9.4.2 The premise that firms seek growth also forms the basis of Wood’s theory of profits. If firms wish to expand they need to increase their productive capacity and in order to increase their capacity they need to invest. Finance for investment purposes comes largely from retained profits. Therefore, firms must plan their strategies such that their profits are sufficiently high to provide the proportion of their investment plans which are required to be internally funded. Thus a given percentage of investment funding is derived from retained profits while the rest must come from borrowing or share issues.

9.4.3 The question is how typical in this respect are subcontractors as a species of firm compared to other industrial and commercial organisations? It is likely that plant hire, casual employment, and discontinuity of work affect the willingness of subcontractors to invest in capital equipment or even plan their sales and profit margins in the strategic manner suggested by Wood, even though contractors in the construction industry require increasing amounts of working capital and resources if they are to meet their increasing needs for liquid assets in advance of their expansion. Moreover, in spite of the uncertainty involved, subcontractors are often employed on the basis of supplying specialist plant and labour,
which requires a certain level of fixed capital investment. The use of specialist subcontractors reduces the down time of equipment so that less discontinuity of use of equipment means a greater willingness to invest in plant by construction subcontractors compared to main contractors, although not as great a use of capital per head as in many other industrial sectors. Nevertheless, as a result of investment and specialisation, the productivity of some subcontractors compared to general contractors remains high in spite of differences in size, which would normally favour the larger firms (Powell, 1996, p.178). It might also be added, that productivity per person in some specialist contractors is relatively high in spite of the higher value adding management activities of main contractors compared to specialist firms.

9.4.4 Wood (1975, p.32) argues that the more volatile a firm's profits, the lower its planned gearing ratio. He predicts that in industries such as capital goods industries, gearing will tend to be lower than for consumer goods industries. Construction is of course a capital goods industry. Its method of funding work with interim payments, the frequency of delayed payments, the provision of short term credit for materials and the frequently low capital equipment requirements of firms may tend to produce relatively low levels of gearing, even for an industry in the capital goods sector, though this will vary depending on the type of contractor and specialism.

9.4.5 The requirement for investment funding may turn out to be so low or so ad hoc that the link with past profits may be broken as other objectives and methods of working peculiar to contracting take precedence. Indeed, the idea that contractors in construction can determine their output in advance in the way managers do in other sectors, even other capital goods sectors, may be misleading.

9.4.6 It may well be that firms in construction adopt a responsive approach after obtaining work, in that resources are only mobilised after tenders have been won. Even if the managers in contracting firms wish to expand their sales, they cannot plan ex ante the purchase of equipment which might be surplus to requirements, especially as profit margins in construction simply do not allow for major errors in capital spending. As a result, capital spending is restricted to actual project requirements, when the cheapest method for obtaining plant in the short term is plant hire, even though in the long run it may turn out ex post to have been more expensive over several projects. The risk of doing otherwise simply deters management.

9.4.7 In tandem with Wood (1975), Penrose (1959) also argues that firms seek to grow, but as they grow their very nature changes. This also occurs in construction as firms not only grow but alter their role within the building project. Thus, firms may take on additional roles, subcontracting work, and expanding into purely management functions, diversifying and merging with other firms in their efforts to expand and improve their market position. In heating and ventilating, many firms have expanded into design as well as providing their traditional services of installing equipment. In this way they have sought to professionalise their role in the construction process. According to Penrose, the major constraint on the rate of expansion of firms is the management services provided by the few people willing and able to undertake expansion plans.
9.4.8 Other constraints on the strategies open to heating and ventilating contractors include low levels of profitability in the initial phase when firms enter the market. One consequence of low profit margins associated with the construction sector is the difficulty of borrowing from banks and thereby obtaining a sufficient gearing ratio to allow for investment and growth, partly funded by external finance. Another constraint on heating and ventilating firms seeking to follow a growth strategy is the low price elasticity of demand for heating and ventilating services in aggregate. This means that the market is not responsive to price reductions for heating and ventilating services thus preventing growth of a firm by lowering its competitive price except at the expense of a competitor. Firstly, after a firm has won a tender for work it has little incentive to reduce its price in order to increase the size of job to its advantage. Post tender variations are not likely to be influenced greatly by keenly priced heating and ventilating packages, which may only form a relatively small building element. Secondly, in order to grow firms need to find alternatives to lower prices, which only force other firms to reduce their prices without any increase in the size of the market. One alternative available to firms comes in the form of new products, which often reduce the costs of installation as new technologies replace older more labour intensive methods. In any case as small and medium sized enterprises, heating and ventilating firms are often too small to invest in any research and development of their own. Instead, they rely on component manufacturers to supply them with new products with increased value added embedded in the component. This enables firms to offer the same heating and ventilating service at a reduced price or an increased service at the same price in order to be competitive.

9.4.9 In the conventional economics of the firm, firms have an incentive to grow in order to utilise their resources fully to take advantage of economies of scale. However, this neoclassical approach is only applicable to one-product firms, which have control over the level of output they produce. In multi-product firms economies of scope create the conditions necessary for expansion.

9.4.10 Penrose (1959, pp. 98-9) argues that there is no maximum size of a company due to diseconomies of scale as diseconomies of scale refer to product lines only. The size of a firm is limited if it is incapable of altering its management structure. Her model of the growth of firms applies to those firms able to make decisions about output, products and markets. In construction, however, firms are not in a position to plan these. Firms, especially subcontractors can only respond to demand put to them and therefore production is largely client led rather than producer led. Contractors therefore always have unavoidable wastage adding to their overheads. As a result, subcontracting, plant hire and casual employment are used to minimise costs to main contractors during a project.

9.4.11 For the more complex case of multi-product firms and firms, (such as heating and ventilating contractors), which do not have complete control over their output decisions, Penrose, (1959, pp. 68-70) suggests the impetus for firms to expand comes from the indivisibility of resources. Assuming constant costs, the lowest cost output occurs at the lowest common multiple of the outputs of all resources taken together. Thus, if all plant and labour in a firm are fully occupied the output may be greater than the firm can sell. If the firm can only sell a proportion of full capacity output, then some plant or labour will be idle for some of the time.
9.4.12 The firm must then use its under-used capacity by diversifying into new markets with new products or services. The spare capacity is therefore an opportunity to expand by using resources at no opportunity cost. Otherwise that spare capacity is a burden to be carried by those resources actually used productively, and this burden only adds to the firm’s overhead costs of production.

9.4.13 Although Penrose recognises that there may be some examples where diversification is likely to be less efficient than specialisation, she does not accept this to be generally the case. Otherwise firms in general would not expand and diversify in the manner described above. Nevertheless she notes that as industries develop firms increasingly specialise in fewer lines of production. Presumably, construction would be a good example of such an industry, (see Table 10.2), and heating and ventilating as an example of such specialisation.

9.4.14 In fact, according to Penrose (1959, pp. 72-3), firms always have spare capacity in the form of under-used resources. They therefore tend to expand by diversifying in order to use the specialist skills, plant and equipment surplus to the current requirements for a given product or service. This is the essence of the term ‘economies of scope’. When firms diversify they enter new markets and expand in new directions, but the same problem of the lowest common multiple constantly reappears, with some other new additional resource now underutilised. And so the incentive to expand remains and is ever present, even during recessions. In the heating and ventilating industry, contractors have diversified into refrigeration and air conditioning and servicing as well as electrical contracting.

9.4.15 Penrose (1959, p. 229) refers to *interstices* as those opportunities left to smaller firms by larger firms. In construction, the largest firms allow subcontractors to undertake work on their behalf since it enables the main contractors to spread risk, cut down on overheads and increase their flexibility to respond to fluctuating demand. This view is reinforced by Hughes, Gray and Murdoch (1997), Lansley (1987) and Constantino et al. (2001). Lansley (1987, p.149), for example, sees subcontracting as having advantages for both subcontractors and main contractors faced with the problem of unpredictable demand. For the specialist firm subcontract work enables it and its skilled workers to move between several projects in the same period. For main contractors subcontracting provides the ability to use specialists as and when required without the burden of the costs of employing them when there is no work available.

9.4.16 However, this is only one point of view even within main contractors, namely the point of view of those at the corporate level. For those managing on site, Lansley points out that there are disadvantages of employing different subcontractors to carry out work packages. These disadvantages include additional management problems, delays and increased transaction costs. While Constantino et al. (2001, p.444) find similar arguments in their survey of housebuilders and commercial construction in the US in favour of subcontracting, they point out the tautological argument that although firms do not in general measure transaction costs as such, firms assume subcontracting is justified. The continued use of subcontracting suggests the associated transaction costs are lower than the costs incurred by those firms carrying out work using directly employed labour. Firms adopt subcontracting because it is cheaper than employing people directly and it is cheaper because
they would not otherwise adopt subcontracting. It is, however, argued below that subcontracting does not necessarily reduce transaction costs.

9.5 The business context of subcontractors’ strategies

9.5.1 Main contractors, many of which are themselves small enterprises, may have much in common with subcontractors, while many specialist firms are medium or large concerns. However, this research highlights a number of differences between main contractors and subcontractors in general and heating and ventilating contractors in particular. These differences include:

- Subcontractors are located mainly at the interface between component manufacturers and construction, whereas main contractors are by and large located at the interface between construction and employers.
- Subcontractors are therefore also at a greater distance from clients or architects than are the main contractors. This factor adds obstacles and barriers to and extended lines of communication between specialist subcontractors and architects or employers.
- The actual execution of work (i.e. transformation of material inputs within the industrial capital circuit) is undertaken by subcontractors and not in the main by main contractors.
- Subcontractors carry out specific work packages which do not stand alone (i.e. they depend on co-operation of others at the same level in the project organisation) whereas main contractors have formal contractual control over others. Subcontractors do not have any formal control over others.
- Subcontractors only present for part of a project whereas main contractors present for the duration. The longer the time on site, the greater the opportunity to compensate for costly errors earlier on (n.b. variations).
- Contractors adopt an active role as instructors, whereas subcontractors are passive, only acting when instructed (subcontractors only see that part of a contract considered relevant for their subcontract by the main contractor).
- When construction tender prices are falling, to maintain profit margins main contractors are in a strong position to pass on lower construction prices to their subcontracted specialists and in their turn their specialist subcontractors are in a strong position to pass on lower construction prices to their labour.
- When demand for construction is growing specialist firms pass on higher labour and material costs in the form of higher tenders for specialist work. In turn main contractors pass on higher specialist costs in the form of higher final building costs or else find their working capital squeezed.

9.5.2 These last two points highlight the financial interactions between main and specialist contractors. Ball (1988 p.149) has pointed out that when the prices they tender decline, main contractors need to pass on their lower prices to their suppliers. Otherwise profits are squeezed. In fact, large contractors are in a stronger bargaining position than their smaller counterparts. Large firms or firms working on large projects may occasionally be able to negotiate lower material prices and thus avoid the need to force cost reductions onto their subcontractor-suppliers. In general, though, it is easier for them to pass on lower main
contractor prices upstream to their subcontractors, and operatives, especially those employed on a casual basis. Certainly if the purchase of materials is done by the main contractors they continue to control these options. As heating and ventilating contractors are usually associated with particular patented products and manufactured components, they are often contracted on a supply-and-fix basis, and may therefore be squeezed by both their manufacturer-suppliers and the main contractors.

9.5.3 Both main and sub-contractors need to maintain adequate working capital in order to survive. In most circumstances main contractors use the working capital of their suppliers (both materials suppliers and specialist contractors) in order to stretch the use of their own working capital or even operate a positive cash flow, whereby they are paid by their employers before paying their subcontractors.

9.5.4 One of the main problems which arises between main and subcontractors is the 'pay when paid' clauses of most contracts. These clauses are often used to delay payment to subcontractors by anything from 5 to 11 weeks or more. By delaying their payments to subcontractors main contractors can reduce their own need for working capital while increasing the working capital requirements of their suppliers. In order to reduce their need for working capital specialist firms attempt to reduce the wages they pay and casualise their workforce.

9.5.5 Other contractual difficulties arising between main and subcontractors include the fact that subcontractors do not always get sight of the main contractor's contract, with the consequence that the subcontractor is not always fully aware of the contractual obligations involved. In 1982 the HVCA noted that subcontractors did not always know the full terms of the contract before they were expected to tender for work. They accused main contractors of sometimes inserting onerous and substantial amendments, which adversely affected the subcontractors to the standard documents (HVCA, 1982, p.51). In any case, contracts tend to be very long and complex and with insufficient time or resources to assimilate the details, misunderstandings, delays and disputes frequently arise, with costly implications.

9.5.6 Gray and Flanagan (1989, p.90) highlight the lack of feedback to subcontractors. With turnover of staff and the continuous changing combination of subcontractors on site together with the small chance of working with the same people or other contractors on different sites, it is difficult for subcontractors to benefit from any feedback in order to improve their working practices. Recent attempts at partnering have tried to remedy poor working practices by offering opportunities for co-operation and communication during projects between the parties.

9.5.7 Gray and Flanagan (1989, p.64) also point out that the changing role of subcontractors is a response to procurement systems that oblige subcontractors to co-ordinate their work with other subcontractors rather than having to rely on the main contractor to do it for them, especially when relations between main and subcontractors can be difficult.

9.5.8 Further difficulties arise for specialist firms in assisting with design, according to Gray and Flanagan (1989, p.39). Subcontractors often need to resolve the conflicting objectives of the design team, the construction process and their own company's
requirements. During the design stage much information is required but because this is often unpaid advice, specialist firms are reluctant to spend a great deal of time if work is not guaranteed as a result. By the time a subcontractor is engaged design decisions will have been taken and it is often too late to alter them without major repercussions and expense. These expenses include the often hidden cost of including late changes such as delays and further changes to the rest of the building. While subcontractors need to become involved with detailed design issues, main contractors off-load responsibility for design onto the architects and the subcontractors.

9.5.9 Of course, the role of subcontractors in construction may well vary from market sector to market sector, depending on the level and amount of specialist knowledge required. For example, heating and ventilating engineers are usually expected to submit designs as part of the nature of their contract. Indeed, under traditional contracting, architects often use specialist firms to help with detailed aspects of design in return for nomination once the main contract has been let.

9.5.10 Hughes, Gray and Murdoch (1997, p.23) saw specialist firms favouring nomination as it allowed them to compete on service and quality rather than just price. However, the shift towards design and build, had given the main contractor rather than the architect greater control over the design process. This shift weakened the position of the heating and ventilating contractor who was then more directly under the control of the design and build contractor instead of being in the rather more secure position of a nominated subcontractor able to play the main contractor off against the architect and client. In any case a number of difficulties concerning the legal complexities of nomination in the context of contractual relations between clients, main contractors and nominated subcontractors has meant the practice has declined in popularity in recent years, according to Hughes et al. (1997, p.26).

9.5.11 Nevertheless, subcontractors are in an inherently weak position compared to main contractors because it is the main contractors who liaise directly with clients and control the payments system. While main contractors have been successful at making subcontractors increase their share of the risk, Gray and Flanagan (1989, p.154) argue that this policy also places main contractors at risk should the subcontractors fail. Driving subcontractors out of business during a project due to onerous conditions would only increase the cost of a project while a replacement subcontractor was found who was willing to take over. Driving subcontractors out of business after their work package has been carried out or after the project as a whole is complete is a different matter. In those circumstances non-payment of a subcontractor may have little long lasting effect on a main contractor.

9.5.12 For subcontractors new pressures emerged in the 1990s recession in the form of partnering. Partnering imposes further informal conditions on subcontractors obliging them to reveal their proposed methods, suppliers, and, most importantly, costs. Partnering appears to be carried out in the name of good practice. It is self evident that all parties involved in a construction project benefit from co-operation rather than confrontation. But it is an example of the prisoners’ dilemma. While it may benefit all to co-operate, partnering provides opportunities for individual members of the team to benefit more by cheating or taking advantage of a strong bargaining position.
9.5.13 In many cases and at its worst, partnering can be reduced essentially to a cost cutting exercise at the expense of the subcontractors. If it were considered a cost adding burden, partnering would not have been taken seriously. Although superficially, it is argued that fewer disputes during a project would benefit all concerned, the main thrust of partnering is to gain the complete co-operation of specialist firms in the design process with a view to reducing overall costs. This can be achieved by paying less to subcontractors for carrying out less work, than might otherwise have been necessary. As overall demand for their services is not a function of the price charged on an individual project, subcontractors have little incentive to reduce the size of their contribution to building projects or their prices. In serial partnering, which offers opportunities for give and take, it is possible to find incentives for subcontractors to concede on the size of their contribution in the hope of reward on the following project. Similarly, Gruneberg (1996, p3) argues that subcontractors may have an incentive to co-operate during a project provided there is sufficient time left for them to make up for a reduction in one area with a variation in their favour later on.

9.6 Transaction costs and subcontractors' strategies

9.6.1 Conventional subcontracting and vertical integration represent the opposite ends of the spectrum of organising activities within the construction process. The use of subcontractors involves markets and unavoidable transaction costs. However, there are several inherent weaknesses in transaction cost analysis, such as the difficulty of measuring transaction costs themselves. Nevertheless, the transaction cost approach is useful as a framework for understanding the relationship between contractors and specialist firms in the construction industry as well as between different specialist contractors working together on the same project. For Williamson (1975), Winch (1995, p.3) and Dietrich (1994 p.3) the starting point of the transaction cost approach is that technologically separate units are assumed to exist. These units must interact with each other to exchange resources, but their transactions involve costs just as ‘friction exists in the physical world’. Transaction costs can be reduced to the cost of discovering prices, the cost of negotiating contracts, and the cost of mis-forecasting when transactions take place prior to production (Dietrich, 1994 pp 15-6). This last point is especially relevant in a construction context, where contracts are invariably signed before work commences.

9.6.2 Dietrich (1994, p.21) describes transaction costs, which arise in construction, although he was not writing specifically about construction. If contracting-out is chosen as the mode of organisation, according to Dietrich, then ex ante transaction costs include the cost of drafting and negotiating a contract. In construction this involves the legal costs as well as the tendering costs of pricing work and participating in the tender procedure, including those tenders not won, and including the tendering process at the subcontract level. Ex post transaction costs include the costs of problems arising when outcomes are at variance with expectations. This occurs in building projects when delays and errors occur on site. Further ex post transaction costs are then incurred when firms dispute the quality of the output or the excess work and costs involved. The cost of arbitration systems or other governance structures when disputes arise and the cost of meetings or other arrangements to avoid disputes are examples of other ex post transaction costs. If, however, a vertically integrated hierarchical mode is chosen, then transaction costs are the administrative costs of co-ordinating ‘departments’ within the single firm.
9.6.3 Hence, the use of partnering and its governance structures still incur transaction costs, though the purpose of partnering is to reduce them. Partnering is designed to overcome disputes, which would otherwise arise on site. Nevertheless, transaction costs arise, according to Williamson (1975) as a result of opportunism and what he terms bounded rationality, and asset specificity. The day to day conflicts which occur on building sites between contractors and their clients, suppliers and co-contractors, can best be explained in terms of these three factors, namely, opportunism, bounded rationality and asset specificity. The relative transaction costs and benefits associated with each mode of organisation (whether partnering or traditional methods are used) will vary (it is predicted) according to the attributes of the transactions in question viz. their uncertainty, complexity, frequency and asset specificity.

9.6.4 Asset specificity is one reason for subcontracting in construction. Because much heavy equipment is needed, it often makes more sense for main contractors to hire plant than to own it. Because of its specificity, it may not be required continuously by any one contractor. On the other hand the plant and equipment may be shifted from one project to the next even if the next is under the control of a different main contractor. In this case asset specificity may be used by the subcontractor to advantage, as different main contractors rely on the same subcontractor for particular services, such as piling. However, when several subcontractors own the same type of equipment their position is weakened as main contractors may play one subcontractor off against the other. Subcontractors then have to weigh their options of owning equipment that is not in use or accepting a Dutch auction to obtain work at any price.

9.6.5 At the same time the main contractor is under no similar pressure since no equipment is owned by the main contractor and any increase in the cost of hiring would be passed on in the form of higher costs to their clients. All main contractors are aware that other main contractors competing for the same jobs would also face similar costs of hiring. In contrast, for heating and ventilating contractors the many different systems they install involve a degree of commitment and a limited investment in training, tools and sometimes a stock of spare parts. They often compete with each other by offering differentiated heating and ventilating systems. Indeed for this reason heating and ventilating contractors can be said to form a heterogeneous group.

9.6.6 Winch (1995) develops and applies the issues of uncertainty, asset specificity and the frequency of transactions between parties to the construction process. He asserts that where uncertainty and asset specificity are low, markets may be used as a relatively efficient device for reducing transaction costs in total. However, if transactions are sufficiently frequent, then a form of bilateral governance in which both parties to the transaction may form a closer relationship of varying degree short of merger may be set up. This may occur where heating and ventilating contractors provide or service a limited number of components from particular manufacturers or suppliers, where credit and discount arrangements are set up and information is passed through personal contact. Familiarity and trust then create an 'atmosphere', which influences the attitude of the transactors to their mutual benefit. Such relationships may be described as network governance of transactions, and form a continuum from market governance at one end to hierarchies at the other (Winch 1995, p4).
9.6.7 Where the frequency of transactions are relatively low, such as in subcontracting in construction, but where uncertainty and asset specificity remain high, as in construction, formal contractual relations between the parties may be set up to allow for arbitration and negotiation. This tripartite system of governance tends to occur in construction, where third parties may be brought in to resolve disputes (Winch 1995, p.6). Thus in any exchange the terms and conditions may still be contested after the market has carried out its function of allocation.

9.6.8 In their paper, Bowles and Gintis (1993) argue that contested exchange involves both allocation and discipline and that contested exchange may therefore not necessarily be efficient. There is in a sense a trade-off between efficient allocation of resources, which would ultimately lead to Pareto optimality and one, which results from the interaction of two unequal parties to a transaction which is asymmetrical and which would be sub-optimal. In one example given by Bowles and Gintis, of hawks and doves, the survival of one species does not necessarily reflect its efficiency but rather its nature in relation to the other, its power and ability to control. Contested exchange thus depends on the ability of the parties, for example main contractors, to enforce their terms by imposing costs on the other side, for example subcontractors. Most importantly for our purposes they disagree with Williamson when he proposes that transaction cost economics strategies favour the efficient and that market institutions survive if they are relatively more efficient than their alternatives, otherwise they would not survive (in a Darwinian sense). Williamson (1993) defends his position by arguing that contracts are composed of three elements - price, asset specificity and contractual safeguards. All are taken into account in reaching an agreed price. Nevertheless because contracts especially in construction are complex and incomplete both parties are invariably subject to opportunism as projects unfold. Moreover, Williamson argues that as Pareto optimality is a theoretical ideal, the trade-off in contested market situations is not between a real and a theoretical optimum but between two or more relatively efficient solutions.

9.6.9 In conclusion, one may argue that rather than the most efficient solution, the power of one or other party to a transaction determines the outcome of a deal. Transaction costs enter the picture insofar as the ability to exercise opportunism depends on the relative bargaining strengths of the two parties. Such opportunism is a frequent occurrence in construction where unforeseen disputes emerge during the course of a project, between clients and main contractors or between main contractors and subcontractors. As far as heating and ventilating contractors are concerned the power to withhold payment after work has been carried out gives main contractors a strong bargaining advantage. As transactions between any one heating and ventilating contractor and any one main contractor are likely to be one-off, heating and ventilating contractors can be seen as having little power to impose costs on the main contractor once work on a project has been completed. Hence there is a need for the tripartite governance as described by Williamson (1975) and Winch (1995, p.6).

9.7 The persistence of subcontracting in the construction industry

9.7.1 In view of the difficulties arising out of the sub-contractor relationship with main contractors, the question may be asked why, in that case, has subcontracting survived and
increased in the construction industry? According to Cooney (1993, p.75), between 1975 and 1982 firms with over 115 employees increased subcontracting-out as a proportion of all their contract work from 62 per cent to 76 per cent. The corresponding increase for the industry as a whole was from 58 per cent up to 62 per cent. This trend towards subcontracting-out has continued since, especially by the larger construction firms.

9.7.2 Hillebrandt (1971, p.5) implies that in general smaller firms are less efficient than larger firms. It is true smaller firms often use less plant, and sometimes have under-utilised plant. Their management is probably not as efficient as in large firms because of lack of training and their inability to take advantage of economies of scale. However, it can be argued that smaller firms in construction are less efficient because they act as subcontractors doing labour intensive low value work, which is not attractive to main contractors who conduct the high value added management functions. If efficiency contributes to increasing the chances of survival, the Geroski and Gregg (1997, p 145) finding that size did matter is consistent with Hillebrandt. Larger firms tended to be less at risk of failure during recessions than smaller firms.

9.7.3 One view put forward for the persistence of subcontracting in the construction industry concerns the volatility of construction and the vulnerability of firms with a high organic composition of capital (Smyth 1985, p.75). In other words, if firms own large amounts of fixed capital, which they cannot use continuously, the interest and maintenance costs of the capital become a burden on the firm. In order to lower their exposure to the risk of overcapacity firms hire plant and/or use specialist subcontractors. Even variable capital can be minimised by subcontracting piecework to other firms, whose prices and costs are then passed on to clients after the addition of a margin. This method of working enables contractors to continue to take on large projects, even when a flexible response using advanced technology is required. Main contractors can off-load the risks of owning capital or employing specialised skilled workers on to plant hirers and subcontractors. Thus Hughes et al. (1997 p22) attribute the growth in subcontracting in part to technological progress which leads to increased specialisation. As far as heating and ventilating is concerned the increase in specialisation within construction has allowed firms to survive.

9.7.4 Of course, economies of scale do not always favour larger integrated enterprises. The generally relatively small size of subcontractors reflects the size and number of work packages they undertake in any one period as well as the fact that their size relative to main contractors allows main contractors to maintain control over the construction production process (Ive and Gruneberg 2000). Stigler (1951) viewed the division of large industries into small sub-industries as a result of firms taking advantage of specialisation and economies of scale within each specialisation. Similarly, in the construction sector there are a large number of relatively small specialist firms, each concentrating on its own particular part of the process.

9.7.5 The construction industry makes use of specialist firms because they allow flexibility of response to demand. Gray and Flanagan (1989 p.143) view subcontracting as a way of surviving the volatility of the construction market, with specialist contractors increasingly gaining in size, market strength, and bargaining power. It is inevitable in their view that small firms will enter and leave the market depending on the total workload of the industry.
9.8 The strategic options open to heating and ventilating engineers

9.8.1 A large number of strategic options are open to subcontractors. For example, they may choose to develop their specialist skills and invest in plant and machinery which increases or improves their productivity, standards of specification, quality of output, reliability of components, speed of assembly on site, and other aspects of their contribution to the construction process. These strategies ultimately provide increased value added by the specialist contractor using more detailed knowledge-based design inputs and skills, and the supply of trained, experienced and motivated and better equipped specialist engineers. These strategic options apply to heating and ventilating contractors although they do not necessarily adopt them.

9.8.2 For example, investment and training strategies aimed at improving particular detailed aspects of the building process give specialist firms opportunities to differentiate their services and increase their profit margins. However, relatively little training is undertaken in-house by heating and ventilating contractors due to the increasing prevalence of labour only subcontracting. Qualitative technical and product differentiation between specialist firms are also options available to heating and ventilating contractors who supply different components. In contrast main contractors are expected to provide a non-differentiated product or service defined by the specifications given in tender documentation.

9.8.3 One option open to main contractors is expansion abroad. This option while possible is however, more complex for specialist firms. In most cases specialist contractors would be too small to justify setting up foreign operations, or their contribution to a building project would be too small to justify the additional overhead costs of travel and accommodation compared to a local provider. Component manufacturers are, of course, in a position to export their output to local firms abroad. In the 1997 HVCA Specifier’s Guide are listed 310 HVCA member firms prepared to carry out work abroad, which does not necessarily imply that they had all indeed done so previously (Specifier’s Guide 1997 p.327-340). Also, several of the members of the HVCA Major Contractors’ Group report foreign earnings in their annual accounts, but these are never more than a relatively small proportion of turnover.

9.8.4 Other strategies open to large main contractors include undertaking build, own, operate and transfer (BOOT) projects. This option is not usually available to specialist firms. One reason for this is that while main contractors are management and finance orientated, subcontractors are based on skills and assets, such as specialised plant and equipment.

9.8.5 Barriers to entry and exit also affect the strategic options open to firms. As with any market, decisions to enter or exit depend on the size of the barriers. The barriers to entry and exit into and out of the heating and ventilating industry are relatively low, like the rest of the construction industry, compared to other industrial sectors such as manufacturing. The major barrier to entry for heating and ventilating contractors is the ability to tender for work. Looking vertically forwards from the point of view of new entrants into the heating and ventilating market, the time needed to establish legitimation, namely client contacts and a good reputation with main contractors form one of the main barriers to being invited to tender. Vertical backwards integration from heating and ventilating contractors, because
particular components may be specified, may involve close links with suppliers. In other words, in general it is the linkages with suppliers and clients rather than fixed capital commitments which form the obstacles to entry. As the barriers to entry tend to be related to marketing factors, decisions to enter may be responsive to demand and current market opportunities and short term profitability rather than any long run strategy.

9.8.6 The main barriers to exit concern the asset and skill specificity of heating and ventilating contractors and engineers. Their specialist technology and techniques tend to have a narrow application, even linked to installing particular prefabricated components. Departure from the market means these skills and knowledge would not necessarily be applicable or useful elsewhere and the company might have to cease trading. Managers and the working proprietors of small firms would lose their main source of income if the firm were to close.

9.8.7 Decisions to exit may be more related to the expected high opportunity cost of leaving the market, which leads firms to delay making the decision to leave the market in recessions until long after losses have begun to be incurred. In Figure 8.1, this can be seen in the time lags between the upper turning point and the peaks in bankruptcies and insolvencies, which follow. Particularly in recessions competition is a zero sum game in which firms as a whole cannot expand. Therefore, one question raised by Penrose (1959, p.244) of relevance here is whether or not small firms are more adversely affected by the downturn in trading conditions than large firms.

9.9 Concluding remarks

9.9.1 As subcontractors in the building process, heating and ventilating firms are often to be found at several removes from the client and in a weak negotiating position. Heating and ventilating contractors need to overcome their marketing and production difficulties if they are to survive. To achieve this objective it appears that firms’ best interests are served if they manage growth. Growth is not only a measure of success, relieving the workforce from the threat of redundancy, it enables the firm to remain competitive and survive. The issue is the relationship between growth and both size-survival and entity-survival. If there is a trade-off between growth rates and survival, as annual growth rates increase the survival of firms becomes more doubtful. Low growth rates and negative growth rates will also likely have detrimental affects on a firm’s survival chances. The question is what rate of growth in the heating and ventilating industry is most closely associated with size and entity survival?

9.9.2 The other main points of this chapter include:
- The role of subcontractors has changed as they have found it necessary to assume some of the managerial functions traditionally carried out by main contractors.
- Subcontracting in the construction industry allows production flexibility.
- Because of the level of uncertainty in the construction market the strategies of firms tend to be reactive and change over time depending on circumstances.

9.9.3 In view of the dynamic nature of the industry and the need to adapt to changing circumstances, the following chapter considers the changing market conditions brought about by changes in the business cycle.
Chapter 10  Business cycles and the responses of heating and ventilating subcontractors to recessionary pressures

10.1  Introduction

10.1.1  In the second edition of *Industrial Economics and Organisation*, Hay and Morris (1991, p.27) see costs as determining in part a firm’s prices, and in turn its prices determine its share of the market and the combination of prices, costs and market share determine a firm’s profits. In the first edition they point out that industrial economics is concerned with the relationship between costs and demand and how that relationship is determined (Hay and Morris, 1979, p.18). One aspect of this relationship in construction is the procurement method used by clients to undertake construction work. During the construction business cycle this relationship varies as the relative bargaining strengths and weaknesses of clients and contractors are affected by the movement of the market along the spectrum from a buyers’ market to a sellers’ market and back to a buyers’ market again. In construction this manifests itself in the shape of the terms and conditions clients, contractors and subcontractors are able to impose on each other. During recessions clients are able to impose harsher conditions on contractors, whereas during recovery periods, contractors are in a position to off-load risk to some extent on to other parties.

10.1.2  When market conditions deteriorate and onerous procurement conditions are imposed by the client, the main contractor is in a position to pass on at least part of the burden of onerous conditions to the subcontractors. When market conditions improve for main contractors they can off-load risk back on to clients and subcontractors. However, regardless of the market conditions subcontractors still need the work offered by main contractors and still need to work through main contractors. Main contractors are therefore always in a position to dominate subcontractors and the ability to impose costs on the other party is invariably greater for main contractors than for subcontractors. For example, when problems arise between main contractors and their clients, payments to subcontractors are usually adversely affected (Latham, 1994, p.93). Subcontractors are in effect unsecured creditors of main contractors and have few sanctions they can impose and until recently little recourse to the law.

10.1.3  While it might appear that a number of developments have taken place over recent years concerning procurement methods, these changes have merely involved a shift in the relationship between contractors and their clients. The basic subordinate position of subcontractors has remained relatively untouched, although the 1996 Housing Grants, Construction and Regeneration Act attempted to strengthen the position of subcontractors seeking redress. Traditional contracts have declined in importance as construction management and management contracting have become increasingly popular as methods of building work procurement. This shift reflected the fact the construction market had become a sellers’ market for main contractors in the mid to late 1980s. Main contractors were thus able to off-load risk and reduce their working capital requirements. However, when the market turned down, design and build began to increase as a proportion of all procurement methods. This reflected the change in the construction market to a buyers’ market, as clients were able to place more burdens on main contractors, forcing them to take on greater responsibilities for design work if they wished to tender for work. This is supported by
Akintoye (1994) and Hillebrandt et al., (1995, p.83). By 1993 approximately half of all work was carried out using design and build contracts.

10.1.4 The purpose of this chapter is to lay down the theoretical framework of the business cycle in order to show that the business methods adopted in one period, which enable firms to grow and survive, may not necessarily be appropriate in the next, due to changing trading conditions external to the firm. As a small component of the economy the heating and ventilating industry has little, if any, measurable effect on the economy as a whole, whereas the heating and ventilating industry itself is affected to a large extent by changes in the rest of the economy.

10.1.5 This chapter is not concerned with macroeconomic business cycles as such. The theoretical approaches used to explain cyclical movements in the whole economy involve creating a model in which expenditures are also seen as sources of revenue. Conventional approaches to business cycle theory relate business cycles to the whole economy. At a macro-economic level concepts such as the multiplier effect and the accelerator principle emphasise the interaction between different sectors of the economy. In this thesis business cycle theory is used in order to understand the cyclical effects of the economy on demand for heating and ventilating engineers as measured in the micro-economic data.

10.2 The construction business cycle and the heating and ventilating industry

10.2.1 For firms in any one industrial sector especially one as small and specialised as heating and ventilating, the cyclical model can only be used to explain changes in demand and costs. In the case of heating and ventilating contractors demand is measured by output, turnover or revenues and revenues are injections into the industry. Expenditures by heating and ventilating firms on buildings, materials and plant represent a leakage (or import). Even investments made by firms in firms in heating and ventilating will not have a significant multiplier effect on the economy or even the heating and ventilating industry itself, though investment increases the capacity of the firms in the industry. For this reason, changes in the economy as a whole, which affect the heating and ventilating industry can be viewed as exogenous factors. What matters here is the effect of cyclical changes on heating and ventilating contractors but not the macroeconomic reasons for these changes.

10.2.2 Nevertheless it is important to place changes in the heating and ventilating industry in a wider economic context. The industry is not insulated against changes in the rest of the economy and changes in heating and ventilating relate to changes in the economy as a whole. Figure 10.1 shows total construction output, and the disaggregated components of new build and repair and maintenance. Similarly heating and ventilating output is also shown as total output comprising new build and repair and maintenance. While construction repair and maintenance was greater than new build during the 1980s, in heating and ventilating new build always remained greater (in most years far greater) than repair and maintenance work. From Figure 10.1 total demand for construction as measured by construction output can be seen to consist of periods of expansion (1955 to 1968, 1970 to 1973, 1977 to 1979, 1981 to 1990, 1993 to 1997) followed by periods of contraction (1968 to 1970, 1973 to 1977, 1979 to 1981, 1990 to 1993). Figure 10.1 also demonstrates that disaggregated demand does not necessarily follow an identical pattern in each sub-market, implying that particular sub-
markets in construction may follow distinct patterns of demand or output of their own. In Figure 10.1 new work appears more volatile over the period as a whole since 1955 than repair and maintenance though the volatility of repair and maintenance increased after 1971.

10.2.3 Establishing the causes of these changes in construction output lies beyond this research. It is the effect of changes in the economy and construction on the heating and ventilating industry, which is of interest here, because it is of concern to heating and ventilating contractors to know whether demand for heating and ventilating precedes or follows these changes in construction demand and to see if the relationship can be modelled, with a view to anticipating likely demand levels in the heating and ventilating market.

**Figure 10.1 Construction and heating and ventilating output 1955-1997 at 1995 prices**

Source: Table 1.6 Output at 1995 prices, DETR, unpublished.

Note: Construction industry measured on left axis, heating and ventilating industry on right axis

10.2.4 Clarke (1992 pp.49-50) discusses the merits and demerits of adopting a cyclical view of history in the first place. The idea that history repeats itself in a cyclical fashion or that it in some sense moves in a logical uni-dimensional direction are unnecessarily limiting and quite possibly misleading. Change is complex and occurs over time in several ways simultaneously. It is arbitrary to consider one variable over time, such as population, wages or prices, as if it is central to developments taking place. Indeed, she argues that cycles imply an inevitable rotation of distinguishable stages, boom, recession, slump and recovery. This approach had already led many writers such as Kuznets, to spend time discussing the duration of cycles and to seek specific but repetitive causes for the timing of events and changes in the rate of change of particular variables, using econometric models linking dependent and independent variables. Unfortunately, such models are incapable of accounting for the inconsistencies in and inconclusiveness of their own results, which indicate that cause is not always followed by effect, when a number of intervening variables are present.
10.2.5 This uni-dimensional view of time at worst disregards historical time and at best obscures it. In earlier chapters the study of the historical context attempted to capture to some extent the chaotic nature of interacting factors. At different times different factors have different influences over events. Development is not mechanical. Romer (1996) and Leslie (1993) would agree with Clarke on this point, although Romer adopts a post-Keynesian approach while Leslie supports a neoclassical model. Mechanistic approaches are now considered obsolete and unproductive by most macro economists (Romer 1996).

10.2.6 Leslie (1993, p.130) confronts the historians’ argument that each cycle is a unique combination of events, and notes that there are sufficient common features shared by different business cycles to justify attempts to build an economic theory. These shared features include similar variations in output across different sectors of the economy, apart from agriculture and natural resources. This argument is supported in Figure 10.2, which illustrates the GDP and construction output. Both time series show similar peaks in 1973, 1979 and 1989 to 1990. Another feature of all cycles, also suggested in Figure 10.2, is that durable goods sectors such as property related sectors vary to a greater extent than non-durable goods sectors.

**Figure 10.2 Index of total construction output and GDP 1955 to 1996 at 1995 prices.**

![Graph showing GDP and construction output indices from 1955 to 1996.](image)

Source: Construction output data at 1995 prices provided by the DETR (unpublished)

Note: GDP deflated using 1985 weightings

10.2.7 This additional volatility can be seen in Figure 10.3. The first differences in the indices of GDP and construction output indicate business cycles as the variation in output
from one period to the next. GDP may be used as a measure of the business cycle for the economy as a whole. As the variation of GDP over time is the average cycle for all sectors of an economy, Sherman (1991 p.10) uses the term ‘reference cycle’ to refer to the GDP in contrast to ‘specific cycles’ which refer to the variation of particular macroeconomic variables over time. As an average of the economy as a whole the reference cycle varies less than specific cycles. Based on annual data the major recessions in construction and the economy in 1974, 1981 and 1991 and upper turning points occurring in 1978, 1983 and 1987 to 1988 show that the business cycles of construction and the economy as a whole were concurrent.

Fig 10.3 Annual changes in construction output and GDP 1955-1996 at 1995 prices.

Source: Construction output data at 1995 prices provided by the DETR
Note: GDP deflated using 1985 weights

10.2.8 In this research construction indicators may also be viewed as having specific cycles. These specific cycles may therefore lead or lag the reference cycle. Because output and costs of the heating and ventilating industry are not significant in terms of the whole economy, they are affected by the business cycle but as has been pointed out above, it would be unreasonable to suggest they could cause statistically significant changes in the opposite direction.

10.2.9 Begg, Dornbusch and Fischer (1994, p.549) provide a textbook definition of the business cycle as the short-term fluctuation of total output around its trend path. For example, according to the Solow growth model, the balanced growth path is the trend path, assuming incomes, capital, labour and the effectiveness of labour (or the application of knowledge to work and productivity) were all increasing at a constant rate (Romer, 1996 p.15). This 'equilibrium' or balanced growth path is achieved because it allows capital to
expand at a certain rate which nevertheless requires extra labour which together with capital (taking technological progress into account) produces additional output which increasing incomes are able to absorb and hence further re-cycle income. According to this model, it is shocks to the system that prevent growth achieving this balance, with resulting fluctuations in the rate of economic expansion. However, such a model is inappropriate for the heating and ventilating industry. The macro-economic model assumes the extra output is absorbed by the extra incomes created in the process and re-cycles it. However, for any given industry, it does not follow that the expansion in their output and incomes will lead the workforce producing it to increase their purchases of their own output.

10.2.10 Of course economists recognise that cyclical fluctuations are not regular, apart from seasonal variations, (Romer 1996 p.147; Leslie 1993 p.128). Consequently, as pointed out above, most modern macro-economists are not concerned with deterministic models of cycles, such as 3 year Kitchin cycles, 10 year Juglar cycles, 20 year Kuznets cycles or 50 year Kondratiev cycles. Fluctuations are caused by a variety of discrete factors occurring at irregular intervals. These shocks of varying sizes go on to impact on the economy in a number of ways. Disagreements between neo-classical and Keynesian approaches arise as to how these shocks affect the economy, but, as has been pointed out above, such a discussion lies beyond the scope of this research. Nevertheless, discrete and irregular shocks affect the heating and ventilating industry directly (as with large changes in relative energy prices) and indirectly (as when interest rate changes affect investment in construction).

10.2.11 In the end this debate about business cycles concerns the underlying nature of the economy. The question is whether or not there exists an equilibrium growth pattern disturbed by shocks to the system or whether the economy is in a constant process of dynamic change. Although it is not the purpose of this research to enter or resolve this debate, the approach adopted here is a contingent approach based on historical time. Economic variables either rise or fall for irregular periods, which form patterns over time but which are not predictable or determined endogenously.

10.2.12 Like Clarke (1992), Arestis (1992 pp.88-9) points out that in post-Keynesian economics, economics is an historical process in historical time. Real events follow on from each other. This is distinct from the grand neo-classical synthesis, which looks upon time as a logical sequence of events within an economic model. Moreover, because of uncertainty, expectations play an important role in determining economic outcomes. These outcomes are once again constrained by the political and economic institutions, which determine the parameters within which decisions can be taken and the methods used to carry out transactions. Clearly heating and ventilating firms are affected by cycles in demand and costs and one would not expect growth to be steady in the heating and ventilating industry.

10.3 The nutcracker theory

10.3.1 Sherman (1991 p.11) discusses Wesley Mitchell's account of the business cycle. Mitchell divided the cycle into 9 stages from lower turning point to lower turning point. Stage 1 is the first quarter. Stage 5 is the peak and stage 9 is the last quarter. Stages 2, 3 and 4 occur during the expansion phase and tend to be longer than stages 6, 7, and 8, which occur during recessions. Sherman, (1991 p.3), defines the business cycle more broadly as a period
of expansion in economic activity followed by a period of contraction. Economic activity can be measured in terms of a number of variables, including output, employment, and profits and losses.

10.3.2 Sherman's approach applied to the heating and ventilating business cycle may be based, for example, on an *ex post* analysis of the aggregate annual wage bills of members of the HVCA. Taking a cycle to be the period from one lower turning point to the next, the *cycle base* is the average value of the variable during the cycle. It is therefore possible to calculate the variable at any given date as a percentage of the cycle base. This shows the relative position of the variable compared to the whole cycle, and is known as the cycle relative (Sherman 1991 p.12). Cycle relatives have various applications. For example, cycle relatives can be indexed and then used to compare cycles. The rate of growth of a variable can also be calculated by measuring the change in cycle relatives.

10.3.3 Cycle relatives can also be used to compare the amplitude of cycles. Sherman (1991 p.16) adopts the following method to measure cycle amplitudes. To measure the extent of the expansion phase, the cycle relative at the beginning of the cycle is subtracted from the cycle relative at the peak. Similarly, the amplitude of the contraction phase is the cycle relative at the lower turning point minus the cycle relative at the peak, which produces a negative value.

10.3.4 Sherman (1991 p.128) describes the sequence of phases in the business cycle for an economy as a whole. For Sherman the key variable is profits, the residual of revenues after deducting costs. As this residual varies over the cycle, according to Sherman, in certain phases of the cycle profits may be squeezed. Hence, he calls his model the *nutcracker theory*. Sales rise rapidly in the recovery phase but then slow down as the economy enters the prosperity phase. Later on in the prosperity phase, profit margins on turnover and the return on capital employed decline. These trends indicate coming recession and an absolute drop in profits, especially when turnover decreases. Later still, firms' capital requirements for new investment decline. At the peak, total sales and net investment start to go down. As recession slows down the rate of decline in sales also decelerates. Gross investment increases and capacity-adding investment is planned, as confidence returns. At the lower turning point sales and net investment begin to rise and recovery starts a new cycle.

10.3.5 This general picture of the business cycle may not apply to all subcontractors in the construction industry. This is partly because just after the upper turning point of the cycle, as turnover begins to decline, the need for working capital also declines just at a time when contractors receive final settlements (usually containing the profit element) of jobs completed at or just before the peak. Secondly, it does not apply to all subcontractors partly because they tend to hire plant and equipment rather than invest in new capacity or the cost of new equipment is relatively low in labour intensive specialisms. Describing the experience of the business cycle from the point of view of heating and ventilating contractors using Sherman's approach a simplified sequence of 6 phases might follow a pattern beginning with the recovery phase. In this phase, phase 1, firms experience growing demand in the form of an increase in the number of tenders they are invited to submit. Following a period of low mark-ups firms find their tender success rate is high and the increase in their workloads encourages them to increase their mark-up percentages. Although their mark-ups may be greater, to begin with their labour and material costs rise relatively slowly.
10.3.6 However, in phase 2 as work increases shortages of labour force firms to increase their wage rates to attract and hold on to workers. Material prices also begin to rise rapidly as suppliers no longer find it necessary to discount their goods to the same extent as before. The heating and ventilating contractors nevertheless find that demand for their services is sufficiently strong for them to pass on these cost increases even using the same mark-up percentages. Thus without altering their percentage mark-ups firms net revenues (after direct costs) continue to rise, absorbing increased costs, partly because the total value of the mark-up per job increases and partly because the number and/or size of jobs and hence turnover increases. As workloads continue to rise, bottlenecks begin to appear. Firms may even increase their percentage mark-ups towards the end of the recovery phase only to find that labour, material and plant hire costs have risen above expectations and can no longer be easily accommodated within budgets.

10.3.7 Thus as full capacity is approached, phase 3, waiting times for materials cause delays and inferior labour is hired causing costs to rise disproportionately and in an unplanned and unanticipated manner. Firms can no longer fulfil their commitments on time. As the market becomes saturated either because demand no longer increases (for exogenous reasons) or because delays are anticipated so that alternatives outside the heating and ventilating industry are sought, gross turnover becomes increasingly difficult to increase. As a result profit margins are squeezed as firms reduce percentage mark-ups in order to win work although their costs may be rising on new jobs and growth in firms' output decelerates, stabilises and then falls. Total demand for heating and ventilating contractors is not determined by the price of heating and ventilating contracts but by the requirements of building projects already undertaken by main contractors. Heating and ventilating contractors as a group can only respond passively as demand reaches its climax and begins to reverse.

10.3.8 In phase 4, as output falls, revenues from previously completed work and retention monies enable firms to survive in the short term, overcoming cash flow shortages occurring on current jobs. In phase 5 the volume of new work under-performs expectations and revenues decline. However, the prices of labour and materials continue to rise as overall demand for inputs is still relatively high compared to other phases in the cycle. The reservation wage is based partly on immediate past experience, which may make people hesitate before agreeing to undertake work at lower rates of pay. Firms nevertheless eventually reduce the wages paid passing on their own lower tender prices in the form of lower wages. Consequently, as profits are squeezed and workloads decline fewer casual workers are employed or re-employed and firms reduce their costs in line with the decline in workloads. However, as the volume of work decreases and the profit margins decline, it becomes increasingly difficult for firms to manage their working capital and overheads. The profits squeeze in this period then begins to force increasing numbers of firms into liquidation and capacity in the industry is further reduced.

10.3.9 During the recession phase, phase 5, the strongest firms survive due to cash reserves and their ability to operate on lower mark-ups. They may also be supported if they are subsidiaries of financially sound holding companies. Price competition between firms forces firms to reduce their percentage mark-up and profit margins and the mass of profits produced declines. Wage rates and wages decline too as work becomes increasingly difficult to find for workers and contractors pass on their profits squeeze to the labour force in the form of
lower wage rates and hours worked, and reduced conditions and terms of employment. Discounts are offered by suppliers on material supplies, as inventories begin to increase beyond expectations or plans. However, in spite of these cost reductions, so fierce is the competition for work, contractors undercut each other in a bid to obtain a cash flow, by reducing percentage mark-ups still further.

10.3.10 Hillebrandt et al. (1995, p.23) point out that those subcontractors involved at the front end of projects tend to be the first to feel the impact of recessionary pressures. Coming later in the building process, heating and ventilating contractors have more time to anticipate demand and adapt to changing market conditions. For this reason heating and ventilating contractors may be in a position to mitigate the worst effects of volatile demand on their production programmes and employment patterns.

10.3.11 Eventually in phase 6 the rate of decline in the market slows down and surviving heating and ventilating firms begin to find their order books fill up once more. This occurs not because aggregate demand for heating and ventilating has increased but because the rate of decline in capacity of the industry declines more rapidly at this stage than the rate of decline in demand. Hence the rate of decline of industrial capacity itself slows down. Total demand may still be in decline but the remaining firms feel under less pressure to reduce their prices. Indeed, individual firms may see an increase in their workloads. One further reason for the reduction in pressure on surviving firms is that as total demand is still in decline, labour costs continue to drop. Although workloads stabilise at a low level, the cash flow derived from current jobs enables firms to regain confidence when bidding for work. Some firms may even experience full order books at this point. For many firms, the decline in prices is matched by the decline in costs, preserving their profit margins albeit on smaller turnovers.

10.3.12 At some point phase 1 begins the cycle again as aggregate demand begins to increase for exogenous reasons as far as heating and ventilating contractors are concerned. Because of the size of the industry and their late phase in the construction process, the heating and ventilating industry has no or very little influence over demand for their services in aggregate. It is a question of heating and ventilating contractors as a whole responding to increased demand if or as and when it arrives, though individual contractors may be able to compete effectively in a zero sum game for work at any point in the cycle. Finally, it does not follow that business cycles faced by individual heating and ventilating contractors follow a slowing down in the rate of growth or decline before a change in direction. Indeed, because of the size of building projects a period of expansion may come to an abrupt end as large projects reach completion and are not replaced, to be followed by the sudden arrival of a period of decline and markedly lower orders.

10.4 The response of plumbing and heating and ventilating firms to the recession of 1990-1993

10.4.1 During the recession of the early 1990s reduced demand forced many main contractors to alter their strategies. Diversification as a strategy for growth, according to Hillebrandt et al. (1995 p.125), was no longer relevant in a declining market. For specialist subcontractors it had never been a serious option apart from diversification into different
regions to find markets for the same specialism elsewhere. Nor was it possible to funnel profits from contracting into new and diverse investments. Either profits were non existent or they were needed to maintain cash flow in contracting (in both senses of the word) activities.

10.4.2 Nevertheless, one option open to those firms with spare capacity in a declining market is to use that capacity to diversify and enter new markets. However, in plumbing, heating and ventilating it appears that far from firms diversifying into other fields, other types of firms in the construction industry penetrated the market for plumbing, heating and

<table>
<thead>
<tr>
<th>Markets Types of firm</th>
<th>General contracting</th>
<th>Plumbing and H and V market</th>
<th>Electrical contracting</th>
<th>Misc.</th>
<th>Total turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td>General contractors</td>
<td>35,898</td>
<td>386</td>
<td></td>
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<tr>
<td>Civil contractors</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plumbing and H and V firms</td>
<td>144</td>
<td>4,128</td>
<td>432</td>
<td>48</td>
<td>4,800</td>
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<tr>
<td>Electrical contractors</td>
<td>36</td>
<td>4,005</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carpentry and joinery firms</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Painting and decorating firms</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roofing firms</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastering firms</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glaziers</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demolition firms</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaffolding firms</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant hirers</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation firms</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspended ceilings firms</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor and wall tiling firms</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Miscellaneous firms</td>
<td>432</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total plumbing and H and V market</td>
<td>5,397</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ventilating work. If this option of diversification was taken up it was taken up by others rather than heating and ventilating contractors. Looking at the evidence available in Table 10.1, the following picture of plumbing and heating and ventilating contractors and their specialist market emerges, based on a survey conducted by the Building Services Research and Information Association (BSRIA) and Construction and Forecasting Research Ltd (CFR) in 1994.

10.4.3 In 1993 the turnover of heating and ventilating contractors was £4,800m of which 86 per cent was undertaken in the plumbing, heating and ventilating market, 9 per cent in the electrical contracting market and 3 per cent in general contracting. This data may be used as a measure of the flexibility or diversification of plumbing and heating and ventilating contractors. In Table 10.2 the degree of specialisation in their own specialism at 86 per cent compares to 99 per cent by scaffolders but only 50 per cent by demolition companies. The mean and standard deviation of specialisation in their own specialism by all types of contractors was 83.25 per cent and ±12.58 per cent respectively. This therefore implies that although plumbing and heating and ventilating firms happened to be close to the average of specialisms in the construction industry the range of degrees of specialisation from one type of construction firm to the next was wide.

10.4.4 From Table 10.1 the plumbing and heating and ventilating market was worth £5,397m in 1993. Of this, the share of the market held by plumbing and heating and ventilating firms was 76.5 per cent or £4,128m. General contractors took 7 per cent of the heating and ventilating market although their £386m share only represented around 1 per cent of their own total output and was therefore relatively insignificant compared to the £35,898m of general contracting work they undertook. The third largest share of the heating and ventilating market was undertaken by electrical contractors at 6.7 per cent or £36m, which represented 8 per cent of their own output. This compares to the £432m electrical contracting work undertaken by plumbing heating and ventilating firms and the £4,005m electrical contracting work undertaken by electrical contractors themselves. While plumbing and heating and ventilating contractors only diversified out of their own specialism by 14 per cent of their output other firms took 23.5 per cent of the plumbing and heating and ventilating market according to Tables 10.1 and 10.2. This meant that other firms had more experience of the heating and ventilating market than vice versa. Firms from outside the heating and ventilating industry, who purchased substantial share holdings in heating and ventilating contractors, penetrated the heating and ventilating industry. For their part major heating and ventilating contractors rarely diversified by taking over firms outside the heating and ventilating market.

10.4.5 From Table 10.2 general contractors if anything appeared to diversify less than the average for the construction industry, especially compared to ‘specialist’ contractors such as plumbing and heating and ventilating firms, civil engineering contractors, and suspended ceiling contractors. General contractors concentrated 93 per cent of their output on general contracting. Only scaffolders were less diversified. Plumbing and heating and ventilating engineers carried out 14 per cent of work outside their own specialism. The evidence of the BSRIA report for 1993 does not particularly support nor contradict the view that diversification had been widely adopted as a strategy by contractors coping with the 1990 recession, though of course, no data is given for earlier or later years.
10.4.6 Due to the low profitability of firms in the recession of 1990-93, companies across the construction industry made necessary managerial and structural changes (Hillebrandt, Cannon and Lansley, 1995, p.101). In some main contractors, Hillebrandt et al. (1995, pp.110-1) found reductions in managerial staff from 10 to over 30 per cent as a response to the drop in demand and output. Cuts in the employment of operatives as well as management, wages and salaries, the disposal of subsidiaries, and the write-down of asset values were all carried out at this time and accepted by staff and shareholders alike. Other cuts in spending included training budgets. In periods of growth, firms can absorb excess spending on management perks such as company cars, future oriented investment and other expenses. In periods of contraction, some of these expenditures become an unacceptable burden threatening the survival of the firm. Many of these strategic options were also open to heating and ventilating contractors.

Table 10.2 Flexibility of construction firms in 1993, according to specialisation in own specialism

<table>
<thead>
<tr>
<th>Type of firm</th>
<th>Percentage of work</th>
<th>Type of firm</th>
<th>Percentage of work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scaffolding</td>
<td>99</td>
<td>Glazing and windows</td>
<td>87</td>
</tr>
<tr>
<td>General contractors</td>
<td>93</td>
<td>Floor and wall tiling</td>
<td>86</td>
</tr>
<tr>
<td>Plant hire</td>
<td>93</td>
<td>Plumbing and Heating and Ventilating</td>
<td>86</td>
</tr>
<tr>
<td>Roofing</td>
<td>92</td>
<td>Civil contractors</td>
<td>78</td>
</tr>
<tr>
<td>Plastering</td>
<td>92</td>
<td>Insulation</td>
<td>73</td>
</tr>
<tr>
<td>Painting and decorating</td>
<td>91</td>
<td>Suspended ceilings</td>
<td>70</td>
</tr>
<tr>
<td>Electrical contracting</td>
<td>89</td>
<td>Miscellaneous</td>
<td>64</td>
</tr>
<tr>
<td>Carpentry and joinery</td>
<td>89</td>
<td>Demolition</td>
<td>50</td>
</tr>
</tbody>
</table>


10.4.7 Reductions in output and employment, according to Geroski and Gregg (1997, p 146) are textbook responses to recession. From a survey of firms belonging to several different industries (including construction) Geroski and Gregg concluded that most firms prefer to close establishments and cut employment costs rather than reduce their prices, when confronted by recessionary pressures. In this respect heating and ventilating contractors (and possibly most firms in construction) are distinct from other sectors. Firstly, they cannot close ‘establishments’ which in construction are projects on site without breaching contractual obligations. Their barriers to exit are high. Secondly, unlike manufacturing industries where markets tend to be fixprice, construction subcontractor markets tend to be flexprice, along the lines described by Morishima (1984) and Gruneberg and Ive (2000). Consequently, contractors across the construction industry from main contractors to heating and ventilating contractors do indeed reduce their prices at the tendering stages in response to recessionary pressures.
10.4.8 Hillebrandt et al. (1995, p.132) note that recessions may be viewed as an opportunity for firms to make necessary corrections to their modus operandi. They point out 5 main areas where improvements in performance may be detected. They are:

- control of the main board
- employment of efficient managers
- efficiency and sensitivity of planning
- scope of marketing, and
- financial strength.

10.4.9 During growth phases in the business cycle firms can adopt strategies based on improved cash flows and profits provided the expansion of the firm does not outpace its working capital. According to Hillebrandt et al. (1995, p.123) the additional money earned from contracting may be used to finance investment in property or other outside interests, as well as diversifying within construction by moving into new markets at home and abroad. Expansion also enables firms to undertake ever-larger projects.

10.4.10 Hillebrandt et al. (1995, p.124) see growth of firms in terms of the size necessary to compete with large contractors abroad and large foreign firms entering the UK market. While very little heating and ventilating work was reported as taking place abroad in the accounts and annual reports of firms in the study of major contractors in this research, size remained an important marketing tool to secure large heating and ventilating contracts in the domestic market. Firms such as Drake and Scull used their annual reports to advertise the large and prestigious projects completed by them each year.

10.4.11 Hillebrandt et al. (1995) argue that growth of the market is necessary to reduce competitive pressures and restore profit margins. This may appear to contradict Sherman's approach, which argues that there is a threat to profit margins, when demand increases and costs rise as the capacity of suppliers is reached. A rise in the cost of materials and labour raises subcontractors' costs which are then passed on to main contractors at the tender stages and during the building process. These price increases in turn then threaten to squeeze main contractors' profits. However, it is only in the last part of the expansion phase when the profit margins of contractors are squeezed. Otherwise main contractors benefit from growth because of widening margins, higher volumes and improved capital utilisation ratios, even though plant is hired on an ad hoc basis in general. However, it should be noted that competition from large foreign firms does not apply to specialist subcontractors to the same extent as it does to main contractors. The competitiveness of subcontractors depends more on their ability to supply a given product or service rather than their having the financial muscle to oversee the construction production process, although they require sufficient liquid reserves in case payments to them for work already carried out are delayed.
10.5 The absence of a predictable pattern of cyclical changes

10.5.1 In their behavioural approach to the firm, Cyert and March (1992, p.119) argue that the business environment is “unpredictably unstable” and that firms are constantly engaged in a process of reacting to it. At different points in the business cycle the degree of slack within any given firm varies. They describe slack as the excess resources used by the firm over and above that necessary for it to maintain production. Slack is a kind of economic rent which management and the coalition of groups within the firm are in a position to acquire for themselves in order to relieve themselves of pressures, stress and strain, or to make themselves more comfortable, add status or increase rewards and bonuses.

10.5.2 Cyert and March (1992, p.189) state that success tends to breed slack, with the result that there is a muting of the problems of scarcity. They imply that as a company’s profitability increases there is a softening in the firm’s approach to cost control and investment. They argue that subunit (such as project) demands for additional resources are more likely to be met as they come into less conflict with other demands for funding. It therefore follows that internal conflict within firms increases at different phases of the business cycle. The major problem with such a behavioural approach to firms is obtaining a suitable measurement of conflict in relation to slack over the business cycle. As a consequence the argument remains descriptive and largely intuitive rather than providing a predictive model. Nevertheless it does illustrate that the behaviour and strategies of firms are likely to vary over the business cycle.

10.5.3 The absence of a predictable pattern of cyclical changes can be seen in Figure 10.4, which shows the annual changes in aggregate real wages of member firms of the HVCA, and annual changes in heating and ventilating output, construction output and GDP between 1956 and 1996. (Figure 10.5 omits GDP and is inserted for the purpose of clarity only). Provided the percentage increases remained positive, the output of the heating and ventilating industry and the construction industry expanded. Thus, if in year $t_1$ there is a 5 per cent expansion followed by a 2 per cent increase in year $t_2$, the output of the industry would have increased by 7.1 per cent since the beginning of year $t_1$. Figures 10.4 and 10.5 would illustrate this by indicating a decline in the rate of growth. Hence, although there was a downward trend in the rate of growth from 1961 to 1968, in that period aggregate wage returns almost doubled (see Figure 11.2).

10.5.4 In Figure 10.5 changes in construction output and aggregate wages in the heating and ventilating industry appear to be co-incident variables throughout the period of study. Simultaneous high and low rates of growth particularly in 1967, 1974, 1978, and 1991 with similar patterns of decline and recovery from 1965 to 1979 support the view that there is no visual evidence of a time lag between the two variables before 1979. However, since 1988 in spite of the co-incident lower turning points in the two variables in 1991, the earlier pattern of co-variance between the two growth rates appears to have broken down. In the mid 1970s for example, the decline and recovery of construction and wage returns occurred simultaneously. In contrast, in 1987 the peak in growth rates in construction output was only followed 3 years later by a peak in the rate of growth of the wage return data.
Looking at changes in the rate of change (acceleration) in Figure 10.4, in the 37 years of continuous data available in only 3 periods (1965-6, 1974, and 1989-90) did heating and ventilating accelerate while both construction and GDP slowed down. On the other hand in 5 years (1959, 1964, 1975, 1987 and 1994) heating and ventilating decelerated while the construction industry and the GDP both accelerated. In all other 27 years heating and ventilating, construction and GDP all increased or decreased together.

Looking at the annual changes in GDP, construction output, heating and ventilating output and wage returns in Figure 10.4, in the 29 years between 1959 and 1996 (excluding 1980 to 1987 because of missing wage return data) the annual changes in all 4 variables can be compared. There were only 2 years when the rate of growth of all four increased (1976, 1978), and only 3 years (1962, 1979, 1991 and 1992), in which they all decreased. In only 15 years did both wage returns and heating and ventilating output either accelerate or decelerate together. They accelerated together in 6 years (1961, 1976, 1978, 1989, 1990, and 1995), and in 9 years, they both decelerated, namely 1959, 1962-4, 1973, 1979, 1991, 1992 and 1996. It is therefore difficult to predict changes in annual wage returns on the basis of changes in heating and ventilating output.

In the 41 years of GCPI deflated wage data, by and large, periods of growth tended to last either one or two years as did periods of deceleration. However, between 1961 and 1974 the general trend was one of a declining rate of increase in aggregate annual wage returns, with aggregate wage returns actually declining by over 10 per cent in 1974. The recession in the early 1990s caused growth rates of the construction industry variables to decline in 1991 and 1992. In 3 periods (in 1969, from 1972 to 1975, and from 1991 to 1994) does Figure 10.4 show negative growth in aggregate wage returns. To summarise these findings, as far as the heating and ventilating industry is concerned, no fixed period short run business cycle can reasonably be discerned from the wage return data.

The GDP appears to follow a much more predictable and far less volatile pattern than wage returns. In only 3 periods does GDP actually show a decline, namely: 1974 to 1975, 1980 to 1981 and 1991 to 1992. For the rest of the period between 1949 and 1996 the economy appeared to grow at up to 5 per cent per annum, but more usually in the 2 to 3 per cent range. In comparison, the trend in the rate of growth of aggregate wages was downwards between 1956 and 1974, declining to a growth rate of approximately -11 per cent in 1974 alone. Although relatively volatile, the long run average annual growth rate of wage returns remained above the long run annual growth rate of the GDP from 1956 to 1996. This implies that although some productivity improvement was enabling employers to control their real total annual wage bills over the long run, they were still able to pay their workforce a higher real income. However, taking only the short run period between 1988 and 1996, no such trend can be seen.
Figure 10.4  Annual percentage changes in GDP from 1949, HVCA wage returns from 1956, heating and ventilating output from 1958, and construction output from 1956 to 1996

Sources: HVCA declared wage returns ledgers
GDP, Table 1.3 ONS, Economic Trends Annual Supplement 1997 edition No 23, HMSO
GDP deflated using GDP implied deflator at market prices, Table1.1 Prices, Economic Trends Annual Supplement 1997 edition No 23, ONS, p.7
Construction industry series deflated using GCPI.
10.5.9 Figures 10.4 and 10.5 show the annual real rates of growth of construction output, heating and ventilating output and wage returns. The annual rates of growth of heating and ventilating and construction follow a volatile but generally long run declining trend from 1956 to 1973 without any subsequent clear upward trend in annual growth rates since 1974. The depression of 1973 to 1977 can be clearly seen, as can the disruption caused by the recession of the early 1990s. Nevertheless, the data shows little predictability between the variables except perhaps between construction output and wage returns as shown in Figure 10.6.

Sources: HVCA declared wage returns ledgers; Economic Trends Annual Supplement 1997, No 23, HMSO
Note: Construction industry series deflated using GCPI.
10.6 Concluding remarks

10.6.1 One of the conclusions that may be drawn from the nutcracker theory is that pressure on profits may be most acute at the upper turning point in the business cycle. As a result firms require liquid resources to ensure they have sufficient funds to avoid a cash flow problem, though in construction retention monies and late payments may continue to support firms after decline in demand has become apparent. At the lower turning point in the cycle, firms' cash flows are likely to be positive as demand and prices rise before costs, especially labour wage rates. The risk facing heating and ventilating contractors at this point in the cycle is over-rapid expansion, which exhausts working capital and leads to cash flow difficulties. It follows then that appropriate strategies may differ at different points in the cycle.

10.6.2 Many, indeed most, firms do survive any one recession. Recent building cycles, for example, from 1973 to 1979, from 1979 to 1990 and from 1990 to 1996 and beyond have tended to be relatively long and far more volatile compared to earlier short 4 year cycles. Market exit may be expected more in long lasting downturns than if cycles were short and expected to be short. Depending on its liquidity and capital reserves, a firm's ability to survive recessions and take advantage of booms may be the major factor in determining its survival and growth. Many heating and ventilating firms survive by adopting and adapting new methods, technologies and products. Larger firms with larger cash reserves are in a stronger position to do this than smaller firms. This appears to be the case in the heating and ventilating market. New technologies are continually being adopted as a consequence of merger activity.

10.6.3 This fits in to the needs of smaller rapidly expanding firms. They either wish to sell to capitalise on the early development of an innovation, or require the additional marketing and financial strengths of a larger firm to exploit the specific competitive advantage of the small firm before others have time to imitate it. There are also opportunities for large firms during recessions as merger or being taken over by another company is an option for a fundamentally sound firm, which may be in financial difficulties in a declining market, as in the Schumpeterian 'creative destruction' model. The business cycle is therefore central to understanding changes in the population of firms in the heating and ventilating industry.

10.6.4 This chapter has argued in favour of the following propositions:

- There is no one correct way to conduct business because what may be prudent in one set of conditions may not be prudent in another.
- As far as heating and ventilating firms are concerned the business cycle affects demand for their services as exogenous, discrete and irregular shocks.
- There is no predictable pattern of annual expansion and contraction in the heating and ventilating industry in relation to the construction industry or the economy at large.
- However, the relationship between annual changes in aggregate wages in the heating and ventilating industry and total construction output is closer than heating and ventilating wages and heating and ventilating output.
- If the recession of the early 1990s was typical, during periods of recession in the construction industry outside firms have used the opportunity to penetrate the market for
the heating and ventilating rather than heating and ventilating contractors diversifying out of their own specialism.

10.6.5 Many of the propositions of this chapter can be examined by studying the time series of gross domestic product, construction output, heating and ventilating output and annual wage returns. These are therefore examined in detail in the chapters which follow. The next chapter discusses the use of aggregate annual wage returns as a proxy for heating and ventilating industry output and firms’ annual wage returns as a proxy for their turnover, which is one of the conventional measures of size of firm.
Part 5 Findings
Chapter 11  The use of wage returns as a proxy for output

11.1 Introduction

11.1.1 The main questions raised in this research are related to the behaviour of subcontractors as traced by the annual wage returns of heating and ventilating contractors submitted to the HVCA. By convention firm size is usually measured by assets, employment, sales or net output. If annual wage returns are to be used as a measure of size and hence growth, the issue is the extent to which annual changes in wage returns can be taken as a good proxy for annual changes in turnover or in net output (value added).

11.1.2 This chapter compares HVCA aggregate annual wage returns to the official output and employment data of the heating and ventilating industry as a whole and describes trends in heating and ventilating output. The aim of this chapter is to demonstrate that HVCA wage return data may be used as a proxy for output.

11.1.3 If the ratio of total wages to value added in the period under study was reasonably stable, aggregate annual wage returns may then be seen as a central variable of the heating and ventilating industry representing a proxy for net output. Wage returns measure the total amount paid to the labour force, a measure of the share of value added paid to labour.

Figure 11.1 Total annual wage returns of members of the HVCA 1945-1996 at current prices

Notes: Declared total wage returns 1946-97. Annual HVCA wage roll, excluding assessed firms' assessments and 'no data' cells. List based on the alphabetical list of members, using folio numbers
Sources: HVCA Annual Returns and Payments Ledgers

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11.1.4 This chapter begins with a description of the behaviour of the time series of aggregate wage returns. This is then compared to time series of work done and turnover. A time series of total current wages paid to employees of heating and ventilating contractors, who were members of the HVCA, is illustrated in Figure 11.1. The change of annual wages paid by members is due to changing membership or organisational density, increases in wage rates, changes in total hours worked per employee and changes in the number of employees.

11.1.5 Deflating the wage return data given in Figure 11.1 using the Gross Construction Product index (GCPI), the GDP implied deflator (GDPI), and the retail price index (RPI), produce different though broadly similar constant price time series. For the period 1955 to 1996, omitting 1980 to 1986, the GCPI deflated wage return series is slightly less volatile than the other two deflated series. Using the GCPI the ratio of the standard deviation to the mean was 0.25 compared to 0.27 and 0.28 for GDPI and RPI deflated data respectively. The deflated wage returns are given in Figure 11.2.

Figure 11.2 Deflated wage returns 1948-1997 all at 1995 prices, using GDPI, RPI and GCPI

Notes: Declared total wage returns 1946-97
Annual HVCA wage roll, excluding assessed firms' assessments and 'no data' cells.
Sources: HVCA wage return data.
Implied GDP deflator, Table 1.1 National Accounts, Economic Trends Annual Supplement 1997, No 23, ONS, p.7
RPI, Table 2.1, Economic Trends Annual Supplement 1998 edition No 24, ONS, p.135
Adjustment method: GDPD 1990 = 100 data multiplied by 83% (relation in 1995)
GCPI derived from current and constant construction output series provided by the DETR, 2000.

11.1.6 Over the period, both the number of firms in the heating and ventilating industry and the number of firms in the HVCA tended to grow, though at different rates, as shown in Figure 8.3. A high proportion of the larger firms in the heating and ventilating industry are members of the HVCA, and a much lower proportion of smaller firms. Thus the average output (or wage bill) of HVCA members is significantly larger than the average output (or wage bill) of all firms in the industry.
11.1.7 This is confirmed in Figure 11.3, which shows the time series of GCPI deflated wage returns per HVCA member from 1971 to 1996. On average total wage returns per HVCA firm were greater than the work done per firm for the industry as a whole. Both series show a declining average size over the whole period although in real terms by 1996 the average size of firm in the heating and ventilating industry as a whole returned to the average size of firm which had existed in 1980. These trends had been caused by the increase in the number of very small firms since the early 1970s.

**Figure 11.3 Wage returns per HVCA firm and work done per heating and ventilating industry firm 1971-1996**

Sources: Housing and Construction Statistics, Tables 3.1 and 3.10

HVCA wage return data
Notes: All data deflated using the GCPI
Growth in average size of firm based on wage returns between 1980 and 1986 is an assumed straight line.

11.1.8 Figure 11.4 uses the log-transformed GDPI deflated wage returns to illustrate the annual rate of growth in aggregate real wage bills of HVCA member firms. The gradient of the deflated data shows that total wages paid between 1964 and 1994 did not grow taking the period as a whole. This does not necessarily imply that real wage rates did not increase, especially as the number of directly employed people declined after 1974. However, since the end of the 1960s, the wage return series was affected by the switch from direct employment to labour only subcontracting. A negligible trend growth in aggregate wage returns is the result of the increase in real wages per employee being largely off set by the

1 According to Housing and Construction Statistics, Annual, Table 3.4, the total number employed in 1964 was 40,300 and in 1994 it was 44,100 having peaked at 66,400 in 1974. Note: pre-1973 data is adjusted to take account of change in definition of firms sampled in 1973.
decline in the number of the direct employees of HVCA members. It is not certain to what extent direct employees were replaced by subcontracted labour not recorded in the data. In any case, total real wage returns did not grow in the long run, and this reflected static though volatile output, changes in the composition of output, changes in technology and productivity, and changes in employment practices beginning in the mid 1960s.

**Figure 11.4 Wage returns 1948-1996 at 1995 prices deflated by GDPI**

Notes: Implied GDP deflator, 1995 = 100, Table 1.1 National Accounts, Economic Trends Annual Supplement 1997, No 23, ONS, p.7 and Table 2.1, Economic Trends Annual Supplement 1998, No 24, ONS, p.135  
Adjustment method: GDPD 1990 = 100 data multiplied by 83% (relation in 1995)  
Source: HVCA wage return data

11.2 Private Contractors Census 'work done' by heating and ventilating engineers, HVCA turnover and HVCA wage returns

11.2.1 Figure 11.5 shows heating and ventilating industry output data for the years since 1957, when the annual series began and the total turnover data of those HVCA members who provided wage returns for the period 1987 to 1996. HVCA member firms' turnover represented approximately 76 per cent of the estimated output of all heating and ventilating contractors in 1987, 95 per cent in 1990 and 78 per cent in 1996. These figures exclude those members whose wage returns were assessed, and are therefore possibly an underestimate of the proportion of the industry covered by the HVCA in terms of turnover or output. The difference between HVCA members' turnover and total output narrowed in the peak year of 1990. This implies that non-members were not as able as members to take advantage of the boom in sales. The larger firms, who tended to be members of the HVCA may have been in a better position than the smallest firms to take on the larger speculative commercial projects, which were characteristic of the boom in the late 1980s. This is not to
Figure 11.5 Wage returns 1955-1996, output of the heating and ventilating industry 1957-1996 and turnover of HVCA members 1987-1996 at constant 1995 prices

Notes: Wage return data on right axis, turnover and total annual heating and ventilating output on left axis. Data deflated using GCPI 1995 = 100
Sources: HVCA wage return data and Housing and Construction Statistics, Annual, DoE and DETR.

Figure 11.6 Log scale of annual heating and ventilating output and wage returns 1956-1996

Note: data deflated using GCPI, 1995 = 100
Declared total wage returns 1957-97
Sources: Housing and Construction Statistics, Annual, DoE and DETR and HVCA wage return data
say there were no very small firms who were members of the HVCA. In Figure 11.5 output, turnover and wage returns all appear to have peaked in 1990 with recovery beginning again in 1994. In general, wage returns, heating and ventilating output and HVCA firms’ turnover appear to follow similar patterns.

11.2.2 In Figure 11.5 aggregate wage returns peaked in 1968 and remained more or less at the same level until the late 1980s. Indeed the peak year of wage returns in 1990 was not sustained and aggregate real wage returns returned to the levels first achieved in the 1960s. While aggregate wage returns appear to have led heating and ventilating output in the early period, by 1979 the relationship appears to have changed and by 1990 the two series were concurrent. Figure 11.5 shows aggregate wage returns and HVCA members’ turnover in the period 1987 to 1996 varied closely with each other but differed somewhat with heating and ventilating output. Long term differences between heating and ventilating output and wage returns are shown in Figure 11.6, which uses a log scale to illustrate differences in growth rates between heating and ventilating output and annual wage returns. The log scale of the two variables shows that their growth rates have in fact followed similar paths. In general the patterns of growth matched simultaneously.

Figure 11.7 Indices of annual aggregate wage returns of the HVCA 1948-1996, annual heating and ventilating output 1957-1996, and total turnover of HVCA firms 1987-1996, 1987=100

11.2.3 Figure 11.7 shows the indices of aggregate HVCA firms’ wage returns, the aggregate turnover of HVCA firms, and total output of the heating and ventilating industry all deflated by GDPI. Since 1987 movements in wage returns appear to have remained relatively close to movements in the official output data, though not always in the same direction. The HVCA turnover series introduced in 1987 shows that the large absolute difference between the wage return series and the heating and ventilating industry gross output series in Figure 11.5 is due to the high ratio of gross output to wage returns per firm. This is especially the case where
the wage return data is defined to exclude payments to labour only subcontractors. This high ratio of gross output to wages implies a low ratio of value added to purchased inputs, as profit margins in heating and ventilating firms are similar to those found in other parts of the construction industry.

11.2.4 The decline in all three series between 1990 and 1993 reflects the relative decline in construction prices compared to the rest of the economy. This is because Figure 11.7 is deflated using GDPI, which is an average for the whole gross domestic product. However, to measure the real decline in construction, given that construction prices declined, the GCPI deflated data shown in Figure 11.8, demonstrates a more accurate magnitude of the recession in terms of the volume of construction work carried out.

**Figure 11.8**  Index numbers of aggregate HVCA wage returns and estimated heating and ventilating industry output 1957-1997 at 1995 prices, 1995 = 100

Sources: HVCA wage returns
Heating and ventilating output data from PCC in Housing and Construction Statistics, Annual, DETR
Note: All data deflated using the GCPI, 1995 = 100

11.2.5 In Table 11.1 the correlation coefficient of aggregate HVCA wage returns and heating and ventilating output between 1957 and 1979 was 0.81. This fell to 0.40 for the period between 1987 to 1996, confirming the divergence shown in Figure 11.8. However, wage returns appear to have a consistently high correlation coefficient with HVCA turnover provided the data is deflated and log-transformed. The correlation coefficient of wage returns and HVCA turnover from 1987 to 1996 is 0.92, making wage returns an acceptable proxy for turnover of firms in the HVCA. This is consistent with the correlation coefficient of HVCA members’ aggregate turnover to heating and ventilating industry output from 1987
to 1996 at only 0.53. This suggests a wide divergence between the output of the heating and ventilating industry as a whole and the output of HVCA members. The correlation coefficient of the first differences of turnover and wage returns is discussed below in paragraph 11.3.7.

11.2.6 Although wage returns can be seen to correlate with output and turnover, the same cannot be said for the relationship between wage returns and employment (especially of directly employed operatives). No positive correlation would be expected, of course, if real wages per worker (for whatever reason) were tending to rise over time when the numbers employed were in decline.

### Table 11.1 Correlation coefficients of HVCA wage returns, heating and ventilating output and HVCA members’ aggregate turnover

<table>
<thead>
<tr>
<th>Economic variables</th>
<th>Correlation coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVCA wage returns(^1) and HVI output 1957 to 1979(^2)</td>
<td>0.81</td>
</tr>
<tr>
<td>HVCA wage returns(^1) and HVI output 1987 to 1996(^2)</td>
<td>0.40</td>
</tr>
<tr>
<td>HVCA wage returns(^1) and HVCA members’ turnover 1987 to 1996(^1)</td>
<td>0.92</td>
</tr>
<tr>
<td>HVCA members’ turnover(^1) and HVI output 1987 to 1996(^2)</td>
<td>0.53</td>
</tr>
</tbody>
</table>

Note: All data is GCPI deflated at constant 1995 prices and log-transformed.
Sources: \(^1\) Declared wage returns
\(^2\) Housing and Construction Statistics, Annual, DoE and DETR.

11.2.7 The use of wage returns as a proxy for output is supported by the argument that the long run rate of growth of output (from 1961 to 1996) is closer to the long run rate of growth of wage returns than it is to employment. This is indeed found to be the case in Table 11.2 which shows the long run growth rates of a number of variables in heating and ventilating and construction output. The average rate of growth in wage returns from 1961 to 1996 was 0.84 per cent per annum. Heating and ventilating output over the same period grew at 1.85 per cent per annum, whereas employment in heating and ventilating contractors remained almost constant between 1961 and 1996 rising on average by only 0.26 per cent per annum. If wage returns are taken to be a proxy for output then the output of HVCA firms grew more slowly than the total output of the heating and ventilating industry. However, the discussion up to this point has been based on long run growth trends. Using the data in this form is prone to auto-correlation leading to higher correlation due to the similar but completely independent growth trends of the time series. Before accepting wage returns as a proxy for turnover further analysis is required especially concerning annual data and annual changes.

11.2.8 Table 11.2 also shows the long run growth rates of a number of construction industry output variables. For example, from 1961 to 1996 although total construction industry output increased at the rate of 0.93 per cent per annum, construction industry new build output declined on average by 0.3 per cent per annum. In the following analysis of wage returns two
Table 11.2 Annual percentage growth rates of the heating and ventilating and construction industries 1961-1996

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVCA aggregate wage returns</td>
<td>0.84</td>
</tr>
<tr>
<td>HVI total employment</td>
<td>0.26</td>
</tr>
<tr>
<td>HVI total output</td>
<td>1.85</td>
</tr>
<tr>
<td>Construction industry all new work</td>
<td>-0.3</td>
</tr>
<tr>
<td>Construction industry repair and maintenance</td>
<td>2.93</td>
</tr>
<tr>
<td>Construction industry all work</td>
<td>0.93</td>
</tr>
</tbody>
</table>

Notes: 1961 was the first year of continuous HVI employment data found. HVCA annual wage return data deflated using the GCPI 1995 = 100. Wage return data for 1980 to 1986 assumed to be straight line. Long run average growth rates measured as linear trend of annual series. Sources: DETR for construction industry new build and repair and maintenance output at 1995 prices. Housing and Construction Statistics for heating and ventilating output data deflated using the GCPI 1995 = 100 HVCA annual wage returns

Distinct periods are used, from 1958 to 1979 and from 1989 to 1996. These years are used, because there was a gap in the wage return data from 1980 to 1987 and because the heating and ventilating industry output series began in 1957. If annual changes in wage returns depend on annual changes in construction output, then it follows that:

\[
\Delta W_{Rt} = f(\Delta C_{It}, e) \tag{11.1}
\]

where \(\Delta W_{Rt}\) = annual change in aggregate wage returns in year \(t\)
\(\Delta C_{It}\) = annual change in construction output in year \(t\)
and \(e\) = error term.

11.2.9 Using regression analysis to analyse the relationship between 1958 and 1979 Equation 11.1 becomes:

\[
\Delta W_{Rt} = \beta_1 + \beta_2 \Delta C_{It} \tag{11.2}
\]

The result of running a regression on the first differences of both wage return and construction output data from 1958 to 1979 in Equation 11.2 produces:

\[
\Delta W_{Rt} = 2314583.5 + 4917.870\Delta C_{It} \tag{11.3}
\]

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>11297158</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.4493057</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>22</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>20</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>1217.437</td>
</tr>
</tbody>
</table>
11.2.10 If a one-year time lag is introduced Equation 11.2 becomes:

$$\Delta W_R t = \beta_1 + \beta_2 \Delta C_I_{t-1} \quad (11.4)$$

Equation 11.4 produces the following regression equation for wage returns 1958 to 1979 lagged one year behind construction output:

$$\Delta W_R t = 4321373.2 + 2252.093 \Delta C_I_{t-1} \quad (11.5)$$

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>14487968</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.094</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>22</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>20</td>
</tr>
<tr>
<td>Std Err. of Coef.</td>
<td>1560.712</td>
</tr>
</tbody>
</table>

11.2.11 From Equation 11.3 the coefficient of determination of the regression of wage returns and construction industry output between 1958 and 1979 is therefore 0.45 but only 0.09 when a one year time lag is introduced. This result therefore implies that a 45 per cent variability of annual aggregate wage returns may be accounted for by changes in construction output in the same year, assuming ceteris paribus.

11.2.12 A similar analysis of the period from 1989 to 1996 produces the following results in Equations 11.6 and 11.7:

$$\Delta W_R^{*t} = 1607753.7 + 6306.650 \Delta C_I^{*t} \quad (11.6)$$

where \( \Delta W_R^{*t} \) = annual change in wage return 1989 to 1996

and \( \Delta C_I^{*t} \) = annual change in construction output 1989 to 1996

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>22052313</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.324</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>8</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Std Err. of Coef.</td>
<td>3716.183</td>
</tr>
</tbody>
</table>

and

$$\Delta W_R^{*t} = -823039.3 + 4723.948 \Delta C_I^{*t-1} \quad (11.7)$$

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>22561347</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.293</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>8</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>6</td>
</tr>
<tr>
<td>Std Err. of Coef.</td>
<td>2997.365</td>
</tr>
</tbody>
</table>
11.2.13 Although the number of observations is only 8, the coefficient of determination of the concurrent series is only 0.32 and is 0.29 when a one year time lag is introduced. These results imply a weak link between construction output and wage returns.

11.2.14 However, it is as a proxy for heating and ventilating output that wage returns are to be used and it is therefore the relationship between wage returns and heating and ventilating output rather than construction output that is of interest. A set of regressions were also run relating changes in wage returns to changes in heating and ventilating output between 1958 and 1979, again using concurrent and lagged data.

11.2.15 The model used is given in Equation 11.8

\[ \Delta \text{WR}_t = f(\Delta \text{HVI}_t, e) \] (11.8)

where \( \Delta \text{WR}_t \) = annual change in aggregate wage returns in year \( t \),
\( \Delta \text{HVI}_t \) = annual change in heating and ventilating output in year \( t \)
and \( e \) = error term.

11.2.16 The equivalent regression equation is given by:

\[ \Delta \text{WR}_t = \beta_0 + \beta_1 \Delta \text{HVI}_t \] (11.9)

Regressing the first differences of both wage return and heating and ventilating output data from 1958 to 1979 in Equation 11.9 produces:

\[ \Delta \text{WR}_t = 4608329.7 + 0.023 \Delta \text{HVI}_t \] (11.10)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>14891007</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.095</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>21</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>19</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.016</td>
</tr>
</tbody>
</table>

11.2.17 The value of R^2 in Equation 11.10 is only 0.09. When a one year time lag is introduced into the model the following regression equation for wage returns 1958 to 1979:

\[ \Delta \text{WR}_t = 613183.2 + 0.006 \Delta \text{HVI}_{t-1} \] (11.11)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>15604435</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.007</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>21</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>19</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.017</td>
</tr>
</tbody>
</table>

11.2.18 The coefficient of determination of the model in Equation 11.11 was extremely low at 0.007. It would appear from these results that annual wage returns are not strongly related to annual changes of the output of the heating and ventilating industry. This suggests, at first, that wage returns are a poor proxy for heating and ventilating industry output.

11.2.19 The timing of construction output and both heating and ventilating output and wage returns shows that annual changes in wage returns reflect construction output.
consistently and concurrently. However, the relationship between changes in heating and ventilating demand and changes in total wages appears to present a confusing picture. In fact from Figures 11.9 and 11.10, no particular regular relationship between the annual changes in heating and ventilating demand and changes in the total heating and ventilating wage bill emerges either in the concurrent or the lagged data. This is confirmed below by the very low values of \( R^2 \) found in regressions of the time series. Time lags based on annual time series do not therefore make a useful contribution to understanding the relationship between construction output, heating and ventilating output and heating and ventilating wage returns.

**Figure 11.9** Annual percentage changes in heating and ventilating output and HVCA wage returns 1958-1996

**Figure 11.10** Annual percentage changes in heating and ventilating output (\( \Delta HVI_t \)) 1958-1996 and HVCA wage returns (\( \Delta WR_{t+1} \)) lagged by one year 1958-1996

Sources: Housing and Construction Statistics, Annual, DETR and HVCA wage returns ledgers
Notes: \( HVI_t \) = heating and ventilating industry output in year \( t \)
\( WR_{t+1} \) = wage returns lagged one year
11.2.20 This would also support the argument above that total annual wages in heating and ventilating are determined more by labour market conditions in the construction industry as a whole rather than by the level of activity in the heating and ventilating market. Consequently, this conclusion to some extent weakens the link between the aggregate HVCA wage return data and aggregate heating and ventilating industry output, as the correlation coefficient of the first differences of concurrent wage returns and heating and ventilating output from 1957 to 1996 is only 0.29.

11.2.21 Nevertheless, it does not necessarily imply that output and total wages are not good proxies for each other at the level of the firm, or indeed, the industry. The discussion so far has been concerned with annual changes in wage returns and annual changes in heating and ventilating output. If growth rates of firms and the industry are being considered it is appropriate to take longer term periods into account and not just single year growth rates to investigate underlying trends and changes. Annual data contains statistical noise which 5-year moving averages partly remove. Figure 11.11 shows the 5-year moving average of wage returns and the 5-year moving average of the output of the heating and ventilating industry. The wage return data relates to the 5-year moving average from 1958 to 1977 and 1989 to 1994 because of the availability of data. The analysis below therefore deals with both periods separately.

**Figure 11.11** 5-year moving averages of annual percentage change in wage returns 1958-1977 and 1989-1994 and heating and ventilating output 1960 to 1994

Source: Housing and Construction Statistics, Annual, DETR
HVCA wage returns ledger
11.2.23 In order to make consistent comparisons below only wage returns from 1962 to 1977 are used in the following analysis. Thus for the period 1962 to 1977, Equation 11.12 states that the 5-year moving average of wage returns is a function of the 5-year moving average of the output of the heating and ventilating industry.

\[ \text{WR}^*_{t} = f(\text{HVI}^*_{t}, e) \] (11.12)

where \( \text{WR}^*_{t} = 5\)-year moving average of annual percentage changes in aggregate wage returns in year \( t \) from 1962 to 1977

\( \text{HVI}^*_{t} = 5\)-year moving average of annual percentage changes in heating and ventilating output in year \( t \) from 1962 to 1977

and \( e = \) error term

\[ \text{WR}^*_{t} = \beta_1 + \beta_2 \text{HVI}^*_{t} \] (11.13)

11.2.24 Regressing the data used in Figure 11.11 and substituting in Equation 11.13 gives:

\[ \text{WR}^*_{t} = -0.13 + 0.573 \text{HVI}^*_{t} \] (11.14)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>4.7687</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.2662</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>16</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>14</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.2541</td>
</tr>
</tbody>
</table>

11.2.25 As \( R^2 \) is only 0.27 heating and ventilating output in any one year is not a particularly strong determinant of wage returns. However, the following equations show the regression of the 5-year moving average of heating and ventilating output in year \( t-1 \) on the 5-year moving average of wage returns in year \( t \). The resulting regression equation is given in Equation 11.15.

\[ \text{WR}^*_{t} = \beta_1 + \beta_2 \text{HVI}^*_{t-1} \] (11.15)

For wage returns from 1962 to 1977, the data shows:

\[ \text{WR}^*_{t} = 0.88 + 0.280 \text{HVI}^*_{t-1} \] (11.16)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>5.3887</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.0630</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>16</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>14</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.2883</td>
</tr>
</tbody>
</table>
11.2.26 If heating and ventilating output is lagged by 2 years, then for wage returns from 1962 to 1977, the regression equation becomes:

\[ WR_{t} = \beta_{1} + \beta_{2}HVI_{t-2} \]

(11.17)

and the regression is:

\[ WR_{t} = 1.88 + 0.013 HVI_{t-2} \]

(11.18)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>5.5665</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.0001</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>16</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>14</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.2973</td>
</tr>
</tbody>
</table>

11.2.27 Clearly, after 2 years changes in heating and ventilating output had little effect on changes in wage returns. However, running the regression of Equation 11.19 for heating and ventilating output from 1962 to 1977 produces the following result:

\[ HVI_{t} = \beta_{1} + \beta_{2}WR_{t-2} \]

(11.19)

Equation 11.8 becomes:

\[ HVI_{t} = 1.98 + 0.602 WR_{t-2} \]

(11.20)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>3.4082</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.5383</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>16</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>14</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.1490</td>
</tr>
</tbody>
</table>

11.2.28 The coefficient of determination of Equation 11.20 is 0.54 which is a higher \( R^2 \) than found in any of the other regressions run. This implies that over 50 per cent of the variation in heating and ventilating output can be accounted for by the change in wage returns two years earlier. This suggests that firms increase their labour inputs two year before output increases. The increase in labour may be due to short term responses to demand but having increased capacity it would appear that turnover increases in response, perhaps because of additional marketing effort by firms and increased in house technical knowledge.

11.2.29 Concurrent data for heating and ventilating output from 1962 to 1977 shows that:

\[ HVI_{t} = 2.7 + 0.465 WR_{t} \]

(11.21)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>4.2967</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.2662</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>16</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>14</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.2063</td>
</tr>
</tbody>
</table>
11.2.30 In Equation 11.21 the value of $R^2$ when the series are concurrent is again only 0.27. This suggests that wage returns in any one year are not a strong predictor of heating and ventilating output in the same year. If wage returns could be used to anticipate heating and ventilating output two years later in the period prior to 1977, the same relationship does not appear to hold in the period from 1989 to 1994.

$$WR_t^* = -1.80 - 0.803 HVI_t^* \quad (11.22)$$

where $WR_t^*$ = 5-year moving average of annual percentage changes in aggregate wage returns in year $t$ from 1989 to 1994

$HVI_t^*$ = 5-year moving average of annual percentage changes in heating and ventilating output in year $t$ from 1989 to 1994

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>2.0931</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.1033</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>6</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>4</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>1.1834</td>
</tr>
</tbody>
</table>

11.2.31 In Equation 11.22, which regresses concurrent wage return data and heating and ventilating output, $R^2$ is only 0.1 showing a relatively weak relationship between the output of the industry and the aggregate wages paid to labour by HVCA members. However, when time lags are introduced into the wage return data, the value of the coefficient of determination increases to 0.41 with a lag of one year and 0.46 with a lag of two years in Equations 11.23 and 11.24 respectively.

$$WR_t^* = -0.73 + 0.656 HVI_{t-1}^* \quad (11.23)$$

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>1.7029</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.4064</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>6</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>4</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.3965</td>
</tr>
</tbody>
</table>

$$WR_t^* = -0.93 + 0.651 HVI_{t-2}^* \quad (11.24)$$

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>1.6206</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.4624</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>6</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>4</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.3511</td>
</tr>
</tbody>
</table>

11.2.32 This might imply that wage returns in the period between 1989 and 1994 had a tendency to follow industry output after a lag of one or two years. However, the value of $R^2$ in Equation 11.25, which only models wage returns from 1991 to 1994 and heating and ventilating output as the dependent and independent variables respectively is also of a similar
order at 0.44. These results can only be indicative as only 4 observations were possible and the available data did not allow comparable years to be assessed.

\[
HVI_t^\prime = -0.82 - 0.278 \, WR_{t-2}^\prime
\]  

where \( WR_t^\prime \) = 5-year moving average of annual percentage changes in aggregate wage returns in year \( t \) from 1991 to 1994.

\( HVI_t^\prime \) = 5-year moving average of annual percentage changes in heating and ventilating output in year \( t \) from 1991 to 1994.

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>0.7545</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.4368</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>4</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>2</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.2231</td>
</tr>
</tbody>
</table>

11.2.33 This analysis suggests that in the period between 1959 and 1977 increases in labour expenditure increased capacity and this allowed firms to expand after a time lag. This occurred at a time of predominantly direct employment. By 1991 casual employment replaced direct employment. As a result, firms tended to respond to changes in output rather than seek increased capacity through increased employment. Although employment costs declined as a response to the decline in demand and output due to the recession between 1991 to 1994, the response of firms in those years indicates the underlying trend and cause. Firms did not increase their capacity by employing labour directly and this was reflected in the lack of real growth in the industry extending back to the 1970s.

11.3 Use of wage returns as a proxy for turnover, value added and gross output

11.3.1 Aggregate wage returns are a product of the number employed by HVCA members and the average wages paid per worker per year. The proportion of the total number of heating and ventilating firms which happen to be members of the HVCA in any particular year also affects the ratio between wage returns and heating and ventilating industry output. For example, if the percentage of heating and ventilating firms taking up membership of the HVCA increased over time, then aggregate wage returns would reflect higher membership numbers but not necessarily growth in the output of the heating and ventilating industry.

11.3.2 It might be expected that wage returns reflect the level of output and changes in market conditions over time and in response to the business cycle. If wages represented the greater part of all costs then, in an industry known to have relatively low profit margins, the total wage bill (as measured by wage returns) would be expected to be closely related to total output of HVCA member firms. However, the evidence suggests that wage costs represent less than 15 per cent of the turnover of HVCA firms, (see Table 11.3).

11.3.3 A much stronger link could be predicted to exist between wage costs and value added, than between wage costs and total output. Unfortunately we do not possess value added data, either for individual firms from company accounts, or for the heating and ventilating industry from official statistics.

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11.3.4 It is possible that changes in profit margins and costs other than wages could cause large percentage changes in the measurement of output from one year to the next, which are not reflected in changes in wage bills. The use of wage bills as a proxy for value added depends on a high labour intensity in the heating and ventilating industry. In the event, the relationship between wage returns and turnover between 1987 and 1996 was relatively stable.

11.3.5 Table 11.3 compares wage returns as a percentage of turnover of the same heating and ventilating firms in the period 1987 to 1996 from data provided by the HVCA. With the exception of 1990, wages were between 13 and 15 per cent of turnover in each year, tending to increase over time as a percentage of turnover. The mean percentage of total wage returns to turnover for the period 1987 to 1996 is 13.6 per cent. The relationship between the two variables is in general relatively stable from one year to the next.

|------|------|------|------|------|------|------|------|------|------|------|

Notes: TWR = Total wage roll, including LOSC; TO = Aggregate annual turnover. All data at current prices
Source: HVCA wage returns

11.3.6 This is confirmed in Figure 11.12, which shows that turnover grew until 1990, and then declined until 1994, the pattern of growth and decline appearing to be reflected in the annual wage returns.

Figure 11.12 Index of HVCA firms’ turnover and wage returns 1987 to 1996 at 1995 prices.

Source: HVCA wage return and turnover data.
11.3.7 The time series of turnover and total wage roll are thus comparable. The similarities between the two series are confirmed using a comparison of first differences. Figure 11.13 shows the annual changes of turnover and wage bills between 1988 and 1996 and supports the argument that for members of the HVCA annual changes in wage returns can be taken as a proxy for changes in turnover. The correlation coefficient of the annual percentage changes in real aggregate wage returns and turnover was 0.90.

Figure 11.13 Annual percentage changes in turnover and aggregate wages 1988 to 1996 at 1995 prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Turnover</th>
<th>Total wage roll</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1991</td>
<td></td>
<td></td>
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<tr>
<td>1992</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Annual percentage changes in turnover and total wage roll. The total wage roll is the aggregate wages paid by members of the HVCA.
All data deflated using the GCPI 1995 = 100
Source: HVCA wage returns and turnovers.

11.3.8 Although these wage returns from 1987 onwards included in principle both directly employed labour and labour only subcontractors, it is possible that some labour only subcontracting was not recorded in the data, for a number of well known reasons. Nevertheless Table 11.4 shows the dramatic increase in labour only subcontracting as a proportion of total labour employed by members of the HVCA reported to the HVCA between 1987 and 1996, the percentage reported almost doubling in the 10 years shown. This increase may be as much due to improved reporting as an indication of an increase in casual employment in the heating and ventilating industry, as both are likely to have been the case.
Table 11.4 Subcontracted labour as a percentage of aggregate wages 1987-1996.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WR Subcon.)/TWR</td>
<td>15.01</td>
<td>15.70</td>
<td>19.17</td>
<td>18.23</td>
<td>18.92</td>
<td>17.21</td>
<td>20.19</td>
<td>22.39</td>
<td>25.38</td>
<td>29.72</td>
</tr>
</tbody>
</table>

Note: WR (Subcon.) = Aggregate annual wage roll paid to subcontracted labour. TWR = total wage returns
All data at current prices
Source: HVCA wage returns

11.3.9 Alternatively, the relationship between turnover and the wage bill may be viewed in terms of the total output per £1 spent on wages. Table 11.5 shows that between 1987 and 1996 the annual turnover per £1 spent on wages by HVCA members was between £6.72 and £7.59, with the exception in 1990 when the ratio peaked at £8.12. Based on this data for the period 1987 to 1996, the mean was £7.4.

Table 11.5 The ratio of turnover to wages, 1987-1996

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TO/TWR*</td>
<td>7.25</td>
<td>7.59</td>
<td>7.49</td>
<td>8.12</td>
<td>7.40</td>
<td>7.38</td>
<td>7.50</td>
<td>7.28</td>
<td>7.09</td>
<td>6.72</td>
</tr>
</tbody>
</table>

Note: *As a measure of productivity this table shows the value of output per £1 spent on wages (including LOSC).
All data at current prices
Source: HVCA wage returns

11.3.10 If aggregate annual wage returns are used as a proxy for output or turnover, annual wage returns can be factored into a formula to predict output for any given year. Table 11.6 shows estimated annual aggregate turnover for the period 1987 to 1996, using the mean ratio of turnover to wage returns, namely 7.4.

Table 11.6 Actual and estimated turnover, 1987-1996

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated turnover</td>
<td>2000</td>
<td>2013</td>
<td>2066</td>
<td>2339</td>
<td>2117</td>
<td>2068</td>
<td>1795</td>
<td>1784</td>
<td>1919</td>
<td>2036</td>
</tr>
<tr>
<td>Actual turnover</td>
<td>1963</td>
<td>2071</td>
<td>2096</td>
<td>2572</td>
<td>2122</td>
<td>2068</td>
<td>1824</td>
<td>1759</td>
<td>1843</td>
<td>1854</td>
</tr>
<tr>
<td>Error</td>
<td>37</td>
<td>-58</td>
<td>-30</td>
<td>-233</td>
<td>-5</td>
<td>0</td>
<td>-29</td>
<td>25</td>
<td>76</td>
<td>182</td>
</tr>
<tr>
<td>Error %</td>
<td>1.8</td>
<td>2.8</td>
<td>1.4</td>
<td>9.1</td>
<td>0.2</td>
<td>0.0</td>
<td>1.6</td>
<td>1.4</td>
<td>4.1</td>
<td>9.9</td>
</tr>
</tbody>
</table>

Note: All data in £m at 1995 prices, deflated using GCPI
Source: HVCA wage returns

Figure 11.14 shows the cyclical pattern of the errors given in Table 11.6. In 1990, for example, the model underestimates turnover by £233m.
Figure 11.14 Difference between estimated and actual turnover 1987-1996

Note: All data in £m at 1995 prices, deflated using GCPI
Source: HVCA wage returns

Figure 11.15 Estimated HVCA turnover and heating and ventilating output 1955-1997 at 1995 prices

Note: Both series based on GCPI deflated data 1995 = 100.
Sources: HVCA wage return data, and HVI output, Housing and Construction Statistics, Annual, DETR
11.3.11 The results of Table 11.6 produce a mean error of ±4.6 per cent. On this basis, turnover of HVCA members can be estimated for earlier years (for which direct turnover information is unavailable) using the same ratio of turnover to wages of 7.4 to factor up the wage returns. Figure 11.15 shows the estimated turnover of HVCA members based on annual wage return data for the period 1957 to 1996.

11.3.12 A comparison of the series can be divided into three periods: namely, up to 1968, 1969 to 1979, and 1987 to 1996. In the first period, using wage returns as a proxy for heating and ventilating industry output, the size of HVCA members’ aggregate turnover and expansion up to 1968 are overstated. The rate of increase in the estimated turnover of HVCA members was faster than the rate of increase in the whole industry and the estimate of aggregate turnover of HVCA members exceeded the estimate of output for the whole industry. In the period between 1969 and 1979 estimated turnover declined before output of the heating and ventilating industry but also recovered before the expansion of the industry, which began in 1976. In the third period since 1987 although the series are in general concurrent, the decline in estimated turnover of HVCA member firms was greater than the decline in the industry as a whole.

11.3.13 One reason for the differences between the series is that employment practices changed from directly employed labour to casual employment and the definition of wage returns which excluded labour only subcontractors in the period up to 1979 included both directly employed and casual workers in the period after 1987. Because of these long term trends the interpretation of wage returns as a proxy for heating and ventilating industry output cannot be held to be consistent over the long run. However, the mean error of the estimates was only ±4.6 per cent between 1987 and 1996. Given the limitations described above concerning the period prior to 1968, wage returns produce an acceptable proxy for HVCA turnover within an acceptable error margin over the long run though not necessarily for any given year.

11.4 Productivity

11.4.1 One reason wage returns have limited usefulness as a proxy for industry output or indeed HVCA members’ turnover in the long term is because of changes in productivity over time. If labour productivity increases then output increases more than labour input. If output per worker increases then wage rates per worker may rise unless wages are more responsive to changes in the labour market than to changes in productivity.

11.4.2 If wage rates rise, firms may respond by substituting labour with capital and the increase in capital intensity has the effect of increasing productivity. At the same time the increase in productivity creates the opportunity for firms to employ fewer people albeit at higher wage rates and still increase output without necessarily increasing total wage costs. However, this effect of rising wages may be mitigated if the rise in productivity leads to lower unit costs, which are then used by firms to lower their output prices in competition with other firms. Indeed, improvements in productivity do not necessarily lead to increased output if the market cannot absorb the increased production. Thus productivity changes may detach aggregate wage returns from output in a number of different ways.
11.4.3 Changes in the productivity of heating and ventilating firms as measured by output and numbers employed given in *Housing and Construction Statistics* can be estimated from the data used in Figures 11.15 and 11.16. Figure 11.16 gives the time series of employment patterns in the heating and ventilating industry from 1961 to 1997. The graph shows that the number of operatives (including trainees) and APTCs declined from its peak in 1974. The level of employment in 1997 was almost the same as that given for 1961. These trends are, of course, similar to those found in other sectors in the construction industry.

11.4.4 Figure 11.15 shows the gross output of the heating and ventilating industry from 1957 to 1996. A measure of productivity in the heating and ventilating industry can be derived from the series of real gross output shown in Figure 11.15 and the total employment data illustrated in Figure 11.16, by dividing annual gross output by the number employed. This measure of annual gross productivity at 1995 prices is given in Figure 11.17. Productivity per person increased from £26,000 in 1961 to £56,000 per annum in 1997, giving a long run annual rate of increase in productivity per person of 2.21 per cent per annum, as stated earlier in Chapter 7 Section 3.

11.4.5 It can be seen from Figure 11.18, which shows the indices of employment and wage returns from 1961 to 1996, that although the pattern of employment shares some common features with wage return data neither series can be seen as a reliable indicator of the other. As the data is deflated using the GCPI, wage returns are measured relative to the price of all construction output rather than the real purchasing power of wages.
Figure 11.17 Gross productivity per person in the heating and ventilating industry, 1961-1997 at 1995 prices.

Source: Housing and Construction Statistics, Annual, DETR
Note: Pre-1973 data adjusted to take change of definition in 1973 into account.

Figure 11.18 Indices of operative and APTC employment in the heating and ventilating industry and HVCA wage returns 1961-1996

Note: APTC = administrative, professional, technical and clerical staff
Sources: Private Contractors’ Census and Housing and construction Statistics, DETR, annual.
HVCA wage returns at constant 1995 prices deflated using the GCPI
11.4.6 Figure 11.19 uses only the total employment and wage return data in Figure 11.18. With the proviso that total employment figures are taken from the Private Contractors' Census and represent a distinct sample (though overlapping) of firms compared to the membership of the HVCA, a comparison of the two series shows that from 1961 to 1968 wage returns rose slightly faster than total employment. This suggests that construction prices were rising at a lower rate than money wages, so that real wages were rising in terms of construction output prices. In the period from 1968 to 1973, employment rose relative to wage returns, which implies that real wages (relative to construction costs) were falling, assuming wage returns represented a constant proportion of actual total employment. This fall in real wages coincided with prices and incomes policies which affected employers' ability to increase wages and the increase of casual employment following the introduction of Selective Employment Tax (SET) in 1968. The employment and wage return data imply that the effects of prices and incomes policies and of SET were to encourage the switch to labour only subcontracting, whilst overall reducing the relative price of directly employed labour compared to construction.

**Figure 11.19 Indices of HVCA wage returns and total employment in the heating and ventilating industry 1961-1996**

![Graph](image)

**Note:** APTC = administrative, professional, technical and clerical staff

**Sources:** Private Contractors' Census and Housing and construction Statistics, DETR, annual.

HVCA wage returns at constant 1995 prices deflated using the GCPI

11.4.7 From 1973 to 1979 and 1987 to 1989 wage returns broadly declined and rose in line with employment, again implying constant real wages. From 1989 to 1990 the rise in wage returns but not in employment implies an increase in real wages as capacity was approached in the construction boom of the late 1980s. From 1990 to 1994 wage returns moved in line
with employment but from 1994 to 1996 they rose relative to employment reflecting an increase in real wages. Indeed since the mid 1970s, Figure 11.19 clearly shows that while employment has been on a downward trend in general, wage returns (which since 1988 have included labour only subcontractors) have broadly increased.

11.4.8 Wage returns reflect total wages paid by firms. As total wages grew at a slower rate than output, then the difference may be attributed partly to productivity improvements after wage rate changes and real price effects (in response to market conditions rather than inflation). Hence net productivity growth is the difference between the growth of long run annual output and average annual wage bills net of wage rate changes. The following formula, Equation 11.26, (based, for example, on Davis and Pointon 1994, p.61) uses the growth rate of real (i.e. deflated) wage returns but ignore real changes in wage rates:

\[
P_g = \left[\frac{(1 + HVI_g)/(1 + W_g)}{1}\right] - 1
\]

where

- \( P_g \) = annual real productivity growth rate
- \( HVI_g \) = heating and ventilating industry growth rate
- \( W_g \) = wage return growth rate

11.4.9 The ratio of the average annual growth of the heating and ventilating industry (according to work done figures in the annual Private Contractors Census) to the annual average growth rate of firms' aggregate wage returns provides an estimate of average annual productivity improvement. From 1961 to 1996 the average annual growth of the heating and ventilating industry was 1.85 per cent per annum and firms' wage returns grew at the rate of 0.84 per cent per annum in the same period. These figures imply that productivity as measured by the annual change in real output per pound spent on wages in the heating and ventilating industry increased at the rate of only 1.00 per cent per annum on average. From 1972 to 1996 the long run annual rate of change in productivity actually declined to -0.11 per cent per annum. This decline in 'productivity' may have been partly because real prices of heating and ventilating equipment and services may have declined in much the same way as other high technology goods markets. Also, real wages may have increased as a share of value added in the period, especially as the heating and ventilating market did not increase in real terms in the period between 1971 and 1996, a feature which can be seen in Figure 11.15.

11.4.10 These results using wage return data are less than the productivity increases implied in the data of the Housing and Construction Statistics discussed above. The wage return data give the impression of declining productivity especially after 1972. The long run data for the period from 1961 to 1996 based on official statistics gives an average rate of increase in productivity per person of 1.58 per cent per annum, accelerating to 2.33 per cent per annum between 1972 and 1996. The difference between the two assessments of productivity changes, however, can probably be accounted for by the increase in labour only subcontracting which is excluded from the official figures of those employed in the industry but not from the wage return data submitted to the HVCA. Therefore, with declining direct employment and rising casual employment, it is reasonable to suggest that the HVCA based estimates of productivity changes are likely to be more accurate than the official based calculations.
11.4.11 Although HVCA firms' wage returns may be a reasonable proxy for HVCA firms' turnover, as this discussion of productivity has shown wage returns do not provide an accurate proxy of employment, the difference being accounted for by productivity improvements and changes in wage rates. Nevertheless, an analysis of the wage returns of individual firms does help to provide an analysis of the relative changes taking place between firms in the industry and they also permit an analysis of the relationship between growth rates and survival of individual firms.

11.5 Concluding comments

11.5.1 If we are interested in using wage returns as a proxy for turnover (or even value added), it follows that the validity of this approach is weakened the smaller the proportion of costs represented by wages. According to Fleming and Tysoe (1991, p135-6), the ratio of labour to materials used by members of the HVCA to price contracts ranged from 13:87 to 60:40. They found that almost half the respondents used a ratio of 35:65, which is the ratio used by the BCIS to calculate its price indices for heating and ventilating and air conditioning work. Clearly the range of figures given for the labour weighting in work by heating and ventilating contractors reflects the kind of work undertaken by different firms as well as the type of equipment used, investment undertaken by the firm and the capital intensity of the different processes they undertake.

11.5.2 If firms rely on labour to differing extents, then their ability to withstand pressure of pay rises will vary from firm to firm. A given pay increase affects some firms more than others depending on the weighting given to labour costs. It is quite likely that where labour costs represent a high proportion of costs, firms will resist pay rises to a greater extent. On the other hand, those firms with the lowest proportion of labour costs are in the strongest position to absorb pay increases without passing on the increase. However, in considering wage returns as a proxy for turnover it is assumed that a straight line relation exists between labour costs and output which applies equally to all firms in the industry.

11.5.3 Furthermore, the aggregate wage bill is the product of the number of firms and the size of the average wage bill, which in turn is the product of the number of people employed, their hours worked and the average wage. It therefore follows that knowing the aggregate wage bill does not necessarily indicate anything concerning the behaviour of these independent variables. Using the aggregate annual wage bill as a proxy for turnover therefore ignores the impact of increasing productivity, changing technology and changes in real prices of the output of heating and ventilating contractors. These factors impede the usefulness of wage returns as a measure of size, but other measures also have their limitations.

11.5.4 Shalit and Sankar (1977 p.293) compared a number of measures of firm size. These measures were annual value of sales, assets net of depreciation and depletion, number of employees, stockholders' equity (defined as capital stock, surplus and retained earnings) and market value at the year end. They concluded that, no one measure was better than the others.
in all applications. They pointed out that employment was a poor predictor of sales, assets, equity and market value. However, while employment is a real resource, the other four measures are financial variables. In this research wage returns (a financial variable) are used rather than numbers employed.

11.5.5 It was necessary to find a proxy, which shows changes in the relative size of firms since 1946. Thus, wage returns are used as a proxy for turnover or output, because of the difficulty of obtaining reliable data on output from accounts especially before 1968. Indeed, even obtaining the accounts of small and medium sized enterprises still leaves the problem of interpretation and consistency of accounts for research purposes. Fortunately, certified annual wage returns have been filed by all members of the HVCA. These wage returns have formed the basis of their membership fee calculations since the HVCA was formed in 1903.

11.5.6 In summary, wage return data provides the total wages paid by firms per annum. The use of wage returns as a proxy for turnover is however, somewhat limited. The total wage bill is the product of numbers employed and the average wage. From the annual total it is not possible to determine whether changes in the total are due to changes in the number employed or to changes in the average wage paid, especially as overtime could be earned without any change in the rates of pay. Although the wage return data may reflect output, it does not take account of profit margins and changes in technology and the types of work undertaken.

11.5.7 Having discussed the use of annual wage returns as a proxy for output, the following chapter examines the relationship between the time series of aggregate annual wage returns and other time series of the economy as a whole and the construction industry. Changes in GDP, construction output and heating and ventilating output are shown to have varying effects on total wage returns.
Chapter 12 The relationship between heating and ventilating output, heating and ventilating wage bills, construction output and GDP

12.1 Introduction

12.1.1 The previous chapter established that the HVCA annual wage returns are a reasonable proxy for the output of member firms. This chapter examines the economic context of these wage returns in terms of data provided in official publications such as Housing and Construction Statistics and the National Income Accounts. The relationships between the GDP, construction industry output, heating and ventilating output and aggregate annual wage returns are studied. Changes in GDP cascade down to the wages paid by firms. Such a model assumes that changes in GDP affect the construction industry, which in turn leads to changes in demand and output of heating and ventilating firms. As heating and ventilating demand changes there are changes in the level of employment and wages paid to heating and ventilating engineers, which in turn affect wage returns.

12.1.2 Aggregate wages of HVCA firms used in this analysis are a function of wage rates, employment, technology, self employment and membership of the HVCA, and not only a function of macroeconomic factors such as national income and general demand for construction. The growth patterns of firms (measured by wage returns) over time may therefore be correlated with a number of external and internal factors.

12.1.3 In Section 12.2 the relationship between heating and ventilating output and GDP is discussed. This is followed in Section 12.3 by a discussion of the relationship between heating and ventilating output and construction output. Whereas sections 12.2 and 12.3 are concerned with trend rates of growth, Sections 12.4 and 12.5 deal with the relationship between heating and ventilating output in terms of their annual changes. Section 12.6 combines GDP, construction and heating and ventilating output in a model of the determinants of wages in the heating and ventilating industry. Sections 12.3, 12.4 and 12.5 deal with Propositions (i) and (ii) stated in Chapter 2 on the relationship between the output of the heating and ventilating industry and construction industry output.

12.2 Proposition (i), a. - The trend rate of heating and ventilating output growth exceeds the trend rate of growth of GDP

12.2.1 Real GDP and heating and ventilating output are plotted in Figure 12.1. In most years between 1957 and 1972 the output of heating and ventilating grew more quickly than GDP, indicating that the rate of expansion of the heating and ventilating industry was above average for the economy as a whole. After 1972 the output of the heating and ventilating industry became more volatile without showing a clear pattern of growth.

12.2.2 Figure 12.2 illustrates the long run relationship between heating and ventilating output and GDP using a log scale. While GDP continued to grow throughout the period, heating and ventilating output only grew until 1972. Since 1972 the output of the heating and ventilating industry remained at a similar level until at least 1996.
Figure 12.1 GDP 1948-1996 and heating and ventilating output 1957-1996 at 1995 prices

Sources: Heating and ventilating output, Housing and Construction Statistics, DETR, Annual GDP, Table 1.3 ONS, Economic Trends Annual Supplement 1997, No 23, HMSO
Notes: GDP implied deflator at market prices, Table 1.1, Economic Trends Annual Supplement 1997, No 23, ONS, p. 7
Notes: GDP is measured on the right y-axis. Total wage returns on the left axis.
Heating and ventilating output deflated using the GCPI, 1995 = 100. GDP deflated using the GDPI, 1995 = 100

Figure 12.2 Log scale of GDP 1948-1996 and heating and ventilating output 1957-1996 at 1995 prices

Sources: Heating and ventilating output, Housing and Construction Statistics, DETR, Annual GDP, Table 1.3 ONS, Economic Trends Annual Supplement 1997, No 23, HMSO
GDP implied deflator at market prices, Table 1.1, Economic Trends Annual Supplement 1997, No 23, ONS, p. 7
12.3 Proposition (i), b. - The trend rate of heating and ventilating output growth exceeds the trend rate of growth of construction output

12.3.1 In Chapter 2 proposition (i) stated that:

i. the trend growth rate of the output of the heating and ventilating industry exceeds the trend growth rate of the construction industry, and, perhaps exceeds the trend rate of growth of GDP.

12.3.2 In Table 12.1 the trend growth rate of the construction industry between 1957 and 1996, measured as the geometric mean annual growth rate, was only 1.28 per cent per annum while heating and ventilating output grew on average by 2.27 per cent. Overall the heating and ventilating industry therefore grew as a proportion of construction output as its rate of increase was above the average for the industry in general. However, the increase in the share of construction output largely took place in the period before 1973 when heating and ventilating output grew by an average of 6.26 per cent per annum compared to 1.42 per cent for the construction industry as a whole. After 1974 neither construction nor heating and ventilating grew rapidly. The heating and ventilating industry only managed to maintain its relative share of construction output as its growth rate was marginally less than construction at 1.42 per cent per annum compared to 1.53 per cent for construction as a whole. These results run counter to expectations as mechanical and electrical services are generally seen as increasing their share of construction work at least until 1996.

12.3.3 Heating and ventilating increased its share of construction output up to 1973. Since 1973 its share has remained static. By the mid 1970s the retro-fitting and upgrading of central heating and air conditioning systems in existing buildings had already taken place by and large. Moreover, the annual proportion of new build which incorporated heating and ventilating systems had risen since the Second World War but by the mid 1970s had perhaps reached a stable 'saturation' level. Thus, any increase in the share of services in recent years may have been due to the increase in other electrical and mechanical elements rather than heating and ventilating.

12.4 Proposition (ii), a. - The annual change in heating and ventilating output is a function of construction industry output in the same year.

12.4.1 Table 12.1 compares the periods before and after 1973. From 1957 to 1973 the output of the heating and ventilating industry grew at the rate of 6.26 per cent per annum compared to only 3.99 per cent for the construction industry as a whole. After 1973 the average long run rate of growth of heating and ventilating output was slightly less than the annual rate of growth of the construction industry at 1.42 compared to 1.53 per cent per annum. The table confirms that the relationship between heating and ventilating industry output and construction output altered in the two periods. Using correlation coefficients of the concurrent first differences (annual changes) of construction and heating and ventilating industry output, in the period from 1957 to 1997 the correlation coefficient was 0.27. In the period between 1957 and 1973 it was only -0.20, and from 1974 to 1997 it was still only 0.38. When a one year time lag is introduced the correlation between annual changes in
heating and ventilating and construction output between 1958 and 1973 increases to 0.46 but falls to 0.25 for the period between 1973 and 1996. Although the statistical relationship of annual changes in the two series is weak, there is a marked difference between the two periods both when the time series are concurrent and when a time lag is introduced.

### Table 12.1 Growth rates and correlation coefficients of the first differences of heating and ventilating and construction industry output 1957-1996

<table>
<thead>
<tr>
<th></th>
<th>Correlation coefficients (R)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1957 - 1996</td>
<td>0.27</td>
<td>0.22</td>
<td>2.27%</td>
</tr>
<tr>
<td>1957 - 1973</td>
<td>-0.20</td>
<td>0.46</td>
<td>6.26%</td>
</tr>
<tr>
<td>1973 – 1996</td>
<td>0.38</td>
<td>0.25</td>
<td>1.42%</td>
</tr>
</tbody>
</table>

Sources: Construction output data supplied directly by the DETR and Private Contractors’ Census.

Note: all data deflated using the GCPI

HVI = heating and ventilating industry

CI = construction industry

12.4.2 To study the effect of annual changes in construction on heating and ventilating further proposition (ii) in Chapter 2, stated:

ii. *if the annual variation of output of the heating and ventilating industry follows a pattern significantly different from the construction sector, as a whole, then demand for heating and ventilating cannot be predicted from construction output.*

12.4.2 In order to assess the relationship between construction output and the output of the heating and ventilating industry between the late 1950s and late 1990s, a number of regressions were run. The first set of regressions (discussed in this section) was based on the annual data being concurrent. The second set of regressions based on heating and ventilating output lagged one year behind construction output is discussed in Section 12.5.

12.4.3 The relationship between construction output and demand for heating and ventilating services can be given as a simple probabilistic model of heating and ventilating industry output, such that:

\[
HVI = f(CI, e)
\]  

(12.1)

where \(HVI\) = output of the heating and ventilating industry

\(CI\) = output of the construction industry

and \(e\) = error of prediction.
12.4.4 It would therefore follow that:
\[ \Delta HVI_t = f(\Delta CI_t, \epsilon) \]  
(12.2)

Where \( \Delta HVI_t \) = change in heating and ventilating industry output in year \( t \)
\( \Delta CI_t \) = change in construction industry output in year \( t \)

12.4.5 This model becomes:
\[ HVI_t = \beta_1 + \beta_2 CI_t \]  
(12.3)

and
\[ \Delta HVI_t = \beta_3 + \beta_4 \Delta CI_t . \]  
(12.4)

12.4.6 Taking Equation 12.3, a regression model based on GCPI deflated log-transformed data for the period 1957 to 1996 produces the following regression results:

\[ \ln HVI_t = -7.22 + 1.38 \ln CI_t \]  
(12.5)

Note: \( \ln = \) natural log 
Standard error of regression 0.155 
R Squared 0.747 
df 38 
No. of observations 40 
Std Err of Coef. 0.131

12.4.7 With a relatively high \( R^2 \) of 0.75, three quarters of the variation in heating and ventilating can be accounted for by changes in the construction industry. This implies that between 1957 and 1996 there was a long run relationship between heating and ventilating output and construction output.

12.4.8 The first year of the time series of annual data of heating and ventilating output and construction output used here was 1957. However, in order to enable annual changes and a time lag of 1 year in heating and ventilating output to be treated consistently, it is necessary to use the time series from 1959. This allows a regression based on concurrent annual changes to be compared to the results of a regression based on the annual change in construction output in year \( t-1 \) and heating and ventilating output in year \( t \). Running a regression on Equation 12.4 which relates annual changes in heating and ventilating output to annual changes in construction output for the period from 1959 to 1997 produces Equation 12.6:

\[ \Delta HVI_t = 18.37 + 0.022 \Delta CI_t \]  
(12.6)

Std Err of Y Est 189.713 
R Squared 0.072 
No. of Observations 39 
Degrees of Freedom 37 
Std Err of Coef. 0.013

12.4.9 The coefficient of determination, \( R^2 \), of Equation 12.6 is only 0.07. This result is consistent with the findings in Table 12.1. Thus, annual changes in heating and ventilating output cannot be accounted for by changes in construction output.
12.5 Proposition (ii), b. - The annual change in heating and ventilating output in year $t$ is a function of construction industry output in year $t-1$.

12.5.1 When lagged behind construction by one year the model of annual changes in heating and ventilating and construction output from 1959 to 1997 becomes:

$$\Delta \text{HVI}_t = 21.516 + 0.0186 \Delta \text{CI}_{t-1} \quad (12.7)$$

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>191.920</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.049</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>39</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>37</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.013</td>
</tr>
</tbody>
</table>

12.5.2 The value of $R^2$ in Equation 12.7 is only 0.05, again indicating little relationship between heating and ventilating output and the previous year’s construction industry workload.

**Figure 12.3 Annual changes in heating and ventilating output ($\Delta \text{HVI}_t$) and construction output ($\Delta \text{CI}_{t-1}$) 1957-1997**

Source: Housing and Construction Statistics, DETR
Notes: data deflated using GCPI
$\Delta \text{HVI}_t = $ annual percentage change in heating and ventilating output in year $t$
$\Delta \text{CI}_{t-1} = $ annual percentage change in construction output in year $t-1$
Hence, in 1969 HVI = HVI in 1969 and CI = CI in 1968, construction series shifted one year to the right.
12.5.3 Figure 12.3 shows heating and ventilating output leading construction output by one year. In the years up to 1972 the output of the heating and ventilating industry appears to follow the output of the construction industry. This implies a time lag of two years in changes in heating and ventilating output behind changes in construction output. However, from 1972 there is no such pattern. This points to the fact that the time lag between construction output and heating and ventilating output is not constant and the relationship between construction industry output and heating and ventilating output changed after 1972. Basically, the following questions therefore arise. Why was there a two-year time lag prior to 1972 but not after? If there is no relationship between annual changes in construction output and heating and ventilating output in the period after 1972, can any other relationship between the two time series be established?

12.6 Wage returns, construction and GDP: the determinants of wage income in the heating and ventilating industry

12.6.1 Having discussed the general relationship between aggregate annual wage returns and GDP and compared the annual changes in the output of the heating and ventilating industry and construction industry, a model may now be developed using these independent variables as determinants of incomes in the heating and ventilating industry.

12.6.2 The model of aggregate wages adopted here assumes that,

\[ W_t = \sum w_{it} \]  

(12.5)

where \( W_t \) = aggregate wages of all firms in period \( t \), and \( w_{it} \) = total wages paid by the \( i \)th firm in period \( t \)

At an individual firm level,

\[ w_{it} = r_{it} \cdot l_{it} \]  

(12.6)

where \( r_{it} \) = average wage rate paid by the \( i \)th firm in period \( t \), and \( l_{it} \) = number employed by the \( i \)th firm in period \( t \).

In turn,

\[ l_{it} = \frac{d_{it}}{x_{it}} + e \]  

(12.7)

where \( d_{it} \) = demand for the services of the \( i \)th firm in period \( t \), (measured as the value of output) \( x_{it} \) = labour productivity of the \( i \)th firm in period \( t \), and \( e \) = the random disturbance term.

Substituting (12.6) and (12.7) into (12.5)

\[ W_t = \sum r_{it} \left( \frac{d_{it}}{x_{it}} + e \right) \]  

(12.8)
At an industry level a simple model of aggregate wages might assume that:

\[ W_t = f(D_t, NI_t, e) \]  \hspace{1cm} (12.9)

where \( W_t \) = aggregate industry wages
\( D_t \) = demand for heating and ventilating contractors in period \( t \)
\( NI_t \) = national income in period \( t \).

12.6.3 The relationship between annual construction industry output and heating and ventilating output was not found to be significant according to the results of regressions and correlations coefficients given above. These results were found to be based on annual data, whereas quarterly data might be expected to show much closer interdependence. Assuming demand for heating and ventilating contractors is related to the level of construction industry output, adapting Equation 12.9 to fit available data, the determinants of aggregate wage returns may be given as the following function:

\[ WR_t = f(CO_t, NI_t, e) \]  \hspace{1cm} (12.10)

where \( WR_t \) = aggregate wage returns in year \( t \)
\( CO_t \) = construction industry output in year \( t \)
\( NI_t \) = GDP in year \( t \)

12.6.4 If construction industry output and GDP are assumed to be the sources of heating and ventilating demand, Equation 12.10 becomes:

\[ WR_t = \alpha + \beta_1 CO_t + \beta_2 NI_t \]  \hspace{1cm} (12.11)

where \( \alpha \) = constant.

12.6.5 Assuming wage returns are a function of construction industry output and GDP, Equation 12.11 is found using log-transformed GDPI deflated data, 1995 = 100 with 1990 weights. GDPI is used as the deflator, because the regression analysis is used to measure the effect of the whole economy and an industrial sector on the total wages of members in one particular industry. Only years in which GDPI deflated data were available for all time series are used. Those years were 1957 to 1979 and 1987 to 1996, omitting 1980 to 1986. Applying multiple regression to the data on a Quatro Pro spreadsheet produced the following result:

\[ \ln WR_t = 8.02 + 1.25 \ln CO_t - 0.17 \ln NI_t \]  \hspace{1cm} (12.12)

Standard error of regression 0.079
R Squared 0.918
df 30
No. of observations 33

12.6.6 The value of \( R^2 \) implies that the regression accounts for over 90 per cent of the variation in wage returns. The negative coefficient of GDP implies that aggregate wages declined slightly relative to national income, which may be accounted for by the decline in the number employed and only a relatively small improvement in productivity compared to other sectors of the economy. This decline may also have to do with the collection of data and the increase in the use of a casual workforce over time not fully recorded in the data.
12.6.7 A narrower construction industry based model of the determinants of annual wage returns can be derived by omitting GDP and deflating the log-transformed data for the years 1957 to 1996, omitting 1980 to 1986, using the GCPI, 1995 = 100. Thus if,

\[ WR_t = f(CO_t, e) \]  

(12.13)

then,

\[ WR_t = \alpha + \beta CO_t. \]  

(12.14)

Then from the data,

\[ \ln WR_t = -6.62 + 1.13 \ln CO_t \]  

(12.15)

Standard error of regression 0.078
R Squared 0.90
df 31
No. of observations 33

12.6.8 Again a relatively high value for $R^2$ suggests that long run changes in wage returns are related to construction industry output. A further simplification of the model can be derived if wage returns are viewed as a function only of heating and ventilating output. Using GCPI deflated data and running a regression on wage returns and heating and ventilating industry output produces the following equation:

\[ WR_t = \alpha + \beta D_t \]  

(12.16)

where $D_t = \text{heating and ventilating output in year } t$

Thus, \[ WR_t = 0.41 + 0.664D_t \]  

(12.17)

Standard error of regression 0.125
R Squared 0.75
df 31
No. of observations 33

12.6.9 The relatively low value of $R^2$ for Equation 12.17 compared to the value given for $R^2$ in Equation 12.15 indicates that wage returns are more related to changes in construction in general than to the heating and ventilating industry in particular.

12.7 Concluding remarks

12.7.1 In summary, wage returns appear to be more responsive to construction output than heating and ventilating output. This implies that the labour market wage rate for heating and ventilating engineers is influenced more by the level of demand in the whole construction industry rather than in heating and ventilating alone. There is not a separate labour market for heating and ventilating. It is part of the construction industry labour market and firms in heating and ventilating must compete for labour in that market. It is this competition in the construction industry labour market that is reflected in the significantly higher $R^2$ coefficient of the construction industry output compared to the coefficient of heating and ventilating industry output, when regressing wage returns with the output figures for heating and ventilating and construction output.
12.7.2 This implies that the labour market for heating and ventilating engineers is not separate from the rest of the construction industry and wages and conditions are determined more by the state of the construction market as a whole than by conditions in the heating and ventilating industry itself.

12.7.3 Thus the main points to emerge from this statistical analysis so far are that:

- annual changes in heating and ventilating output are much more volatile than construction industry output.
- The long run growth rate of the heating and ventilating industry exceeded the long run growth rate of construction from 1957 to 1997.
- Apart from the mid-1970s to the mid-1980s, changes in the construction industry series in any given year are a poor guide to changes in the heating and ventilating industry.
- Wage returns were more sensitive to changes in construction output than changes in heating and ventilating output in the period between 1957 and 1996.
- There is evidence of a long run relationship between the heating and ventilating industry and construction. However, the annual variation in heating and ventilating output between 1957 and 1997 does not appear to be determined by short run (i.e. annual) changes in construction, though quarterly data may reveal very short run linkages.
- When time lags are introduced into the regressions of wage returns, heating and ventilating output and construction the relationship between construction and heating and ventilating is weakened.

12.7.4 Having discussed annual wage returns in aggregate in this chapter the following chapter examines changes within the population of firms. The structure of the heating and ventilating industry is considered in terms of long run changes in the concentration ratio of the member firms in the HVCA. The chapter also analyses the performance of heating and ventilating firms especially the relationship between their size and growth rates in terms of Gibrat's law.
Chapter 13 The industrial structure of the heating and ventilating industry

13.1 Introduction

13.1.1 The previous chapters have shown that wage returns can be used as a proxy for output and as a measure of the relative size of individual firms. Using wage returns in this chapter, the aim is to establish the industrial structure of the heating and ventilating industry in terms of barriers to entry and exit and concentration ratios. Low barriers to entry into and exit from the heating and ventilating industry market would lead to a relatively high turnover of firms and low concentration ratios.

13.1.2 This chapter applies aspects of the structure, conduct and performance paradigm to members of the Heating and Ventilating Contractors Association (HVCA). By implication the member firms themselves may be assumed to share similar characteristics with non-members in the same industry. It is, however, true that before drawing firm conclusions about the industry as a whole, without statistical comparisons of members and non-members, it is only possible to discuss the structure, conduct and performance of the members of the HVCA. A number of different years are used as the starting point for the analysis of growth, namely 1955, 1957, 1960, 1963, and 1970.

13.1.3 The changing structure of the organisational population of the HVCA is first considered in terms of barriers to entry. This is combined with a discussion of the relative growth rates of the market compared to the growth rates of firms. This is followed by a discussion concerning concentration ratios in the heating and ventilating industry. This chapter therefore focuses on two aspects of industry structure, namely barriers to entry and concentration.

13.2 Structural changes, growth rates, and survival rates of HVCA member firms.

13.2.1 It is possible to make inferences about barriers to entry into any industry by comparing the average growth rate of firms and the average growth rate of the industry. Proposition (iii) in Chapter 2 stated that:

\[ \text{if the number of firms in the heating and ventilating industry grows faster than industry sales, then barriers to entry are relatively low. If this is the case the growth rate of the output of the heating and ventilating industry as a whole in any year will be significantly higher than the average growth rate of turnover (sales) of individual firms in the industry.} \]

13.2.2 The higher the ratio of market growth to firms’ average growth, the lower the barriers to entry. For the sake of consistency of analysis, we may take the average annual growth rate of the aggregate of all wage returns of the membership of the HVCA as a proxy for the market, noting that there were more firms in 1996 than in 1955. We may then compare this proxy of the market with the average growth rate of firms, which were members of the HVCA. The annual growth rate of the aggregate of HVCA members was 0.50 per cent per annum. This figure is derived from the regression coefficient of the time series of the log transformed GCPI deflated data. That is, based on wage return data the ‘market’ grew at 0.50 per cent per annum between 1955 and 1996.
13.2.3 The geometric mean of the average annual growth rates of each firm between 1955 and 1996 is found using Equation 13.1.

\[
\text{Geom } F = \sqrt[n]{\prod_{i=1}^{n} f_i}
\]  

(13.1)

where \( \text{Geom } F \) = geometric mean growth rate of all firms

\[ \prod_{i=1}^{n} f_i = \text{product (just as } \Sigma \text{ is notation for summation)} \]

\( n = \text{number of firms} \)

\( f_i = \text{regression coefficient of the log transformed time series of wage returns of firm } i \)

13.2.4 This average growth rate is based on the GCPI deflated regression coefficient of annual wage returns and shows that firms grew on average at 0.44 per cent per annum. Both the market growth rate (0.5 per cent per annum) based on the growth of aggregate annual wage returns and the geometric mean of the growth rates of individual firms (0.44 per cent per annum) are less than the growth rate (1.85 per cent per annum) given in Table 11.2 because the growth rate in Table 11.2 is based on the geometric mean of the geometric mean or exponential growth rates of individual firms whereas the average growth rates given above are based on the coefficient of regression of the size of the individual firms for each year data was available.

13.2.5 The ratio of the growth rate of the heating and ventilating industry output to the growth rate of firms' average wage returns (based on the geometric mean of the regression coefficients of annual size over time is therefore:

\[ 0.50/0.44 = 1.14. \]  

(13.2)

13.2.6 The low average growth rate of firms can easily be explained by the increase in the number of firms, which grew from 328 firms at the beginning of 1955 to 1,160 firms by the end of 1996. From 1955 to 1996 the growth rate of the number of firms as measured by the annual membership of the HVCA was therefore 3.05 per cent per annum, an average rate of increase in the number of firms far in excess of the expansion of the market. The ratio of the growth rate of the number of firms to the market growth rate is 6.1:1.

13.2.7 If the ratio of 1.14 (Equation 13.2) is taken as a measure of market growth to firms' average growth, then the firms already in the market did not on average grow fast enough to absorb all work which was available. Thus some new firms were able to enter the market, a sign that barriers were not prohibitively high. In the absence of comparable data for other industries this long run ratio may be used as a benchmark for the short-term ratios of annual changes in the same data series. This would measure the \textit{ex post} relative ease of entry into the market in any given year. Similarly the ratio of the long run average growth rate in the number of firms over the market growth rate (6.1:1) may also be used as a benchmark within the heating and ventilating industry, against which to measure annual changes over time. These ratios would measure barriers to entry and indicate changes in the competitiveness of the market from year to year.
13.3 Structural change as measured by concentration ratios

13.3.1 A comparison of the size distribution of heating and ventilating contractors with the size distribution of all construction firms by numbers employed is illustrated in Figure 13.1. The distribution of both heating and ventilating contractors and all construction firms reflect the argument in Ive and Gruneberg (2000) that the distributions are bi-modal and tend to polarise at the large and small ends. However, almost 36 per cent of total construction labour is employed by firms employing 7 or fewer people; in heating and ventilating only 19 per cent of labour is employed by firm of this size. In heating and ventilating, the percentages employed by the four smallest size categories are similar, whereas the percentage of employment in construction as a whole declines rapidly across these four size categories of firm. In fact a higher proportion of people were employed in the 14 to 24 size range of heating and ventilating firms than in any of the smaller categories in marked contrast to construction as a whole. There is therefore a tendency for firms to be larger in heating and ventilating than in the construction industry in general.

Figure 13.1 Distribution of employment according to size of firm in construction and the heating and ventilating industry (Oct 1994).

![Figure 13.1 Distribution of employment according to size of firm in construction and the heating and ventilating industry (Oct 1994).](image)

Note: Total employment includes heating and ventilating engineers.

13.3.2 This discussion of the size distribution of firms in the heating and ventilating industry implies that economies of scale favour slightly larger firms in heating and ventilating than in construction in general. Any advantages that heating and ventilating engineering firms might have due to their size, it could be argued, might well be reflected in their growth rates.
Proposition (iv) in Chapter 2 raises the issue in the following terms:

(iv).  *if growth rates of firms in the heating and ventilating industry were size dependent, (contrary to Gibrat's Law) economies of scale would confer an advantage of size, and it would follow that*

(a) the larger the firm the higher the rate of growth,
(b) the higher would become the n-firm concentration ratio and
(c) the higher would become the Herfindahl index.

13.3.3 With reference to proposition (iv)a, which states that the larger the firm the higher the growth rate, the null hypothesis is that there is no significant positive correlation between size and growth rate. The correlation coefficient of the size and growth rates (based on the regression slope) of 1,712 new members of the HVCA between 1955 and 1996 was -0.073. Indeed, the correlation coefficient of size and growth rates was also calculated for each year between 1956 and 1996. In no year was the correlation coefficient greater than -0.08 and in all but one year, 1957, the correlation coefficient was negative.

13.3.4 Using regression analysis of the model,

\[ G_{it} = f(S_{it}, e) \]  

where \( G_{it} \) = growth rate of the ith firm in year t  
\( S_{it} \) = size of the ith firm in year t  
and e = error term

produces the following results:

\[ G_{it} = 0.006 - 0.0005S_{it} \]  

Std Err of Y Est 0.030  
R Squared 0.005  
No. of Observations 1712  
Degrees of Freedom 1710  
X Coefficient(s) -0.000  
Std Err of Coef. 0.000

13.3.5 Equation 13.4 implies that growth rates vary randomly around 0.006 per cent per annum and there is no link to size of firm (Stewart, 1976, p42). Therefore the null hypothesis cannot be rejected. In line with Gibrat's Law, there does not appear to be a clear relationship between the size of heating and ventilating firms and their long run average rate of growth.

13.3.4 Taking the cohort of 467 firms in trade in 1963 as an example, for the purpose of analysis, Table 13.1 shows the relationship between growth rates and various size categories of firm. The standard error in each size category is less than the 95 per cent confidence level. This confirms that growth rates and size are not statistically significant in any size group. However, according to Table 13.1, the geometric mean shows the smallest firms tended to grow fastest and the largest firms tended to grow slowest. Indeed, in Table 13.1 the largest 70 firms only
achieved a negative growth rate of -0.38 per cent per annum. Taking averages for each size category, the breakdown of growth rates in this table appears to support the view that the largest firms grew slowly while the small and medium sized enterprises grew faster than the market could support. However, the range and standard deviations in all size categories are relatively large. For example, the geometric mean, and range of the average annual growth rates of the largest firms was -0.38 per cent with a range from over -23 per cent to over 38 per cent per annum.

### Table 13.1 Growth rates 1963-1996, according to size of firm in 1963

<table>
<thead>
<tr>
<th>Size of firm</th>
<th>0 to 49,999</th>
<th>50,000 to 99,999</th>
<th>100,000 to 199,999</th>
<th>200,000 to 499,999</th>
<th>500,000 and over</th>
<th>All firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geom. Mean</td>
<td>3.62%</td>
<td>1.33%</td>
<td>0.53%</td>
<td>-8.19%</td>
<td>-0.38%</td>
<td>-1.16%</td>
</tr>
<tr>
<td>Arith. Mean</td>
<td>5.59%</td>
<td>2.42%</td>
<td>1.06%</td>
<td>-3.33%</td>
<td>0.04%</td>
<td>0.86%</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.0271</td>
<td>0.0166</td>
<td>0.0099</td>
<td>0.01481</td>
<td>0.0114</td>
<td>0.0074</td>
</tr>
<tr>
<td>Median</td>
<td>1.98%</td>
<td>0.86%</td>
<td>-0.58%</td>
<td>-0.91%</td>
<td>-1.12%</td>
<td>-0.37%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.2425</td>
<td>0.1564</td>
<td>0.1057</td>
<td>0.1589</td>
<td>0.0952</td>
<td>0.1602</td>
</tr>
<tr>
<td>Variance</td>
<td>0.0588</td>
<td>0.0245</td>
<td>0.0112</td>
<td>0.0252</td>
<td>0.0091</td>
<td>0.0257</td>
</tr>
<tr>
<td>Minimum</td>
<td>-31.63%</td>
<td>-44.40%</td>
<td>-23.47%</td>
<td>-99.63%</td>
<td>-23.23%</td>
<td>-99.63%</td>
</tr>
<tr>
<td>Maximum</td>
<td>127.42%</td>
<td>68.47%</td>
<td>43.21%</td>
<td>50.54%</td>
<td>38.64%</td>
<td>127.42%</td>
</tr>
<tr>
<td>Count</td>
<td>80</td>
<td>89</td>
<td>113</td>
<td>115</td>
<td>70</td>
<td>467</td>
</tr>
<tr>
<td>Conf. Level(0.95)</td>
<td>0.0531</td>
<td>0.0325</td>
<td>0.0195</td>
<td>0.0290</td>
<td>0.0223</td>
<td>0.0145</td>
</tr>
</tbody>
</table>

Source: HVCA wage returns

Notes: Size categories of firms according to wage returns in 1963 at 1995 GCPI prices and given in £ sterling.

Growth rates based on linear trend of annual wage returns of individual firms.

Growth rates are based on GCPI deflated wage returns at 1995 prices.

The standard errors, standard deviations and confidence levels are given in decimal places to avoid confusion with the annual percentage growth rates given in the table. For example, standard deviation = 0.2425 represents a standard deviation of 24.25 percentage points.

13.3.5 Neither the geometric mean nor the arithmetic mean alone indicate the distribution and skew of growth rates around the average. Read in conjunction with the median, the arithmetic mean average growth rates in Table 13.1 show the distribution of the growth rates of the firms in the £200,000 to £499,999 was skewed to the left (where the arithmetic mean is less than the median), while the distributions of the other categories were all skewed to the right. Thus the majority of firms tended to have growth rates below their size category arithmetic mean. The growth rates of most firms in the £200,000 to £499,999 grouping were above the average of their size category either declining at a slower rate than the arithmetic mean or even growing.

13.3.6 It may be argued that the unexpected long run negative growth of those firms which were the largest in 1963 can be explained in terms of their ownership or governance, and patterns of employment. In fact these established firms tended to be independent family owned concerns until the 1980s, with traditional employment practices. Being the largest employers of heating and ventilating services they would also have had stronger union penetration and superior working conditions than their smaller counterparts. As a result they may have viewed themselves as carrying on a trade in a traditional way more resistant to change than small firms seeking expansion. The relatively slow rate of average growth of the largest firms implies that the faster growing companies would eventually tend to overtake them.
13.3.7 In contrast the highest growth rates occurred in firms with 1963 wage payments of under £50,000. The relatively rapid average growth rate of the smallest firms may reflect the advantage of economies of small scale of operating in the heating and ventilating industry, which is also typical of the construction industry. For small firms of course, the addition of only one or two people to their workforce can represent a large percentage increase in wage bills (and turnover). It may be that the difficulty or cost of growth is in part a function of the absolute number employed and not only a function of the percentage change. The smallest firms may also have been started by individuals, whose drive, enthusiasm or innovation generated rapid annual increases in turnover.

13.4 Concentration ratios

13.4.1 If over time firms tend to grow, then the longer firms survive the larger they would tend to become. Proposition iv(b) states that if firms’ growth rates are positively dependent on their size, the n-firm concentration ratio will tend to rise. The average growth rate of survivors of any given cohort would tend to be greater than zero, (taking zero to be 0.49 per cent per annum or less). A cohort of survivors here is defined as existing and new firms trading in any given year and still in trade in 1996. This includes either entity, resource or output survival. Three cohorts were used for the analysis, namely the first, fifth and fifteenth year cohorts of available deflated data starting in 1955. Taking the cohorts of the three years 1955, 1960 and 1970, the average annual growth rates based on the slope of the regression of log transformed wage returns of survivors were 0.07 per cent, 0.06 per cent and 0.04 per cent respectively (Table 13.2). As the results are very close to zero, at less than 0.1 per cent per annum, the null hypothesis that the average growth rate of survivors is zero or less cannot be rejected for members of the selected cohorts.

<table>
<thead>
<tr>
<th>Cohort year</th>
<th>Number of survivors</th>
<th>Average annual growth rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>43</td>
<td>0.07%</td>
</tr>
<tr>
<td>1960</td>
<td>55</td>
<td>0.06%</td>
</tr>
<tr>
<td>1970</td>
<td>122</td>
<td>0.04%</td>
</tr>
</tbody>
</table>

Source: HVCA wage return data

13.4.2 To the extent that this argument is accepted, the smaller and medium sized enterprises, which grew faster than the market as a whole were then creating the conditions of their own reduced life expectancy. The only way a market can consist of firms with higher growth rates than the market as a whole is if many firms do not survive, but instead continually find themselves being replaced or taken over by other firms. New growing firms tend to embody new methods and technology and by continually churning firms in the heating and ventilating market, old technology is replaced by the new and more efficient and productive firms. The largest firms could survive by taking over their smaller rivals and adopting their new methods and systems, replacing in part their own existing techniques. In this way they could reduce their risks of
research and development by buying the tried and tested systems of the firms they bought. In this way the largest firms may continue to survive without necessarily expanding rapidly or increasing their share of the market.

13.4.3 Structural change within industries can be conventionally measured by concentration ratios. Concentration ratios were found using 3, 5, 8, 18 and the Major Contractors Group (MCG) firm shares of the annual aggregate wage return data. On the basis of the information and data gathered concerning the MCG (see Chapter 15), it is possible to identify the membership of the group and calculate their aggregate annual wage returns. As the size of the MCG grew to 18 firms, an 18 firm concentration ratio was also calculated for comparison, as not all of the largest firms were necessarily members of the MCG. The 3 firm and 5 firm concentration ratios were used in order to be comparable with normal practice in the UK, according to Devine et al (1985, p.50). As concentration ratios based on the share of the market of the largest firms do not take the distribution of all firms into account an index of concentration was also found for all firms in the HVCA between 1955 and 1997 using the Herfindahl index, (see Chapter 4 for formula and methodology).

![Figure 13.2 Concentration ratios 1945-1996](image)

Source: HVCA annual wage return data.

13.4.4 If the industry was becoming more concentrated over time then the time series of concentration ratios would reflect this trend. In fact from Figure 13.2 the time series of 3-, 5-, and 8-firm concentration ratios appear to be particularly volatile especially after 1973, but with no upward trend. If any trend is present it is a downward one. In fact the 3-, 5- and 8-firm concentration ratios declined by -0.49%, -0.65% and -0.85% per annum respectively between 1945 and 1996. As these results are consistent with the null hypothesis of iv(c), it can be inferred that growth was not size dependent and therefore size did not necessarily give larger firms an advantage over smaller firms in heating and ventilating.
13.4.5 Indeed Figure 13.3 shows a general decline in the average size of firm in the HVCA between 1964 and 1996, as measured by annual wage returns. If the average size of firm declines over time, then Gibrat's law would not hold. Given Gibrat's law the average size of firm would tend to increase. To test the proposition that Gibrat's law has been violated, the following regression was used:

\[ \ln X_t = \beta_1 + \beta_2 \ln X_{t-1} + \beta_3 e_t \]  \hspace{1cm} (13.5)

where \( \ln X_t \) = log transformed average firm size in year \( t \)
\( \ln X_{t-1} \) = log transformed average firm size in year \( t-1 \)

The result of this regression is:

\[ \ln X_t = 0.8203831 + 0.9354244 \ln X_{t-1} \]  \hspace{1cm} (13.6)

<table>
<thead>
<tr>
<th>Std Err of Y Est</th>
<th>0.0712165</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Squared</td>
<td>0.8733863</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>34</td>
</tr>
<tr>
<td>Degrees of Freedom</td>
<td>32</td>
</tr>
<tr>
<td>Std Err of Coef.</td>
<td>0.0629609</td>
</tr>
</tbody>
</table>
13.4.6 The results that $\beta_1 > 0$ and $\beta_2 < 1$ show that the population of firms’ size is regressing towards the mean. This implies that smaller firms were growing faster than larger firms and consequently it can be concluded that concentration was decreasing.

13.4.7 However, the long run trend of the MCG as seen in the linear trend graph of Figure 13.4 shows that the concentration ratio of the MCG as part of the HVCA has in fact remained virtually steady. In contrast, the largest 18 firms in general have declined in relative importance, judging from the linear trend of the 18-firm concentration ratio. This would suggest that membership of the MCG strengthened a firm’s position vis-à-vis the rest of the HVCA and especially compared to the other large firms which were not members of the MCG. Alternatively, it may reflect a greater commitment on the part of members of the MCG to the industry, seeing their future more closely dependent on the heating and ventilating industry with employment policies, which reflect this.

13.4.8 It is this ability of firms in the Major Contractor Group to maintain almost the same concentration ratio, which marks them out as a separate stratum from the rest of the population of firms in the HVCA. Members of the MCG have enjoyed a relatively unchanging share of around 33 to 34 per cent of the market from 1955 to 1996. As these firms are also invariably long lived (see Chapter 15), though not necessarily as independent entities, they form a relatively placid, steady layer of firms, beneath which market conditions, the need for firms to grow, and competition lead firms to fight for their survival.

**Figure 13.4 Linear trends of HVCA concentration ratios 1955 to 1996**

Source: HVCA annual wage return data.

Note: All data was deflated using the All New Construction Price index 1995 = 100. The use of this index does not affect the concentration ratios.
13.5 The Herfindahl index

13.5.1 Looking at the overall structure of the HVCA, the Herfindahl index, \( H = \sum s_i^2 \), where \( s_i \) is the market share of the ith firm, in Figure 13.5 measures the degree of competition within an industry in terms of the distribution of the market share of all individual firms. Between 1945 and 1996 the annual trend of the Herfindahl index of the firms in the HVCA was downward though with peaks in 1946, 1948, 1960, 1965, 1975 and 1992. As the last two peak years were immediately after years in which upper turning points in the estimated output of the heating and ventilating industry occurred, an important feature emerges. Upper turning points may be characterised as periods of crisis, when profits are squeezed and the outlook for future expansion is pessimistic (as described by Sherman, 1991). The ability of the largest firms to survive implies that smaller firms tended to decline faster and new entrants were deterred from joining.

13.5.2 Thus immediately following an upper turning point concentration ratios increased. This may also be because the smaller firms in the industry tend to take the brunt of downturns in the market as subcontractors to the larger firms. The larger firms are in a stronger position to defend themselves and are often able to pass on lower prices by squeezing subcontractor prices and profits. If cash flow difficulties are experienced then subcontractors (especially the smaller firms, who are in a weak negotiating position) tend to be the last in the queue for settlement of accounts. If small firms exit from the market, concentration ratios will increase. This appears to be the case in Figure 13.5.

Figure 13.5 Herfindahl index of the wage returns of HVCA firms 1945-1996

Source: HVCA annual wage return data.
13.5.3 The null hypothesis of proposition (iv)c above states that the average rate of increase in the Herfindahl index is less than or equal to zero. Just as concentration ratios exhibited a downward path, the Herfindahl index also declined by 1.23 per cent per annum on average between 1945 and 1996. This implies the null hypothesis (iv)c cannot be rejected. This shows that size did not lead necessarily to larger firms growing faster than smaller firms and hence going on to capture a larger share of the market.

13.6 Firm size and survival

13.6.1 As shown in Table 13.1, although larger firms tended to experience slower rates of growth than smaller firms, they were still able to maintain a dominant position compared to the whole membership of the HVCA, especially as smaller firms tended to entity-survive for shorter periods than the largest firms. Eventually, however, the faster rate of growth of the smaller firms was partly responsible for diluting the concentration ratio, although this dilution of concentration was slight. The reduction in the concentration ratio has also been due to the increasing net number of new firms joining the HVCA leading to a growth in the population or density of firms over time. This would also account for the negative trend in the Herfindahl index over time.

13.6.2 The average growth rate of all surviving firms of the 1957 cohort, regardless of their size in 1957, was 0.19 per cent per annum, a slightly higher rate than those found in Table 13.2 for 1955, 1960 and 1970. Of the 45 firms in the largest category in 1957 only 6 were in the Top 20 in 1996. Table 13.3 shows that the average rate of growth of these six firms was 1.32 per cent. Of the 45 firms, only 8 entity-survived to 1996 or later, (though 2 other firms supplied wage returns relating to 1995 but not for 1996). The average growth rate of the 8 firms including the 6 in the Top 20 in 1996, was -1.36 per cent with one firm experiencing a negative growth rate as low as -14.10 per cent per annum. This implies that for some of these top firms, their peak had already been reached by 1957 and for the rest of the period of the study they were in long term decline.

Table 13.3 The survivor growth rates of all survivors and the largest firms in the 1957 cohort

<table>
<thead>
<tr>
<th>Survivor firms</th>
<th>Number of firms</th>
<th>Ave. annual growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>All survivors</td>
<td>45</td>
<td>0.19%</td>
</tr>
<tr>
<td>Best performers</td>
<td>6</td>
<td>1.32%</td>
</tr>
<tr>
<td>All largest firms(^{1}), including best performers</td>
<td>8</td>
<td>-1.36%</td>
</tr>
</tbody>
</table>

Source: HVCA wage returns

Notes: 1. Best performers are defined as those in the largest group in 1957 and in Top 20 largest firms in 1997.
2. Largest firms are those firms whose wage bills were £500,000 or more in 1957 at 1995 prices.
All data deflated using the GCPI
Growth rates based on geometric mean of the trend line of the time series of the log-transformed annual wage returns of individual firms.

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13.7 Concluding remarks

13.7.1 Often the largest firms were taken over by firms outside the heating and ventilating industry (see Table 15.1). As subsidiaries they would have been more able to sustain long term decline and even losses, but they may have also incurred some pricing disadvantages and accounting burdens as a result of the actions of their parent company. For example the accounts of several of these subsidiaries include internal lending and other transactions, often in the interests of the parent company.

13.7.2 For these large firms survival has often meant survival in name only. They are no longer independent legal entities. They may have survived in resource terms, but the question remains whether or not there were other strategies, which they could have adopted which would have given them the opportunity to remain as independent firms. As pointed out in Chapter 9, according to Penrose growth strategies are vital for firms to survive and remain independent. For the population of heating and ventilating firms, both large and small, survival is therefore one of the key longer term issues. For this reason the following chapter examines the relationship between growth rates and survival in the heating and ventilating industry between the mid-1950s and the mid-1990s, and the mid-1960s and the mid-1990s.
Chapter 14  The performance of firms in the heating and ventilating industry.

14.1  Introduction

14.1.1  This chapter examines a number of aspects of the performance of firms in the heating and ventilating industry. In particular it discusses the effects of firm size on the survival chances of heating and ventilating contractors. It also considers the implications of both the long run average annual growth rates and single year growth rates of firms as far as their survival is concerned. If growth rates alter survival chances, there may be an optimum target growth rate, which minimises a firm’s risk of failure. Any discussion about growth and survival must take differences between firms into account. The data on HVCA members make it possible to distinguish heating and ventilating industry firms by size and differences between established firms and new entrants.

14.1.2  The chapter therefore begins with a comparison of entrants and incumbents. This is followed by a discussion of the relationship between growth and survival of firms in the heating and ventilating industry. This discussion is based on the average growth rates of firms over their lifetime in the Heating and Ventilating Contractors Association. It takes into account that the volatility of heating and ventilating firms’ output (proxied by wage returns) can have an impact on a firm’s survival chances quite distinct from the average growth rate over a number of years. This volatility may also be associated with the first few years after a firm enters the market and the timing of that entry into the market. The chapter therefore concludes with a discussion of the effects of the timing of the entry of firms in terms of the different phases of the business cycle on the survival chances of firms. In order to examine these aspects of performance, a number of propositions taken from Chapter 2 are tested below.

14.2  The performance of new entrants compared to incumbents

14.2.1  New entrants may be different in character compared to incumbent firms in at least two respects. Firstly entrants may exhibit higher than average growth rates partly because of their novelty and partly because of their size. Secondly new firms entering a market may exhibit higher mortality rates than established firms partly because of their inexperience and partly because of their lack of financial reserves. To test these propositions, it was suggested in Chapter 2 that:

v.  new entrants tend to experience relatively rapid growth and relatively high mortality rates compared to established enterprises.
14.2.2 This proposition can be broken down into two separate parts, which are treated independently of each other. The first part, \((v)a\), concerns growth and the second, \((v)b\), concerns survival rates. The hypothesis of proposition \((v)a\) is:

\((v)a\) new entrants tend to experience relatively rapid growth compared to established enterprises.

14.2.3 To test this hypothesis, the corresponding null hypothesis of hypothesis \((v)a\) states that the average growth rate of new entrants is less than or equal to the average growth rate of mature firms. The population of HVCA firms trading in 1963 has been used as an example, because it is one of the first years in which the data of firms prior to 1961 was not removed in 1970 and 1971. The purpose of the analysis is to demonstrate the approach used to analyse in detail size, growth rates and survival of a cohort of a given year of heating and ventilating contractors. The highest folio number of firms in trade in 1963 was 900, representing the number of firms which had joined the HVCA up to 1964 since the HVCA had been founded at the beginning of the century. Many of these folio numbers were no longer in use even before 1963. The population of new and established HVCA firms on the 31st March 1963, based on the Annual Report of the HVCA was only 450 members. In the course of the year 37 new members joined the trade association (Annual Report of the Council of the Association of Heating, Ventilating and Domestic Engineering Employers (AHVDEE, 1963 p.29).

14.2.4 The annual total membership reported by the HVCA omits firms which resigned in the course of a year although their wage return data might have been filed. Moreover, the wage return data is based on calendar years rather than the HVCA membership year and the year of filing is lagged one year behind the year relating to the data. These reasons account for the differences between the total number of firms liable to file returns relating to the period up to December 31st 1963 which was 499 and the 450 total membership recorded by the HVCA. The number of entrants who filed their first wage returns for 1963 was 50 which is also greater than the number who were officially recorded as new members of the HVCA. In all 494 firms filed wage returns relating to 1963.

14.2.5 Of these 494 firms, 330 had been in business in 1958 or earlier (and therefore qualified as ‘mature firms’ according to the definition given in paragraph 9.3.20 above), and 46 were new entrants, who survived at least one year. The remaining 118 firms had filed wage returns only within the previous five years and are therefore excluded from this comparison. In order to compare the growth rates of new firms to established firms in the 1963 cohort, the performance of firms from 1964 to 1973 was used, because wage return data
for any year is assumed to be for that year ending December 31st. Ten years was used as a convenient cut-off point in order to maintain the distinction between new and established firms. Table 14.1 represents the mature and new firms in the 1963 cohort, which did not resign or leave the HVCA in 1964. The same exercise was carried out for the 1969 cohort.

Table 14.1 The average annual growth rates of new and established firms in the 1963 and 1969 cohorts

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Number of firms</th>
<th>Years of trading</th>
<th>Average annual growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>New firms</td>
<td>1963</td>
<td>46</td>
<td>1964 to 1973</td>
</tr>
<tr>
<td>Established firms</td>
<td>1963</td>
<td>330</td>
<td>1964 to 1973</td>
</tr>
<tr>
<td>New firms</td>
<td>1969</td>
<td>44</td>
<td>1970 to 1979</td>
</tr>
<tr>
<td>Established firms</td>
<td>1969</td>
<td>394</td>
<td>1970 to 1979</td>
</tr>
</tbody>
</table>

Source: HVCA wage return data
Notes: Data deflated using the GCPI 1995 = 100

14.2.6 The geometric mean growth rate from 1964 to 1973 of new firms in the 1963 cohort was 8.68 per cent per annum compared to 0.74 per cent per annum for the mature firms. Similarly, the equivalent figures for the period 1970 to 1979 for the new and established firms in the 1969 cohort were 3.04 per cent per annum and -3.38 per cent per annum respectively. The much lower figures for both incumbents and entrants in the second period compared to the first reflect changed market conditions. Nevertheless, in both periods as the average growth rate of entrants was greater than the growth rate of mature firms, the null hypothesis is therefore rejected, as far as the population of firms in business in 1963 and trading between 1964 and 1973 is concerned and also for firms in business in 1969. In the cohorts of firms trading in 1963 and 1969, new members of the HVCA tended to grow more rapidly than established firms. In principle, a similar analysis could be used to establish the differences between new entrants and incumbent firms for any year.

14.2.7 Although new firms experienced higher annual growth rates than established firms, it does not follow that their survival rates were also greater than the incumbent firms. Turning to the second part of the proposition, the hypothesis of proposition (v)b is:

(v)b new entrants tend to experience relatively high mortality rates compared to established enterprises.
14.2.8 In order to compare the survival rates of entrants and incumbent firms, the cohorts of new and established firms trading in 1957, 1960, 1963, 1966 and 1969 were combined. Figure 14.1 shows the percentage survival rates over the ten-year period following the year of joining the HVCA of new firms compared to incumbents. The discrepancies between the number of firms used in Table 14.1 and 14.2 are caused by incomplete series limiting the amount of data that could be captured. Table 14.2 records the number of firms reporting in 1963, whereas Table 14.1 shows the number of firms in trade in 1963 (according to wage return series) some of whom did not post their wage returns in that year but did so in the previous or following years.

### Table 14.2 Incumbent and entrant firms according to (a) analysis of folios and (b) equivalent recorded HVCA data

<table>
<thead>
<tr>
<th>Year</th>
<th>Incumbents with 5 or more years trading, based on wage returns</th>
<th>Entrants, based on wage returns</th>
<th>Recorded HVCA membership</th>
<th>Recorded new HVCA members</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957</td>
<td>283</td>
<td>13</td>
<td>346</td>
<td>n.a.</td>
</tr>
<tr>
<td>1960</td>
<td>299</td>
<td>43</td>
<td>374</td>
<td>n.a.</td>
</tr>
<tr>
<td>1963</td>
<td>327</td>
<td>50</td>
<td>450</td>
<td>37</td>
</tr>
<tr>
<td>1966</td>
<td>363</td>
<td>61</td>
<td>568</td>
<td>66</td>
</tr>
<tr>
<td>1969</td>
<td>403</td>
<td>50</td>
<td>667</td>
<td>52</td>
</tr>
<tr>
<td>1987</td>
<td>687</td>
<td>66</td>
<td>1155</td>
<td>81</td>
</tr>
</tbody>
</table>

Notes: 1987^ Incumbent firms in 1987 were taken as those in trade in or before 1982 according to HVCA Annual Reports and not the wage return ledger. Established firms were those, whose folio numbers were less than the final folio number less new members in 1982 to 1987. Sources: HVCA wage returns and HVCA Annual Reports

14.2.9 Table 14.2, which gives the number of firms used in the following analysis of percentage survival rates, excludes those firms with less than 5 years membership. A lower percentage of new firms survive than established firms and this relatively lower survival rate continues even up to 10 years after joining the HVCA.

14.2.10 A similar pattern can be seen in the data of new and mature firms in Figure 14.2. The percentage of new entrants in 1987, which survived each year is compared to the percentage of mature firms, which survived having been in trade for at least 5 years before 1987.
Figure 14.1 The 10 year percentage entity-survival rates for 5 cohorts of new and established firms trading in 1957, 1960, 1963, 1966 and 1969.

Source: HVCA wage returns
Note: Mature or established firms includes those trading for more than 5 years prior to new entrants joining.

Figure 14.2 Percentage entity-survival rates 1987-1996 of new and established firms trading in 1987

Source: HVCA wage returns
14.2.11 As an example of a long run time series of survival, Figure 14.3 shows the survival rates of new and established firms in the 1963 cohort over the period from 1963 to 1979. Again the survival rate of established firms is greater than that of the entrants and remains above the survival rate of new firms even after the initial period of the legitimation process. However, this relatively poor survival rate of new firms is partly a statistical phenomenon. That is, given that a relatively high proportion of new firms fail in the first few years, this depresses the proportion of new firms surviving thereafter. However, it does not follow that after a number of years, surviving "new" firms have a lower chance of survival than those firms, which were already established at the time of the arrival of these new firms. This problem is dealt with in the log hazard model of the Cox regression, which is discussed below.

![Figure 14.3 Percentage entity-survival rates 1963-1979 of new and established firms trading in 1963](image)

Source: HVCA wage returns

Note: Mature or established firms in 1963 (i.e. those trading in or before 1958) = 327.
New members in 1963 = 50.

14.2.12 In the very long run apart from the major firms in the heating and ventilating industry, the chances of survival as an independent trading entity of any one firm is remote. In fact, even many of the firms, which survived until at least 1996 as trading entities, did not survive as independent entities. As many as 17 of the 18 largest firms in the Major Contractors Group were subsidiaries of other companies by 1997 (see Chapter 15, Table 15.1).
14.2.13 The hypothesis that age of firm is an important factor in survival appears to be supported by the data for the 1963 cohort. The null hypothesis related to hypothesis (vi) is that the survival rate of new entrants is greater than or equal to the survival rate of incumbents. The data for the 1963 cohort is used to compare the percentage of new and established firms surviving each year between 1963 to 1972. Using a one tail t-test, the null hypothesis can be rejected as \( t = -0.43 \), which is less than \( P = -0.34 \) with 20 df, \( p>0.05 \). There is therefore a significant difference between the survival rates of established firms and the survival rates of new firms in the 1963 cohort. A similar exercise was conducted on the data of the 1972 cohort of firms for the period 1972 to 1996, omitting 1980 to 1986. This comparison showed that \( t = -0.23 \) was not statistically significant (\( P = -0.41 \) with 32 df, \( p>0.05 \)). This supports the argument that differences between the survival rates of new and established firms are not sustained into the long run.

14.3 Long run average growth and survival of heating and ventilating firms

14.3.1 If the above findings are typical, then entrant firms tended to experience higher growth rates than incumbents. However, mature firms tended to survive better in the first ten year period than new entrants but not necessarily in the longer term. The implications of long run average growth rates on the survival of heating and ventilating firms as a whole are now considered in this section.

14.3.2 In the competitive environment of the heating and ventilating industry, some firms expand more rapidly than others. If some firms embody initial competitive advantages over other firms, and if growth is a necessary means towards sustaining an initial competitive advantage, then we would expect the firms that grow fastest also to have the best survival rates, because these would be the firms with competitive advantage. Therefore in Chapter 2, proposition (vi) stated:

\[ \text{in the heating and ventilating industry, relatively fast growth is a predictor of survival.} \]

14.3.3 To test this hypothesis the null hypothesis is that there is no difference between the average growth rates of surviving and non-surviving firms. If the null hypothesis cannot be rejected that would suggest that either initial competitive advantage is rare in the heating and ventilating industry, or that relatively rapid growth is not an effective means to sustain such an advantage.

14.3.4 Taking as an example the HVCA member firms in trade in 1963, 475 survived two or more years, 184 survived up to 10 years, but only 30 firms survived to 1997. Using an
average growth rate based on the log transformed linear trend of the annual wage returns of each surviving firm, the average annual growth rate was only 0.05 per cent, the average growth rate of those firms which survived up to 10 years was 3.7 per cent per annum, and the average growth rate of all non-surviving firms in business in 1963 was 0.91 per cent per annum.

14.3.5 A z-test was used to compare mean annual growth rates of surviving and short-lived firms. The mean difference between the 2 types of firm was not found to be significant at the 95 per cent level of confidence, the z score being -1.94, (p<0.05). A second z-test was used to compare the mean annual growth rate of surviving firms compared to all the non-surviving firms and again the difference of means was not significant at -0.86, (p<0.05). The null hypothesis could therefore not be rejected and hence growth rates can not be reliably used as a predictor of survival.

14.3.6 The distribution of the growth rates of the population of HVCA firms between 1955 and 1996, regardless of their year of joining the HVCA is given in Figure 14.4. According to Figure 14.4, as well as some firms enjoying rapid growth, many other firms experienced rapid decline. Most firms, however, grew at between -9.99 per cent and 9.99 per cent per annum. If a firm worth £10,000 in 1955 grew at a rate of 2.5 per cent per annum for a period of 41 years, it would increase in size to £27,500 by 1996; at 5 per cent per annum it would expand to £74,000 and at 10 per cent per annum it would grow to £497,500.

Figure 14.4 Distribution of average annual growth rates of HVCA firms between 1955 and 1996

Notes: Number of firms 2,827. Growth rates based on linear trend of log transformed deflated annual wage returns
Key to graph: More = 25 per cent per annum and above
25 = 20 to 24.99 per cent per annum, and so on.
Source: HVCA data
14.3.7 Figure 14.5 shows the distribution of growth rates and survival periods of all HVCA firms with 4 or more years trading between 1955 and 1996 based on the years firms filed their wage returns in the HVCA. It should be noted however, that the data is incomplete because of the missing years of 1980 to 1986. The maximum years possible is shown as 42, because of right censoring in 1997. Firms joining between 1980 and 1986 have all been treated as joining in 1986. The measurement of firms’ life span does however take account of missing data in a firm’s series and missing years from 1980 to 1986 where firms declared wage returns before and after a break in the data. However, it is possible that some firms did not necessarily cease trading when they ceased to be members of the HVCA. Nevertheless the graph shows a distribution of survival times, which reflects the notion that survival and growth rates are related.

14.3.8 From Figure 14.5 it can be seen that while firms of any growth rate may only survive for a relatively short period, only those within a moderate range between approximately plus or minus 10 per cent average annual growth appear to have survived longer than approximately 25 years. However, many firms in this narrow range of growth rates did not survive for more than a few years. Naturally those surviving firms formed within the last 25 years of the study have still to prove themselves one way or the other.

**Figure 14.5** Distribution of survival times plotted against growth rates of HVCA firms trading between 1955 and 1996

Source: HVCA wage returns

Notes: Number of firms 2,187. Firms joining after 1993 excluded. Growth rates based on linear trend of log transformed GCPI deflated annual wage returns.
14.3.9 Although a distribution of growth rates and survival appears to exist in Figure 14.5 in support of hypothesis (vi), that growth rates are a predictor of survival, firms with relatively high growth rates may not necessarily survive. They may not survive as separate legal entities not because they failed in business, but because they were attractive to a competitor interested in taking them over, or because of owners’ financial gains from selling the firm, or because the owners wanted to take advantage of enhanced marketing opportunities or expand more rapidly than was possible using only the firm’s own limited resources. This may account for the finding that the correlation coefficients of growth rates and survival indices, using the growth rate based on the slope of the regression (r = -0.09) suggests that there is almost no correlation and that the null hypothesis of hypothesis (vi) cannot be rejected.

14.3.10 However, a superior model based on Cox regression may be used to relate growth rates to survival. Given that a firm survives to any given year, the Cox regression log hazard function provides the rate in that year at which firms with a given long run average growth rate fail to survive. The hypothesis is that growth rates are a determinant of survival. Hence:

\[
\log h(t) = \alpha(t) + \beta_0 + \beta_1 G
\]

(14.1)

where \( \log h(t) \) = log hazard rate function
and \( G \) = growth rate

14.3.11 The null hypothesis is that growth rates are not a determinant of survival and that the coefficient of the growth rate is zero. Applying the survival statistics package in SPSS to estimate the coefficient of growth, the following results were found. This analysis covers the population of firms between 1945 and 1996. The population consisted of 4,198 firms, of which only 1,642 were used in the analysis because of missing folios or insufficient data. In the study the time series of wage returns of 1,196 firms were right censored, surviving beyond 1996, the last year of this study. The coefficient of growth based on the linear trend of log transformed annual wage returns was 3.75 which was statistically significant at the 95 per cent level of significance given an observed significance level of 0.41. Thus using the Cox regression model the null hypothesis that growth is not a significant determinant of survival may be rejected.
14.4 Analysis of growth and size on survival

14.4.1 Although differences in length of survival exist between firms with similar growth rates, in strategic terms firms can adopt growth targets with a view to securing their future. The implication of such strategies is therefore considered in terms of proposition (vii), which states that:

\[ \text{vii. firms that grow within a range around a target growth rate minimise the chance of failure.} \]

14.4.2 The proposition raised in (vii) in Chapter 2, that firms may increase their chances of surviving by controlling their rates of growth can be examined graphically using a scatter plot. Figure 14.6 shows the scatter diagram of the survival index according to growth rates using the linear trend of the log transformed annual wage returns to determine the growth rates of individual firms. Using this method average growth rates of individual firms range from -100 per cent per annum to over 150 per cent per annum but the majority of firms lie between approximately -10 and +25 per cent per annum. Only relatively few firms survive above an index of 0.5 above this range of growth. The star performers can be viewed as those

\[ \textbf{Figure 14.6 Scatter plot of the survival index by average annual growth rate of firms 1955 to 1996} \]

\[ \text{Source: HVCA wage returns} \]
\[ \text{Notes: Number of firms 2,187. Firms joining after 1993 excluded.} \]
\[ \text{Growth rates based on linear trend of log transformed GCPI deflated annual wage returns.} \]
firms with above 20 per cent average annual growth rates with survival indices of 1, or
approaching 1. As has been discussed earlier, many firms with even higher growth rates may
have been taken over as a result of their outstanding performance and potential or may have
merged and subsequently filed much higher wage returns with the HVCA.

14.4.3 The following analysis uses the 1963 cohort of firms because, as noted in Chapter 2,
wage return data of firms no longer in trade in 1961 were removed from the ledgers of the
HVCA. Table 14.3 shows the relationship between the rate of growth and survival regardless
of the size of firms, omitting those firms, which survived for less than one year. In all growth
rate categories the standard error of survival is less than the 95 per cent confidence level
implying that the years of survival are not a statistically significant determinant of growth
rates. This is to be expected as survival follows as a consequence of growth and not the other
way round. Those firms, which grew at a rate of between 0 to 0.99 per cent per annum
tended to be the longest lived, surviving on average for approximately 22 years. Table 14.3
shows that for firms with positive annual average growth rates, the survival period tended to
be negatively correlated with the growth rate. It can be seen that as growth rates increased,
the length of survival tended to decline.

14.4.4 Similarly, (and predictably) negative growth rates tend to be positively correlated
with survival. Thus, the faster the rate of decline, the shorter the period firms survive. Firms,
which grew on average at over 10 per cent per annum survived as members of the HVCA on
average only between 5 and 6 years. However, those firms which declined by more than 10
per cent per annum survived for as long as between 9 and 10 years on average. Though this
may appear logical, in practice firms consistently experiencing difficulties over a number of
years would have ceased trading while some assets were still intact, rather than continue in
business.

14.4.5 If firms with negative growth can survive as long as they appear to in Table 14.3, then
at least one other factor may account for their length of survival. For example, firms may
survive for a number of years with negative growth rates if they are subsidiaries of large
firms, which are willing to support a heating and ventilating firm in order to have a presence
in the market. The role of parent companies is considered below and in later chapters.
However, for a company to survive a period of decline it requires to have sufficient size in
the first place. One firm specific variable, which permits comparisons between firms is the
size of each enterprise. Hence, Table 14.4 relates survival to size. This is not to say that the
size of a firm in 1963 could be said to have an influence on the survival of the firm after
1988. However, it may imply that the larger the firm the more resources it would have at its
disposal and the better able it may be to market its services especially during recessions.
Table 14.3 Years survival since 1963 by percentage rate of growth

<table>
<thead>
<tr>
<th>Percent growth rates</th>
<th>-10% and lower</th>
<th>-5 to -9.99%</th>
<th>-2.5 to -4.99%</th>
<th>-1 to -2.49%</th>
<th>0.0 to -0.99%</th>
<th>0 to 0.99%</th>
<th>1 to 2.49%</th>
<th>2.5 to 4.99%</th>
<th>5 to 9.99%</th>
<th>10% and above</th>
<th>All firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>9.29</td>
<td>15.82</td>
<td>17.37</td>
<td>19.67</td>
<td>21.96</td>
<td>22.22</td>
<td>19.91</td>
<td>17.34</td>
<td>16.13</td>
<td>5.73</td>
<td>15.31</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.92</td>
<td>1.17</td>
<td>1.25</td>
<td>1.85</td>
<td>1.95</td>
<td>1.83</td>
<td>1.93</td>
<td>1.61</td>
<td>1.49</td>
<td>0.62</td>
<td>0.49</td>
</tr>
<tr>
<td>Median</td>
<td>8</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>26</td>
<td>24</td>
<td>16</td>
<td>16</td>
<td>15</td>
<td>4</td>
<td>14</td>
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<td>Mode</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>33</td>
<td>16</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>16</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Maximum</td>
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<td>33</td>
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</tr>
<tr>
<td>Count</td>
<td>56</td>
<td>61</td>
<td>59</td>
<td>36</td>
<td>28</td>
<td>27</td>
<td>33</td>
<td>53</td>
<td>47</td>
<td>67</td>
<td>467</td>
</tr>
<tr>
<td>Conf. Level(0.95)</td>
<td>1.80</td>
<td>2.28</td>
<td>2.44</td>
<td>3.62</td>
<td>3.82</td>
<td>3.59</td>
<td>3.79</td>
<td>3.16</td>
<td>2.92</td>
<td>1.21</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Source: HVCA wage returns
Notes: Growth rates based on linear trend of annual wage returns of individual firms.
14.4.6 In all size categories in Table 14.4 the standard error of years survival is less than the 95 per cent confidence level, implying that years survival in each size category are not statistically significant. Thus size is not an indicator of survival. This is also confirmed by the relatively high standard deviations of years survival within each size category. Nevertheless, according to Table 14.4, while the smallest category of firm (up to £49,999) survive on average approximately 13 years the largest firms (over £500,000) tended to survive the longest at over 16 years. Indeed the median period of survival of the smallest firms was 9 years compared to at least 16 for the largest companies.

<table>
<thead>
<tr>
<th>Size of firm</th>
<th>0 to 49,999</th>
<th>50,000 to 99,999</th>
<th>100,000 to 199,999</th>
<th>200,000 to 499,999</th>
<th>500,000 and above</th>
<th>All firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>13.21</td>
<td>15.65</td>
<td>15.53</td>
<td>15.50</td>
<td>16.63</td>
<td>15.31</td>
</tr>
<tr>
<td>Standard Error</td>
<td>1.21</td>
<td>1.14</td>
<td>0.96</td>
<td>0.97</td>
<td>1.33</td>
<td>0.49</td>
</tr>
<tr>
<td>Median</td>
<td>9</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>10.86</td>
<td>10.78</td>
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<tr>
<td>Conf. Level (0.95)</td>
<td>2.38</td>
<td>2.24</td>
<td>1.88</td>
<td>1.90</td>
<td>2.60</td>
<td>0.96</td>
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</table>

Source: HVCA wage returns
Notes: Size of firm in 1963 is based on GCPI deflated wage returns at 1995 prices and given in £ sterling.

14.4.7 Table 14.5 shows growth rates of the 1963 cohort according to the number of years firms survived. In this table the standard errors in each category of years survival are less than the 95 confidence level indicating that the growth rates associated with each category of years of survival are not significantly different from the population as a whole. Thus longer lived firms do not necessarily grow more slowly than shorter lived firms. Nevertheless, in Table 14.5 the geometric mean of the growth rates of all firms was -1.16 per cent per annum, reflecting the changes in the heating and ventilating market between 1963 and 1996. Only those firms which survived 5 to 9 years and those surviving for more than 30 years showed positive average growth rates with firms which survived more than 30 years achieving an average annual growth rate of only 0.26 per cent per annum. This indicates that even the longest lived firms only managed to grow at just above zero on average though the fastest average long run rate of growth achieved by one firm was as high as 14.57 per cent per annum.

14.4.8 The largest firms in 1963, as mentioned above in Table 14.4, were the most likely to survive the longest. Eventually, many, if not all, were taken over. As subsidiaries of large concerns they would have been able to survive in spite of long term decline at -0.38 per cent per annum (see Table 13.1), because the parent firm often required to maintain a prestigious presence in the heating and ventilating market to demonstrate expertise in construction. It may be argued that the reason for the relatively high negative growth rates of the shortest lived firms often reflects their inability to survive the high levels of risk involved in the building industry. Individuals frequently invest in new firms often growing relatively rapidly in the first few years in the industry. The firm may then either to be taken over by or merged with a competitor or it may be overcome by trading or financial difficulties.
Table 14.5 Growth rates by years survival since 1963

<table>
<thead>
<tr>
<th>Years survival</th>
<th>1 to 4</th>
<th>5 to 9</th>
<th>10 to 14</th>
<th>15 to 19</th>
<th>20 to 29</th>
<th>30 Ail firms</th>
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<tbody>
<tr>
<td>Geom. Mean</td>
<td>-3.25%</td>
<td>1.69%</td>
<td>-2.00%</td>
<td>-2.48%</td>
<td>-1.11%</td>
<td>0.26%</td>
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<tr>
<td>Arith Mean</td>
<td>6.22%</td>
<td>2.37%</td>
<td>-1.61%</td>
<td>-2.28%</td>
<td>-1.01%</td>
<td>0.35%</td>
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<tr>
<td>Standard Error</td>
<td>0.0346</td>
<td>0.0130</td>
<td>0.0118</td>
<td>0.0061</td>
<td>0.0061</td>
<td>0.0047</td>
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<tr>
<td>Median</td>
<td>4.55%</td>
<td>2.62%</td>
<td>-2.67%</td>
<td>-2.90%</td>
<td>-0.44%</td>
<td>0.52%</td>
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<tr>
<td>Std Deviation</td>
<td>0.3263</td>
<td>0.1214</td>
<td>0.0907</td>
<td>0.0617</td>
<td>0.0428</td>
<td>0.0426</td>
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<tr>
<td>Variance</td>
<td>0.1065</td>
<td>0.0147</td>
<td>0.0082</td>
<td>0.0038</td>
<td>0.0019</td>
<td>0.0018</td>
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<tr>
<td>Minimum</td>
<td>-99.63%</td>
<td>-21.96%</td>
<td>-20.33%</td>
<td>-17.40%</td>
<td>-12.91%</td>
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<tr>
<td>Maximum</td>
<td>127.42%</td>
<td>64.20%</td>
<td>26.91%</td>
<td>12.03%</td>
<td>5.40%</td>
<td>14.57%</td>
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<td>Count</td>
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<td>101</td>
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<tr>
<td>Conf Level (0.95)</td>
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<td>0.0254</td>
<td>0.0231</td>
<td>0.0120</td>
<td>0.0119</td>
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Source: HVCA wage returns

Notes: Growth rates are based on GCPI deflated annual wage returns at 1995 prices. Growth rates based on linear trend of annual wage returns of individual firms. The standard errors, standard deviations and confidence levels are given in decimal places to avoid confusion with the annual percentage growth rates given in the table. For example, standard deviation = 0.0346 represents a standard deviation of 3.46 percentage points.

14.4.9 Table 14.5 also shows that the range of growth rates declines the longer firms survive. For firms with less than 5 years membership the range is over 225 percentage points between the firm with the highest positive growth rate of 127 per cent per annum and the highest negative rate at 100 per cent per annum for those firms which went out of business in the year after joining the HVCA. The range of growth rates of firms with 30 or more years in the trade association was approximately 25 percentage points. This implies that firms move up a learning curve over time eventually adopting the modes of behaviour and strategies of the more established firms, possibly resulting in lower annual growth targets and a more standard form of organisational structure and modus operandi. Carroll and Hannan (2000, p7) refer to this process as legitimation.

14.4.10 Table 14.5 thus supports the case for saying that firms eventually settle down to a steadier growth rate, with a range of growth rates which tends to decline slowly over time. This would also support the view that new firms tend to embody new methods, technology and ideas which give them a competitive advantages which they then lose over time as their innovations become the industry norm, or as they are superseded by newer firms with newer technologies. Thus one reason new small firms may grow relatively rapidly is that they introduce a new concept into the market. If that concept fails the firm may not survive. If it succeeds its measure of success is the rapid expansion of sales, which is noticed by its competitors, who then tend to imitate, adopt or adapt the new idea in a Schumpeterian sense. Schumpeter, (1970, p.83) refers to this kind of process as “creative destruction”, as new methods and products replace old. Through the introduction of new products, new methods and new sources of supply the structure of industries continually mutates and this process can be seen in the heating and ventilating industry as new firms enter the market and the older established firms adapt.
14.5 The variance of growth rates and the survival of heating and ventilating firms

14.5.1 Long run average growth rates are only one factor influencing firms' chances of survival. It is perfectly possible for two firms with the same long run average growth rate to experience completely different patterns of variation in their annual growth rates. It can be argued that firms which move from rapid growth to rapid decline are inherently less likely to survive than firms which grow steadily.

14.5.2 The volatility of change may affect firms' ability to survive as each firm responds differently to market conditions and opportunities. In Chapter 2, proposition (viii) suggested that:

viii. The higher the coefficient of variation of annual growth rates, the less likely firms are to survive.

14.5.3 This hypothesis argues that the degree of volatility adversely affects firm's survival. The null hypothesis is that there is no significant correlation between coefficients of variation of annual growth rates and survival. Changes in the annual rate of growth are measured by changes in size from one year to the next. The correlation coefficient of survival index values for each firm and the coefficient of variation of size of their wage returns from 1955 to 1996 was only 0.19, which is not significant. Therefore the null hypothesis that there is no significant relationship between the variation of size and survival and hence variation of growth rates and survival cannot be rejected on the basis of the values of the correlation coefficients.

14.6 The performance of individual firms in the business cycle

14.6.1 It is worth noting from Chapter 10, Figure 10.4, that the output of the heating and ventilating industry and the construction industry and aggregate wage returns in periods between 1958 and 1972 and from 1981 to 1990 appeared to be relatively stable and the periods 1973 to 1981 and from 1991 to 1996, (the last year studied) were relatively volatile. Notwithstanding the volatility in the market in general, hypothesis (ix) suggests that peak rates of growth may indicate a weakness in the management of firms if firms are allowed to expand too rapidly and end up with cash flow difficulties. Such over-trading would likely have a detrimental effect on the survival of firms.

14.6.2 Proposition (ix) therefore states that:

ix. The higher the peak rate of growth the less likely firms are to survive.

To test this hypothesis the correlation coefficient of firms' peak growth rates and survival indices was calculated and found to be 0.04. The null hypothesis states there is no relationship between peak growth rates and survival and this could not be rejected.
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</tr>
</tbody>
</table>

Notes: N.d refers to those years between 1980 and 1986 for which no data is available. Percentages based on all new folios in any given year. Data up to 1961 is unreliable due to the removal of the folios of firms no longer in trade in 1961.
14.6.3 Proposition (x) in Chapter 2 states:

x. **firms survive for different periods depending on the phase of the business cycle in which the firms were founded, i.e. survive longer if founded at or just after a trough than if founded at or just before a peak.**

To test a further hypothesis that the success or failure of a firm depends partly on when the firm was set up in terms of the business cycle, it is necessary to identify those years in which the survival rates of new firms were greatest and lowest. For operational research reasons, the year of joining the HVCA is assumed to be the same as the year of founding.

14.6.4 As in any industry only a proportion of firms survive for more than a few years. Table 14.6 shows the percentage survival rates of new firms. In Tables 14.6 and 14.7 the estimate of new firms is based on folio numbers. The lowest new folio number for any given year is assumed to represent the first new member for that year. As the data for the years prior to 1960 was filleted, missing data on short lived companies in those years produces the low percentages of firms surviving even for only a very few years. Each figure in Table 14.6 represents the minimum percentage of new firms in a cohort of a given year surviving a given number of years. For example, for the 1950 cohort of new firms there is no surviving evidence that more than 38 per cent survived the first 13 years. Table 14.7 also indicates the proportion of new members surviving a given number of years. For example, it shows the percentage of new firms in every cohort from 1947 to 1980, which survived 15 or more years after joining the HVCA.

14.6.5 In Table 14.6 survival rates after 1980 appear to be much lower than the earlier years, with approximately only 40 per cent of entrants surviving beyond 5 years in the later period compared to between 63 to 76 per cent surviving for 5 years or more in the 1960, 1965, 1970 and 1975 cohorts. Clearly the recession of the early 1990s caused many firms to fail, though the 50 per cent survival rate of firms in the 1993 cohort surviving for 5 years or longer indicates that a recovery in the position took place between 1993 and 1997. It appears that a rapid decline in the proportion of survivors of the 1970 cohort occurred in 1976 and 1977, when the surviving proportion of the 1970 cohort declined from 76 to 53 per cent. This reflected the increased volatility of the market since the recession of 1973 and suggests a time lag between a downturn in the market and bankruptcies occurring in firms.

14.6.6 With only 4 new firms in 1956 it is not possible to draw any conclusions about the 1956 cohort. Table 14.7 shows that between 1957 and 1975 5-year survival rates were consistently above 50 per cent, whereas after 1989 the highest 5-year survival rate occurred in 1992 at only 44 per cent, although the trend was rising, given that 1992 was the last available year.

14.6.7 The weakness of Table 14.7 is that it gives the number of firms in a cohort at the start and the proportion of firms surviving a given number of years or more but it omits information about the intervening years. A cohort survival rating method was devised in order to make full use of available annual data and compare the performance of cohorts of different years in terms of their survival as groups of firms. The cohort survival rating is based on the percentage of wage returns of a cohort filed each year for a given number of years after joining the HVCA.
Table 14.7 Survival rates of new firms.
% of new HVCA members surviving:

<table>
<thead>
<tr>
<th>No. of new firms</th>
<th>Year</th>
<th>5 yrs or more</th>
<th>10 yrs or more</th>
<th>15 yrs or more</th>
<th>20 yrs or more</th>
<th>30 yrs or more</th>
<th>40 yrs or more</th>
<th>45 yrs or more</th>
<th>50 yrs or more</th>
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<tbody>
<tr>
<td>26</td>
<td>1947</td>
<td>N.d</td>
<td>N.d</td>
<td>50</td>
<td>38</td>
<td>27</td>
<td>N.d</td>
<td>15</td>
<td>8</td>
</tr>
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<td>18</td>
<td>1948</td>
<td>N.d</td>
<td>N.d</td>
<td>50</td>
<td>44</td>
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<td>N.d</td>
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<tr>
<td>22</td>
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<td>N.d</td>
<td>23</td>
<td>18</td>
<td>9</td>
<td>9</td>
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<tr>
<td>24</td>
<td>1950</td>
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<td>N.d</td>
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<td>17</td>
<td>8</td>
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<td>1951</td>
<td>N.d</td>
<td>N.d</td>
<td>66</td>
<td>42</td>
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<td>N.d</td>
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<td>63</td>
<td>47</td>
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<td>1991</td>
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<tr>
<td>106</td>
<td>1993</td>
<td>50</td>
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<td></td>
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</tbody>
</table>

Notes: N.d. = no data.
Data contained in certain folios was disposed of in 1970 see reference to ledger in Chapter 3. For this reason some of the early data almost certainly under represents the survival rates for the years before 1970.
Data based on folios of wage returns.
14.6.8 These annual percentage points are then averaged to give a total rating for each cohort equivalent to a percentage of rectangle $N_2AT_2O$ in Figure 14.7. If the number of firms in a cohort at time $T_0$ is $N_2$ and at $T_2$ the number of survivors is $N_1$ at $B$, the survival rating measures the area $N_2BT_2O$ as a proportion of the rectangle $N_2AT_2O$, which represents the maximum possible. The dotted lines $N_2C$ and $N_2T_1$ represent fewer firms surviving to year $T_2$ at $C$ than at $B$ and no firms surviving beyond year $T_1$ respectively. However, the rate of decline is unlikely to be uniform as shown, for example, by the straight line $N_2B$. The survival rating attributes a higher percentage to a cohort surviving on the concave blue curve and a lower rating to the convex orange curve, although the starting and surviving number of firms are identical.

Figure 14.7 Patterns of cohort survival.

14.6.9 One problem found in distinguishing the survival rating of cohorts setting up or joining the HVCA in any given year is that while percentage survival rates may be high to begin with, they may decline rapidly thereafter, while for other cohorts the pattern of survival rates over time may be lower to begin with but relatively greater later on. Figure 14.8 illustrates the problem graphically. It is a property of the survival rating method, like the Gini coefficient, that the same survival rating may be generated in an infinite number of ways by the same cohort of firms. Figure 14.8 illustrates three situations in which the cohort consists of $N_2$ firms in year $T_0$ and no firms survive beyond year $T_2$. Assuming $N_1$ and $T_1$ represent half the number of firms and half the period respectively, in each case the cohort survival rating would be the same, namely 50 per cent. In the case of the orange line all firms survive half the period, in the case of the blue line half the firms survive the whole period and in the case of the red line the rate of decline is constant over the whole period.
14.6.10 Nevertheless, using the cohort survival rating method, an attempt was made to compare cohorts between 1962 and 1980 on the basis of the first 17 years after joining the HVCA. However, because of gaps in the data between 1980 and 1988 only 11 years (1970 to 1980 inclusive) could be compared on a consistent basis. To overcome this problem the study was therefore divided into 3 shorter somewhat arbitrary periods.

14.6.11 The period from 1947 to 1961 is omitted because of the folio filleting which occurred in 1971, when the folios of firms no longer in trade in 1961 were removed. Because of the missing data no useful results emerge from a comparison of cohorts in this period. The first set of cohorts studied from 1962 to 1972 was chosen to enable a comparison of the first 9 trading years after joining the HVCA, (up to 1980), in which all data was available without interruption. The second set of cohorts from 1973 to 1980 was selected because of the absence of data for the period between 1981 and 1987. The cohorts of this period were rated according to the survival rates occurring in their respective first, 16th, 17th and 18th years after joining the HVCA. The survival rating of the cohorts in the period 1988 to 1994 are limited by the right censoring of the data which enabled comparison only on the basis of their respective first four years' trading after becoming members of the HVCA. The ranking of cohorts within specified periods is given in Table 14.8, using the number of folios to determine the size of a cohort and the number of wage returns filed each year to measure firms' survival.

14.6.12 Table 14.8 identifies those years when firms joined the HVCA with the highest and lowest overall cohort survival ratings given that the relative rankings apply only within the relatively short periods in which they occur. Of course, cohorts with low overall survival ratings were not necessarily formed in "crisis" years. On the contrary, survival rating is based of the future performance of the firms in a cohort, not the year of formation of the cohort.
Table 14.8 Years with the highest and lowest ranking survival ratings.

<table>
<thead>
<tr>
<th>Period</th>
<th>Highest survival rates</th>
<th>Lowest survival rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962-72</td>
<td>Highest ranking</td>
<td>1969</td>
</tr>
<tr>
<td></td>
<td>2nd highest</td>
<td>1966</td>
</tr>
<tr>
<td>1973-80</td>
<td>Highest ranking</td>
<td>1973</td>
</tr>
<tr>
<td></td>
<td>2nd highest</td>
<td>1974</td>
</tr>
<tr>
<td>1989-94</td>
<td>Highest ranking</td>
<td>1989</td>
</tr>
<tr>
<td></td>
<td>2nd highest</td>
<td>1994</td>
</tr>
</tbody>
</table>

14.6.13 The cohort survival ratings are indexed separately for the three periods around a mean of 100. These indexed values are plotted against the cyclical behaviour of the heating and ventilating industry in Figure 14.9 and can be used to examine the proposition that success or failure are partially linked to the phase of the heating and ventilating business cycle in which firms join the HVCA.

Figure 14.9 Index of heating and ventilating industry output 1957-1997, at 1995 prices 1975 =100, and indices of cohort survival ratings

Source: Housing and Construction Statistics, Annual
Notes: HV1 output deflated using GCPI 1995 = 100
HV1 output indexed 1975 = 100.

14.6.14 In the period from 1961 to 1972 and 1989 to 1994 the index of cohort survival ratings ranged from 90 to 114. Although both periods are similar in terms of the variation of
survival rating around the mean the industrial context was markedly different. From 1961 to 1972 the output of the heating and ventilating industry experienced almost continuous growth. In contrast, the period between 1989 and 1994 was one of relatively slow growth and recession. It would therefore not be possible to conclude from this study that market conditions and the phases of the business cycle appeared to determine the ability of new firms to survive. However, in the period between 1971 and 1980 the decline in the real output of the heating and ventilating industry is reflected in declining survival ratings. Moreover, in the short period between 1989 and 1994 the fall and rise in annual survival rating can be explained by the cyclical behaviour in heating and ventilating output in the early 1990s. Thus, in the periods studied, whereas growth of the heating and ventilating market did not necessarily enhance an entrant's chances of remaining in business, declining output over a number of years tended to shorten the number of years new firms were able to survive.

14.6.15 From Figure 14.9 a number of years emerge as turning points in the heating and ventilating business cycle. These are given in Table 14.9. Taken in conjunction with the survival rankings given in Table 14.8, the lowest ranking years in the second period were 1967 and 1968 which gave new firms several years of growth to establish themselves before the peak year of 1972 and the recession of 1973. Yet survival was relatively difficult for those firms. Although the recession began in 1973 both 1973 and 1974 were the highest survival rated years between 1973 and 1980. These firms were well placed when growth returned to the heating and ventilating market in 1976. The lowest ranking years in this period occurred in 1978 and 1979 just as the market peaked in 1979. A similar pattern can be seen in 1990 when the lowest ranking survival rate coincided with a peak in the market. Only in 1992 can a trough in the heating and ventilating market be associated with a cohort with a low survival rating. However, this may be due to the prolonged duration of the recession beyond expectations or may also be due to the limitations of the data as the data was right censored in 1997. The trough in 1981 could not be assessed because of lack of wage return data.

<table>
<thead>
<tr>
<th>Year</th>
<th>Peak</th>
<th>Trough</th>
<th>Year</th>
<th>Peak</th>
<th>Trough</th>
<th>Year</th>
<th>Peak</th>
<th>Trough</th>
</tr>
</thead>
</table>

14.6.16 The high and low survival cohort years from 1957 onwards can be interpreted to some extent with the advantage of hindsight in terms of Sherman's (1991) nutcracker theory. For example, if the years 1978 and 1979 were years in which firms joining the HVCA tended to have a relatively lower chance of surviving than firms joining in earlier years, they entered the market at a time when labour and materials cost increases were on the point of accelerating and similarly in 1990. Unpredicted cost increases therefore possibly contributed to the vulnerability of firms at the point of entry. Moreover, in those years the real output of the heating and ventilating industry was approaching an upper turning point and profits of new firms would have been squeezed just as the real output of the industry began to decline. Although prices continued to rise the drop in workload would have led to cash flow crises as costs continued to escalate. The escalating costs can be seen in Figure 14.10.
Similarly the relatively high survival ranking of the 1972 cohort would have been assisted by the slowing down of materials cost increases in spite of large increases in wage rates. The high ranking of 1988 occurred at a time of relative cost stability which reduced the adverse effects of cost volatility on the management of firms. There also followed a period when real output was about to increase giving firms the ability to raise prices more than costs before recession set in in 1991. By 1992 a lower turning point had been reached and because of growth in the market, sufficient stability existed for new firms establishing themselves in time for the expansion of the market in the following year.

The significance of a number of covariates (or independent variables) on the survival chances of firms can be modelled using a Cox regression or log hazard model discussed in Chapter 2 using Equation 2.24, which may be given as:

\[
\log h(t) = \alpha(t) + \beta_0 + \beta_1 G + \beta_2 S + \beta_3 J
\]  
(14.2)

where

- \( \log h(t) \) = log hazard rate
- \( G \) = growth rate
- \( S \) = size in 1955 or on joining the HVCA in subsequent years
- \( J \) = year of joining the HVCA

A Cox regression was thus run to model survival as a function of growth, year of joining the HVCA and size of firm in 1955 or when joining the HVCA in subsequent years. The null hypothesis can be accepted for year of joining and size but not for growth. In this model the coefficient of size approaches zero, as does the year of joining the HVCA with significance levels of 0.3 and 0.52 respectively but the coefficient of growth rates at 3.34 is greater than the significance level of 0.46 all at the 95 per cent confidence level. Thus the
null hypotheses that the population values of the coefficients of size and year of joining are zero cannot be rejected but the null hypothesis that the coefficient of the growth rates is zero can be rejected. Growth rates are statistically significant but size and year of entry are not significant covariates of survival.

14.6.20 Reducing the model given in Equation 14.2 by removing size as a covariate, produces:

\[
\log h(t) = a(t) + \beta_0 + \beta_1 G + \beta_3 J
\]  \hspace{1cm} (14.3)

The log hazard model thus becomes simply growth rates and the year of joining the HVCA as covariates of survival chances. This produces the following results. The coefficient of growth at 3.39 is statistically significant (p<0.05), the coefficient of year of joining the HVCA at 0.002 is statistically insignificant at the 95 per cent confidence level. This confirms that growth rates are a statistically significant determinant of survival but not the year of joining the HVCA.

14.7 Concluding remarks

14.7.1 Differences were found between new and incumbent firms in the cohorts of 1957, 1960, 1963, 1966 and 1969. Differences were also found between large and small contractors. Entrants grew faster than incumbents but tended to survive for shorter periods. Larger firms tended to survive longer than smaller firms.

14.7.2 The analysis of growth rates of the population of members of the HVCA revealed that the average growth rate of HVCA firms between 1955 and 1996 was near zero, though growth rates ranged from -100 per cent per annum to over 225 per cent per annum. Although growth rate cannot be relied on as a predictor of survival, because growth rates and survival were not highly correlated, growth rates were nevertheless found to be a significant determinant of survival, using a log hazard model. Moreover, it was found that in the 1955 cohort, the growth rate of annual wage returns of firms was a statistically more significant determinant of survival than size or year of joining the HVCA.

14.7.3 The low average rate of long run average growth rates of heating and ventilating firms reflects the slowing down or deceleration in the trend of the rates of growth in the heating and ventilating industry since 1973. Since 1973 there has been no discernible upward trend in growth rates with the result that firms growing above the average rate of growth have done so at the expense of other firms in the market.

14.7.4 The analysis of heating and ventilating firms has so far been largely based on annual wage return data posted by all members of the HVCA. In contrast the following chapter uses an alternative source of data, namely the annual accounts of firms. It discusses the accounts of those firms, who were members of the Major Contractors Group (MCG). As a select group of firms the MCG formed a sub-population of the largest firms in the heating and ventilating industry. The purpose is to show that discussions of average behaviour and performance varied widely to the extent that it is not possible to draw any meaningful conclusions about their average performance.
Chapter 15  The conduct and performance of the major firms in the heating and ventilating industry who were members of The Major Contractors Group.

15.1  Introduction

15.1.1  The Major Contractors’ Group (MCG) was formed in 1971, comprising a small number of the largest members of the Heating and Ventilating Contractors Association. The following survey of accounts of firms who were members of the Major Contractors Group mainly covers the period 1972 to 1997. The purpose of this survey of a small group of major firms in the heating and ventilating industry is to compare accounting information with wage return data as a guide to a firm’s performance and growth. The survey also examines the effects of the business cycle of the heating and ventilating industry on the reported accounting performance of firms. A further aim of this survey of the largest firms in the HVCA is to deepen our understanding of what has been happening to concentration in this industry, and why.

15.1.2  A total of 18 companies, whose annual reports are held on microfiche in Companies House in London, were analysed out of a total of 20 firms which had been members of the HVCA Major Contractors Group at one time or another. One member of the MCG, MF Kent, was not available in Companies House, London, because it was registered in Northern Ireland. Unfortunately because firms only provided accounts on a voluntary basis before 1970, few companies furnished Companies House with a full set of accounts prior to the early 1970s. Figure 15.1 shows the extent of the data found, each series representing a separate firm’s deflated annual profits.

15.1.3  Table 15.1 shows the firms whose accounts were used to calculate the annual average change in shareholders’ funds. All available data was used and no sampling was carried out. The size of the population varied annually for different variables, depending on the information given in each firm’s annual return. In later years a larger proportion of the 18 accounts could be used but as the population of firms was in any case small and specifically biased to the largest firms, the following analysis is not representative or statistically representative of the wider population of heating and ventilating contractors. Moreover, apart from the inconsistencies of using different firms and different combinations of firms each year depending on the availability of data, there are inconsistencies in reporting accounts from one firm to the next.

15.1.4  There is also the added problem that some firms submitted identical accounts in the 1990s (consisting only of the same balance sheets) in consecutive years, the minimum required because they were no longer trading as separate entities from their parent companies. Some pertinent data was also omitted from certain annual reports, such as the profit and loss accounts of firms whose accounts had been merged with a parent. These firms took advantage of their exemption from the obligation to provide profit and loss accounts under Section 225 of the 1985 Companies Act. Other firms provided only group sets of accounts, making it difficult or impossible to separate their heating and ventilating interests from that of their other activities and subsidiaries. The data used invariably refers, by the end of the period, to group accounts and therefore provides information about the underlying financial strength of the firms rather than purely their heating and ventilating
activities. The survey of accounts nevertheless provides interesting anecdotal evidence concerning the reported performance of a specific group of firms. However, because of the extremely small number of useable accounts especially in some years, any broad conclusions drawn from the results would be unreliable and unjustified.

Table 15.1 Heating and Ventilating Contractors and their Parent Companies in 1997

<table>
<thead>
<tr>
<th>Heating and Ventilating Contractor</th>
<th>Ultimate Holding Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrews-Weatherfoil Ltd</td>
<td>Kvaerner plc</td>
</tr>
<tr>
<td>James Scott Mechanical Electrical Services Ltd</td>
<td>AMEC plc</td>
</tr>
<tr>
<td>Benham Building Services Ltd</td>
<td>Bimec Industries plc</td>
</tr>
<tr>
<td>Brightside Mechanical and Electrical Services Group Ltd.</td>
<td>Mohammed Jalal and Sons Co Ltd, Bahrain</td>
</tr>
<tr>
<td>CWS Engineering Group</td>
<td>CWS Group</td>
</tr>
<tr>
<td>Drake and Skull Engineering Co Ltd</td>
<td>EMCOR Group Inc., Delaware, USA</td>
</tr>
<tr>
<td>Ellis Mechanical Services Ltd</td>
<td>Finaster SpA, Italy</td>
</tr>
<tr>
<td>HAT Lorne Stewart plc</td>
<td>BET plc</td>
</tr>
<tr>
<td>Haden Young Ltd</td>
<td>BICC plc</td>
</tr>
<tr>
<td>Henry Hargreaves and Sons Ltd</td>
<td>Senior Engineering Group plc</td>
</tr>
<tr>
<td>How Engineering Services Ltd</td>
<td>How Group plc</td>
</tr>
<tr>
<td>Lee Beesley Humphries and Glasgow Services Ltd</td>
<td>SMF (Holdings) Ltd</td>
</tr>
<tr>
<td>MF Kent Services Ltd</td>
<td>Registered in N. Ireland.</td>
</tr>
<tr>
<td>Matthew Hall Mechanical Services Ltd</td>
<td>AMEC plc</td>
</tr>
<tr>
<td>Marryat-Jackson-Norris Ltd</td>
<td>Staveley Industries plc</td>
</tr>
<tr>
<td>Rosser and Russell (London) Ltd</td>
<td>Norwest Holst Ltd</td>
</tr>
<tr>
<td>Sulzer (UK) Building Services Ltd</td>
<td>Gebrüder Sulzer AG, Switzerland</td>
</tr>
<tr>
<td>Towco Ltd ceased trading in 1985/6.</td>
<td>Not found</td>
</tr>
<tr>
<td>Wheeler Crittall Berry Ltd/ Crown House</td>
<td>Tarmac plc</td>
</tr>
<tr>
<td>Young, Austen and Young Ltd</td>
<td>Mohammed Jalal and Sons Co Ltd, Bahrain</td>
</tr>
</tbody>
</table>

Sources: Major Contractors Group companies’ annual returns and HVCA Annual Reports.
Note: In 1999 the ultimate holding company became Tilbury Douglas plc.
15.1.5 All of the firms surveyed had by 1997 been taken over by or merged with outside concerns, with the exception of the How Engineering Services Ltd a subsidiary of the How Group plc. This firm, originally William Truswell and Son, purchased by C.P. How in 1947, expanded by taking over a number of heating and ventilating engineering firms in different parts of the country. According to their floatation prospectus, (How Group Prospectus, 1987, p.5), the company saw itself as leading heating and ventilating contractors by 1963, under the umbrella holding company of How Group Ltd. The firm then expanded, according to its prospectus due to the high levels of demand for property and construction at the end of the 1960s and beginning of the 1970s. Since the firm was floated on the stock exchange it continued to grow, according to its annual accounts. However, the son of the founder, Peter How, who became Chairman of the How Group plc, retired in 1997 and in 1999 the firm was taken over by a construction firm, Tilbury Douglas plc. Again the firm did not survive as an independent company without the determination of a family member for it to remain so, in the face of possible offers and take-over bids. Table 15.1 also shows the parent companies of the members of the Major Contractors Group.

15.1.6 This chapter examines the profits, turnover and shareholder funds of the firms in the Major Contractors' Group. Although annual averages of these accounting variables are used in the analysis, there are wide differences between individual firms as suggested by Hannan and Carroll (1992). Appendix 5 shows the graphs of all 18 firms in the survey at 1995 prices and indexed at constant prices.

15.2 Profits

15.2.1 Nevertheless the company accounts of the members of the Major Contractors Group of the HVCA were analysed as far as the published data would allow. The sources of the

Figure 15.1 Profits 1948 to 1997 before tax at 1995 prices

Sources: Major Contractors Group companies' annual returns.
Note: Annual profits deflated using the RPI, 1995 = 100.
accounts used in the analysis are given in Appendix 3 and the figures used in the following analyses of profits, turnover and shareholder funds are given in the tables in Appendix 4. The pattern of profits of the data is illustrated in Figure 15.1. Although it appears that the volatility of firms’ profits increased after around 1975, the variance of profits did not significantly alter thereafter. However as only one or two firms published their profits in the earlier period, it is not possible to say from the information shown that a statistically significant pattern can be discerned. None of the more volatile firms published results prior to 1964. Nevertheless it is clear that one or more firms reported serious losses in 1984, 1988 and 1993. In 1993 the firm whose losses exceeded £20m (at 1995 prices) failed to recover.

Figure 15.2 Average annual percentage change in real profits before tax of major contractors in the HVCA 1972-1997

![Graph showing average annual percentage change in real profits before tax of major contractors in the HVCA 1972-1997]

Sources: Major Contractors Group companies’ annual returns.
Notes: Arithmetic mean of firms’ annual change in profits data deflated using the RPI 1995 = 100,
Arithmetic mean of data calculated only in years when n ≥ 9.
The data is derived from 18 firms, (see Table D in appendix).
If profits in year t are positive, then if in year t +1 profits drop to zero, this is represented as -100%. If in year t+1 profits turn into a loss, this is represented as greater than -100%. If there are losses in year t and losses increase in year t+1, this is represented as a further percentage drop. If losses reduce then the percentage change is upward.
15.2.2 Figure 15.1 illustrates that in each year since 1970 although several firms incurred losses, other firms made profits. Figure 15.2 shows the average annual percentage change in real profits after interest but before tax. Between 1972 and 1990 profits increased from year to year with the exception of 1983 to 1985. In 1983 profits declined on average by over 20 per cent. However, the average annual change in 1984 was greater than -100 per cent implying that many firms incurred actual losses in 1984 as the drop in average profits was greater than the level of profits in the previous year. In 1985 losses increased by a further 25 per cent on average. During the recovery of the following year losses were reduced by 50 per cent but firms had on average not returned to profitability by 1991, when the annual average rate of change in profits indicates that firms' losses began to increase once more. Following a year of losses, any percentage change in the rate of change would need to be greater than 100 per cent to return firms to profitability. In Figure 15.2 in 1988 the average annual rate of change in profits began to decline, supporting the suggestion by Sherman (1991) that profits are squeezed at the top of the business cycle. Indeed, by 1991 the rate of change in average losses fell below zero indicating increasing real losses each year until at least 1997.

15.3 Shareholders' funds

15.3.1 As trends and the timing of particular annual changes are of greater use for this research than the actual size of the variables themselves, the method used to analyse the data provided by the annual accounts of the major contractors in the HVCA has been based on the average annual change in each of a number of variables. These variables are shareholders' funds, tangible assets, turnover, hire of plant and labour costs. Using the annual mean changes of each firm allows that in different years different numbers of firms supplied data, the minimum number of firms in any one year being 9. Thus, for example, Figure 15.3 shows the real annual average change in shareholders' funds for the firms whose accounts were examined in any given year. The graph is based on the data given in Appendix 4 Table C in the appendix of this chapter.

15.3.2 From the annual average change in shareholders' funds given in Figure 15.3, it can be seen that from 1972 to 1981 shareholders' funds increased in most years but since 1982 they have been in decline with short respites between 1989 and 1991 and again in 1996 and 1997. It is therefore not surprising that the period after 1983 can also be characterised as one in which the major firms in the heating and ventilating industry were taken over by firms outside the industry. Moreover, after 1986 several firms in the Major Contractors’ Group took advantage of Section 225 of the 1985 Companies Act and did not report a full set of accounts, their accounting details being included in the Group accounts of their parent companies. Sudden changes in shareholders' funds, including those removed as outliers in Figure 15.3 were largely due to merger activity reflected in the balance sheets, which showed an increase in net assets as a result.

15.3.3 As a general pattern of behaviour it would appear that shareholders' funds grow as a result of merger activity rather than organically. The major firms in the heating and ventilating industry grow as a result of being taken over and consequently use the financial strength of the parent company to expand, consolidate their position or maintain a marketing presence in the heating and ventilating industry. During recessions, shareholders' funds were
"squeezed", by operating losses and by downward revaluations of assets and growth of debt relative to gross assets or capital employed. In the growth phases of the business cycle (such as between 1982 and 1988) either the set of heating and ventilating firms was by and large not making net profits or their net operating profits were being taken by parent companies as dividends or as interest on group loans. It is unlikely that these firms would not in general make operating profits in a growing market, although Figure 15.1 shows several did indeed incur large losses. It is far more likely that as subsidiaries, their operating profits were not being retained and added to the shareholder funds of the heating and ventilating company.

**Figure 15.3 Average real annual percentage change in shareholders' funds of major contractors in the HVCA 1972-1997**

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**Shareholders' funds**

Sources: Major Contractors Group companies' annual returns.
Notes: Arithmetic mean of firms' annual change in shareholders' funds deflated using the GCPI, 1995 = 100.
Arithmetic mean of data calculated only in years when n ≥ 9.
The data is derived from 18 firms, (see Table D in appendix).
Ellis 1997 change in shareholder funds is omitted as an outlier, as are Rosser and Russell 1984, and Young, Austen and Young 1985.

15.3.4 In Figure 15.4 anecdotal evidence concerning shareholders' funds is provided by one member of the Major Contractors' Group, Matthew Hall Ltd, whose record of accounts are continuous since 1964. This example does not support the general trend given by the weighted average of all firms in Figure 15.3. The period of general growth from 1969 to 1980 was followed by a period of fluctuation and stagnation, with shareholders' funds following a volatile path and growing relatively slowly until 1995. Since 1995 the firm's accounts have been absorbed in the Group accounts and no accurate data is available on the
firm at Companies House. The recessions of 1980-1 and 1990-1 show the firm had sufficient reserves to be able to survive the drop in construction demand with only a slight fall in 1992. In 1988 the firm experienced difficulties in spite of general growth in the market. In real terms however, in the period between 1991 and 1994 the firm was only briefly able to recover the high level of shareholders' funds valued at just over £18 million in 1963 at 1995 prices, a figure which reflected group funds including subsidiaries and other members of the group.

Figure 15.4 Shareholders' funds of one firm 1964-1997 at 1995 prices

Sources: Major Contractors Group companies' annual returns.
Note: Data deflated using the RPI, 1995 = 100 with 1975 weights.

15.3.5 A second firm with a long record of accounts, Young Austin Young Ltd., is illustrated in Figure 15.5. Their shareholders' funds increased until 1968. Since then the real value of their shareholders' funds generally declined to the point when in 1980 the company appears to have become technically insolvent, but because it was taken over, the firm was nevertheless able to continue in trade. Neither the firm illustrated in Figure 15.4 nor the firm in Figure 15.5 experienced long run expansion in real shareholder funds or real net worth over the last 4 decades.
15.4 Turnover

15.4.1 The average annual change in turnover is illustrated in Figure 15.6. In 1966 and again in 1972, 1980, 1983 and 1990 turnover increased exceptionally rapidly. Turnover figures in company accounts are lagged and reflect work won one year or more earlier. Thus 1970 growth in turnover may reflect demand expansion in 1968 to 1969. Alternatively the 1980 peak in turnover may have been due to merger activities recorded in the accounts of firms, as increases in turnover were due to the acquisition of subsidiaries. In contrast, the peak in 1990 reflects the height of activity in construction due to the speculative property boom at the end of the 1980s and therefore reflects the increase in work load especially for larger heating and ventilating engineers engaged on commercial projects requiring sophisticated heating and ventilating systems.

15.4.2 The greatest falls in turnover are shown in 1970, 1973, 1977 and 1991 to 1993 and reflect recessions in demand. The real drop in turnover in 1991 to 1993 appears to have been greater in scale and longer than the drop in turnover, which occurred in 1973 and the decline in 1977. Indeed the average turnover of the firms in the survey declined in real terms by over 20 per cent per annum for two consecutive years (see Figure 15.6). The length and severity of the recession in the early 1990s confirms that the drop in demand (turnover) between 1991 and 1993 facing the major firms in the heating and ventilating sector was unprecedented in the post war era.
15.4.3 Figure 15.6 indicates a decline in the growth rate of the industry, as measured by turnover of the largest heating and ventilating contractors. Downward phases in the turnover series indicate a tightening of the market as growth slowed down. This tightening of the market becomes particularly relevant if there is a difference between the rates of change of capacity and sales. If capacity was growing at the same rate as or faster than the previous year, any reduction in the rate of increase in annual turnover, would have represented an increase in spare capacity and therefore an increase in overhead costs per unit of output. Only by laying off labour or selling off plant could firms off-set reductions in turnover, but for firms in aggregate, maintaining their current resource utilisation ratios (the ratio of used to unused resources) profitably would have been increasingly difficult. This would occur even if growth rates were positive and the market was expanding but still in aggregate below that level of growth of turnover necessary for maintaining resource survival.

Figure 15.6 Average annual percentage changes in real turnover 1972-1997

Sources: Major Contractors Group companies' annual returns.
Notes: Data deflated using the GCPI (DETR), 1995 = 100
Arithmetic mean of data calculated only in years when n ≥ 9.
Outlier data for Ellis 1981 omitted.

15.5 Tangible fixed assets

15.5.1 In most industries firms do not respond immediately to changes in the market by altering their fixed assets. However, in many construction firms certain tangible assets such as plant and machinery are often less long lived than in other sectors of the economy. It
therefore follows that changes in fixed assets in construction firms reflect changes in market conditions more than in other sectors. In order to establish part of this argument, an index of the average annual change in the fixed assets of firms in the Major Contractors' Group is shown in Figure 15.7. Some of these annual changes may be partly due to merger activity. These annual changes also reflect changes in the consolidated accounts of the firms in question, and not only their heating and ventilating activities. Nevertheless Figure 15.7 provides approximate data on changes in the size and strength of these firms in terms of their fixed assets from one year to the next, but not necessarily the amount devoted directly to their heating and ventilating activities. A large proportion of the tangible assets of heating and ventilating contractors is comprised of buildings and these are of course usually the longest lived tangible assets of all, notwithstanding their tradability as assets. Nor, of course, does investment in buildings necessarily increase the capacity of the heating and ventilating industry.

15.5.2 Nevertheless the volatility of the average annual changes in tangible assets indicates that the largest heating and ventilating contractors increased their purchases of tangible assets including buildings in some years more than in others. They also maintained their flexibility in response to market conditions. Investment activity increased most in 1977 and again in 1983 (following recession), and in 1986 and fell most rapidly in 1985 and 1993, as illustrated in Figure 15.7.

Figure 15.7 Average annual percentage changes in real fixed assets 1972-1997

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Sources: Major Contractors Group companies' annual returns.
Note: Data deflated using the GDP, 1995 = 100 with 1990 weights
Arithmetic mean of data calculated only in years when n≥ 9.
Young, Austen and Young 1983 change in tangible fixed assets is omitted as an outlier.
15.6 Plant hire and labour

15.6.1 Figure 15.8 shows the average annual percentage change in plant hire and labour costs from 1972 to 1997 and 1973 to 1997 respectively, where the minimum number of firms reporting a variable was 9. Data on direct employment costs did not appear in the notes in company accounts until 1969 except on a voluntary disclosure basis. Firms record plant hire and direct employment costs in the notes to their annual accounts. Indirect labour such as labour only subcontractors’ costs are included in the accounts under cost of sales in the profit and loss account and creditors in the balance sheet. It may be assumed that indirect employment of labour increased in the late 1960s partly as a consequence of Selective Employment Tax. Certainly the data for the years after 1985 imply a drop in employment costs took place at that time in the Major Contractors Group. (The HVCA became aware that firms were understating their labour costs because of the increase in labour only subcontracting. As a result the trade association insisted that members include casual labour as a separate item in their annual returns for the purpose of calculating the HVCA’s annual fees, and labour only subcontractors fees were included in the total wage return data from 1978 to 1996).

15.6.2 In some years, such as 1974, 1985 and 1994, an increase in expenditure in plant hire is accompanied by a decrease in expenditure on direct labour. The increase in plant hire therefore appears to result from a strategy of subcontracting increasing amounts of work and work packages. For example, from Figure 15.8 this substitution of labour by plant hire

Figure 15.8 Average real annual percentage changes in plant hire, 1972-1997 and labour expenditures, 1973-1997

Sources: Major Contractors Group companies’ annual returns.
Notes: Plant hire data deflated using the GDPI 1995 = 100 with 1990 weights. Employee costs deflated using GCPI 1995 = 100.
Arithmetic mean of data calculated only in years when n≥ 9.
Ellis (Kensington) Ltd 1983 change in plant hire is omitted as an outlier, as is HAT Lorne Stewart Ltd 1986.
appears to have occurred mainly between 1984 and 1995 when the proportionate expansion of plant hired by the major heating and ventilating contractors was usually greater than the increase in labour costs. It would appear that the major specialist firms in the heating and ventilating industry tend to adopt similar strategies to main contractors when it comes to employment and plant hire.

15.6.3 Figure 15.9 compares employment costs of firms derived from their annual accounts to their annual wage returns between 1988 and 1996. This shows that wage returns are more volatile than employment costs. This is caused by the fact that wage returns include labour only subcontracting, whereas employment costs only cover those directly employed by the firm. The greater volatility of wage returns reflects the flexibility of the employment of casual workers, who are taken on during peaks of the workload and released during the troughs. At the same time the wage return data reflects the rise in labour only subcontractors' (LOSC) real wage rates during peaks and the reductions in LOSC wage rates during recessions. Changes in aggregate wage returns also appear to lead employment costs at the peak but lag at the lower turning point. However, a longer series would be required before a firm conclusion could be drawn.

**Figure 15.9 Average real annual percentage changes in employment costs and wage returns per firm 1988-1996**

Source: HVCA annual wage returns and annual accounts of firms in the Major Contractors' Group of the HVCA
Notes: All data deflated using GCPI, at 1995 prices
Unweighted arithmetic mean of data calculated only in years when n> 9.
Data for all firms in the MCG used except CWS Engineering Group, for reasons of consistency between wage returns and accounting data.

15.7 Concluding remarks

15.7.1 From the accounts of firms in the Major Contractors Group although the heating and ventilating market did not grow in real terms after the mid 1970s, firms were on average able to maintain their relative positions with growth in turnover occurring more often than decline and contraction. The largest firms’ growth rates were low, not because they had not grown at
all but because they survived only to experience the major recession of 1990 and 1991. Figure 15.3 shows that shareholder funds, a usual measure of firms' size, grew in the 1970s but after 1982 with the exception of 1989 to 1991 there was a consistent decline in reserves. The firms may have grown in the 1970s but several stagnated in the 1980s. This posed major difficulties for firms in the recession of the early 1990s. However, such generalisations based on average results can be misleading as Hannan and Carroll (1992) have pointed out. Indeed, the graphs given in Appendix 5 are evidence of wide variations in the experience of firms within the Major Contractors Group.
Part 6 Conclusions
Chapter 16 Summary of findings and conclusions

16.1 Introduction

16.1.1 This research has studied the structure and performance of the heating and ventilating industry since the Second World War by analysing the population of firms which made up the membership of the HVCA in that period and their wage return data. Of particular interest has been the analysis of growth and survival. This chapter summarises the findings and suggests areas for further research.

16.1.2 The study of firms in the heating and ventilating industry has mainly examined the behaviour of small and medium sized enterprises. Like turning over a rock and observing the fascinating creatures living within the bounds of their own ecosystem, this research has studied the ecosystem of heating and ventilating contractors. Their ecosystem consists of working as subcontractors with other specialist firms within the construction industry to produce buildings. Yet the world of heating and ventilating contractors is a self-contained market in which the firms compete in difficult conditions in a market within a market. Heating and ventilating output is not expanding in real terms because demand for the services of heating and ventilating engineers is a demand derived from the demand for construction. The market has not been expanded by the introduction of innovation. Innovations simply give individual firms a temporary competitive advantage until the other heating and ventilating firms adopt the new technology. Competition in the heating and ventilating industry is a zero sum game.

16.1.3 Yet although firms need to grow in order to survive (Penrose), in heating and ventilating it is not always possible to grow and survive. The rate of growth of many firms exceeds the rate of growth of the market. As the market does not expand fast enough to accommodate the increasing turnovers of its constituent firms, and as competitive advantage is both limited and temporary, the result is that firms grow then fail and there is a constant turnover of firms. This process implies that older firms are continually being replaced by new firms. Many larger long lived firms appear to survive, until one recognises that they have succumbed to take-over and are no longer independent business entities.

16.1.4 These larger ‘survivor’ firms were, however, cushioned because they had become, in the main, subsidiaries of larger outside companies, who value the prestige of a presence in the heating and ventilating industry as proof of their technical competence to undertake construction work. In their accounts there was also evidence of internal transfers of funds from these heating and ventilating companies to their parents, which may have had the effect of depressing their results and also their ability to grow.

16.1.5 Firms in the heating and ventilating industry appear to be doomed to grow for a relatively short period until they are replaced by new firms. This paradox presents an extremely difficult environment for firms in which to operate. Even the largest firms have succumbed to take-overs within heating and ventilating. It remains to be seen whether or not similar difficulties face other specialisms within construction. It is to be hoped that this research provides a precedent for a method of investigating and an understanding of the implications of subcontracting in the construction industry.

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16.1.6 This research has attempted to understand the workings of a market dominated by a few large firms but populated by a large number of small and medium sized enterprises. The central theme of this research has been concerned with the growth strategies firms may adopt in order to enhance their chances of survival. A number of propositions and hypotheses have been discussed and tested to gain an understanding of the complexity and context of the issues involved, as these are seen as being industry specific. The findings of this research are set out in terms of the relationship between the heating and ventilating industry and the construction industry, the structure of the heating and ventilating industry and the growth and survival of firms in the heating and ventilating industry. A brief summary of the ten main propositions and hypotheses given in Chapter 2 and the findings follows.

16.2 The relationship between the heating and ventilating industry and the construction industry

16.2.1 The first proposition was:

i. if buildings become more complex and technologically more sophisticated in their services over time, it follows that the trend growth rate of the output of the heating and ventilating industry will exceed the trend growth rate of the construction industry.

16.2.2 It was found that the heating and ventilating industry did indeed increase its share of construction industry output up until the 1970s. However, since the mid 1970s heating and ventilating has not increased its share of construction output.

ii. If the annual variation of output of the heating and ventilating industry follows a pattern significantly different from the construction sector, as a whole, then demand for heating and ventilating cannot necessarily be predicted from construction output.

16.2.3 It was found that workloads in the heating and ventilating industry were not highly correlated with the construction industry and nor did a time lag (given annual data) between demand in construction and demand in the heating and ventilating industry show significant results.

16.3 The structure of the heating and ventilating industry

iii. If barriers to entry are relatively low, then the number of firms in the heating and ventilating industry would grow faster than industry sales. If this is the case the growth rate of the output of the heating and ventilating industry as a whole in any year will be higher than the average growth rate of turnover (sales) of individual firms in the industry.

16.3.1 In fact taking the period from 1955 to 1996, the average growth rate of the market was marginally greater than the average growth rate of firms. Consequently barriers to entry were deemed to be relatively low.
iv. If economies of scale confer an advantage of size, then growth rates of firms would be size dependent, (contrary to Gibrat’s Law), and it would follow that
(a) the larger the firm the higher the rate of growth,
(b) over the passage of time, the higher would become the n-firm concentration ratio and
(c) the higher would become the Herfindahl index.

16.3.2 Propositions iv(a), (b) and (c) were all rejected. All the tests and results of firms in the heating and ventilating industry were found to be consistent with Gibrat’s Law. Larger firms do not necessarily grow faster than smaller firms. The mean growth rate of survivor firms was not significantly different from zero, which implied that survivors do not necessarily grow. Concentration ratios and the Herfindahl index if anything exhibit long run downward trends indicating that the industry is not becoming increasingly dominated by the largest firms.

16.3.3 However, when a distinction is made between entrants and incumbents, clear differences in behaviour and performance emerge.

v. New entrants tend to experience relatively rapid growth and high mortality rates compared to established enterprises.

This proposition was validated. New firms exhibited on average relatively rapid growth and tended to have relatively low long term survival rates.

16.4 The growth and survival strategies of firms in the heating and ventilating industry

If firms that grow fastest survive, the implication is that they embody competitive advantages which enable them to outstrip their competitors. If firms that grow fastest do not survive, their growth may be due more to an implicit unplanned reactive management strategy, or their non-survival may be due to decisions on the part of the owners to sell either for personal gain or to gain accelerated access to a larger market. It therefore would not follow that growth of itself is a determinant of survival. To test this proposition the hypothesis is that:

vi. in the heating and ventilating industry, growth is a predictor of survival.

16.4.1 Using a Cox regression it was found that growth is a statistically significant determinant of survival. Hypothesis vi was therefore validated. Other factors that were tested included size of firm on joining the HVCA and year of joining the HVCA. Neither of the latter two independent variables was found to be significant.

vii. Firms that grow within a range around this growth rate minimise the chance of failure.

16.4.2 Scatter diagrams in Chapter 14 illustrated the relationship between survival and growth. Using Cox regression, the mean growth rate of firms based on the linear trend of 0.25 per cent per annum and a standard error of 4.54 was found implying that firms
maximised their chances of survival if their long run average growth rate was between - 4.29 and 4.79 per cent.

Other aspects of growth and survival were also tested, including the relationship between the variability of size over time or volatility and survival.

viii. **The higher the coefficient of variation of a firm's annual growth rates, the less likely firms are to survive.**

Hypotheses (vii) and (viii) consider that the chances of survival may be affected by average growth and volatility over the long run. Hypotheses (ix) suggests that the survival of firms might also be affected by an exceptionally high growth rate occurring in any one year.

ix. **The higher the peak rate of growth the less likely firms are to survive.**

16.4.3 Hypotheses (viii) and (ix) were rejected. No correlation was found between the coefficient of variation and survival. Similarly, no correlation was found between peak growth rates and survival.

16.4.4 In the context of the business cycle, the timing of the formation of firms may be expected to favour firms starting in some years more than others. However, it was not possible to validate the hypothesis, which related the year of joining the HVCA and survival.

x. **Firms survive for different periods depending on the phase of the business cycle in which the firms were founded.**

16.4.5 Consistent with Geroski and Gregg (1997), who found that the survival of any given firm in the recession of the early 1990s could not be predicted from any of the variables they tested, it was not possible to determine survival chances based on the year of joining the HVCA. A number of years were identified as crisis years related to the number of insolvencies and the heating and ventilating business cycle, but firms founded in or just before crisis years had similar life spans to firms founded at other times.

16.4.6 As a result of the many dynamic processes within the population of firms, the structure of the heating and ventilating industry did not alter significantly between 1945 and 1996. Concentration ratios show that the major firms in the industry did not increase their share of the market to any great extent. They did, however, increase their influence as a result of organising themselves in the Major Contractors' Group. As a consequence of these institutional changes the division of the HVCA between the interests of the few largest firms and the large number of small and medium sized enterprises has reflected the inherent conflicts, which occur in trade associations, where competing firms join together to form a common defence of the employers in an industry.
16.5 Summary of findings and their implications

16.5.1 A number of broad conclusions can be drawn from this study of heating and ventilating contractors.

- No economies of scale can be identified. As a result there is no particular size of firm, which grows faster or survives longer than any other size.
- There are low barriers to entry into the heating and ventilating industry which cause profit margins to remain low.
- Low sustainable competitive advantage means that firms cannot sustain rapid growth.
- Slightly decreasing concentration over the long run has meant that the heating and ventilating industry has not restructured itself. It remains an industry with a predominantly large number of small firms and a variety of niche markets such as air conditioning, refrigeration, home heating and maintenance.
- The average growth of firms is less than the growth of the heating and ventilating market. Consequently the number of firms in the industry has increased and the new entrants have taken up a proportion of the increased market size. The increase in the market size has therefore not been of as great a benefit to existing firms as they might have needed in order to remain as independent trading entities. It is therefore not surprising to find that all the major firms in the heating and ventilating industry became subsidiaries of other firms outside the heating and ventilating market.
- The optimal survival growth rate is less than the average growth rate of firms. In part, non-survival of fast growing firms is due to failure and cash flow difficulties arising as a consequence of over-trading.

16.6 Further research

16.6.1 The heating and ventilating industry - so far this discussion has been solely concerned with the structure and performance of the firms within the HVCA. The same variables could be used to make a comparison between the members of the HVCA and the firms in the heating and ventilating industry as a whole. This would need a survey based on the DETR’s register of firms in the heating and ventilating industry. The firms in the survey would be comprised of both HVCA member and non-member firms.

16.6.2 These non-member firms are overwhelmingly what Gruneberg and Ive (2000, pp. 80-85) have characterised as near-firms (1 to 3 employees). For near-firms different analytical models are almost certainly required, from those appropriate for the analysis of the kind of firms, who are members of the HVCA.

16.6.3 Trends and cycles - Changes in company account reporting, introduced in the 1985 Companies Act, have meant that it is now virtually impossible to study average or representative business ratios for industries, such as the heating and ventilating industry. In such industries small and subsidiary firms together account for the majority of output. This closes-off one otherwise obvious avenue of further research. Instead it may be worth exploring the response to a direct enquiry to the owners of a sample of heating and ventilating firms for accounting data for past years.
Further research on modelling the long run data of the heating and ventilating industry is suggested by the work carried out on construction output by Notman, D., Norman, G., Flanagan, R., and Agapiou, A., (1998). Construction output data was analysed using ARIMA techniques and a similar approach could be applied to the heating and ventilating industry.

Analysis of value added - this research has formed a first step in considering the possibility of looking at value added by different members in the production process. By investigating wage returns it has been possible to view the contribution of specialist firms in construction. This is in contrast to the output measures used in conventional analyses. If wage returns in the heating and ventilating industry are accepted as a proxy for value added in an industry, which competes on very low profit margins, then changes in wage returns reflect changes in value added over the long run. By identifying the slow growth in wage returns of heating and ventilating engineers, this research has highlighted the relationship between the production of prefabricated building components and the value adding process of installing these components. It is likely that the value added by the installers as a proportion of the gross output of heating and ventilating reflects the fact that an increasing proportion of value added can be attributed to the increased use of prefabricated components, technological improvements and innovations in the products.

The cost of heating and ventilating products for a given level and quality of service may have declined in real terms implying that a rise in the use of heating and ventilating systems in building services is not reflected in the value of output. This leads to the two following questions.

1. Is it correct that heating and ventilating prices have been falling over time? If so, (2) is it correct that the price elasticity of demand for heating and ventilating is low or even inelastic, so that a fall in prices cause only relatively little rise in quantity, leaving the aggregate value of output constant or falling?

It follows that if value added can be used as a means of analysing the construction industry the contribution of component manufacturers, specialist contractors, and main contractors can be assessed, with a view to increasing building efficiency. Such an approach based on an analysis of value added of construction industry output, main contractors’ value added, specialist contractors’ value added and component producers’ value added would enable

- analysis of the construction industry to extend the application of input output tables in construction
- target those sectors in the construction industry which account for increases in value added. This would develop the ideas put forward in the Egan Report, *Rethinking Construction* (1998) and enable an ongoing process of productivity improvement in construction.
- confirm the role of manufacturing in construction and further integrate the design and production of building materials as discussed in the recent study of building materials producers conducted by Davis, Langdon and Everest (2000).
16.6.9 *Growth and survival* - this research has shown that there is a trade-off between growth and survival in the heating and ventilating industry. While growth is necessary for survival, a relatively high growth rate enlarges the income flow in the short run at the increased risk of failure. High growth rates can reward shareholders with an increased dividend stream and increased share valuation, especially when selling on their shares. However, their interest may not necessarily be in the long-term survival of the firm. Managers have an interest in low or moderate growth and their need for continuity of employment implies an interest in the survival of the company.

16.6.10 A number of questions can be suggested to investigate the nature of the respective gains of choosing a growth and survival strategy to the different interests involved. Firstly, what level of capital injection is associated with each growth rate? The capital injected into a firm is its risk capital supplied by its shareholders. There is therefore a need to know how differences in turnover relate to differences in profits, both in terms of the size and the growth rates of firms. Given that firms tend to survive as independent legal entities for a finite period what percentage of non-survival are voluntary or the result of take-overs and what percentage are involuntary or bankruptcies? If a firm is taken over or if non-survival is voluntary, shareholders may gain or at least recover part of their capital. Managers may lose their employment. If the firm is forced into bankruptcy the shareholders lose their capital.

16.6.11 *Trade associations in construction* - a fifth area of research worth considering is work on trade associations in the construction industry. The Heating and Ventilating contractors’ Association is only one of many trade and employer associations representing members’ interests. However, little is known about the structure, operation, strategies and functioning of trade associations in construction.

16.7 Concluding remarks

16.7.1 Finally it has been the aim of this research to study the growth and survival of firms in the heating and ventilating industry by using wage returns as a proxy for size. Although size is usually measured in terms of turnover, numbers employed or net asset values, it was argued that in this labour intensive industry wage returns were a reasonable proxy for turnover and a good proxy for value added or net output. Even if these arguments are not accepted, this study of wage returns can be read as a study of the behaviour of firms and their employment strategies in response to their changing market and economic conditions.

16.7.2 Having discussed the heating and ventilating industry, this research has demonstrated a number of methods of analysis which could be applied to comparable sectors inside the construction industry such as plumbing firms, electrical engineers, and indeed other specialist groups of firm (as well as other specialist industries in other sectors of the economy). The construction industry can be characterised as being composed of many fragmented markets, each with their own peculiarities and social and economic institutions. By understanding differences between types of specialist firms and markets within construction, a new and better understanding of the economics of the construction industry might be developed.
16.7.2 The construction industry can be seen as a microcosm of the economy. This research has shown the economic implications for firms in an industry that is not on a growth path. If global economic expansion is not sustainable then it follows that sooner or later growth in other industries will follow the path already long established in construction in general and in heating and ventilating in particular. The lessons of coping with the paradox of the need to grow in order to survive in a market that is not growing will need to be learned in other industries. In such a scenario the experience of the heating and ventilating industry may come to seen as a forerunner of trends in other sectors.
References
References

AHVDEE, see Heating, Ventilating and Domestic Engineering Employers, Association of


Bennett, J., and Jayes, S., (1995), Trusting the Team, Centre for Strategic Studies in Construction, Reading University of Reading


May/June, p. iii.


Grinyer, P., (1972) 'Systematic Strategic Planning for Construction Firms' in Building Technology and Management, Feb., pp. 8-14


HVCA, see Heating and Ventilating Contractors' Association


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Housing and Construction Statistics, (1998a) Table 6.1(d) p.74, London, DETR

Housing and Construction Statistics, (1998b) Table 1.6 (b) p. 19, London, DETR


McGraw Hill


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Appendices
Appendix 1  Examples of correspondence concerning the annual collection of wage returns

The following two letters found in the ledgers illustrate the effort taken by firms and the association to collect accurate data. The first letter is a copy of a letter found in the Off List membership ledger of the HVCA. The letter was sent by the general manager of JT Meredith and Co. to the HVCA concerning the firm’s contribution. The unwitting evidence it provides is the methodology of collecting fees, and the seriousness with which the subject was taken. The basis of the fees paid by individual members was the wages return, an accountant certified letter stating the wages paid by the firm. This was used to calculate the annual fees due by multiplying the wages return by the subscription rate.

J.T. Meredith and Co. (Engineering) Ltd.
Specialists in heating, air conditioning, combustion and electrical services.

J.H. Razley Esq. 6 Malt Street
Heating and Ventilating Contractors’ Assoc.
Coastal Chambers
172 Buckingham Palace Road
London SW1W 9TD 2nd June 1971

Dear Sir

Subscription assessment 1971/72 - Wages Return

We have received your letter of 20th May 1971.

It must be explained that the reasons for the delay in forwarding a Wages Return are :-
2. J.T. Meredith and Co. (Maintenance) Ltd., was formed on 1st April 1970 and ceased to exist as a trading company on its assets and goodwill being acquired by Planned Maintenance and Engineering Ltd., and the company name changed to J.T. Meredith and Co. (Engineering) Ltd. As and from 1st December 1970, as per the accompanying letter dated January 1971.

You will therefore see that there has not been a “financial year ending” of either company and certified accounts have not been produced.

On the basis of Wages [sic] paid up to 30th November by J.T.M. and Co. (Maintenance) Ltd of £35,100 and from December to 31st March of £16,700 by J.T.M. and Co. (Eng) Ltd, the total uncertified wages is £51,800 (which at 30p per £100 = £155.40p together with the Annual Membership Fee of £7.35 totals £165.75p).

I shall be glad to learn that this assessment meets with your approval and in anticipation thereof, I enclose the Wages Return 1971/2 showing this figure of £51,800, but uncertified.

Yours faithfully
J.T. Meredith and Co. (Engineering) Ltd.
H. Charteris (signed)
General Manager
The second letter was sent by the Secretary of the HVCA to the managing Director of the BCM Heating Company. This letter illustrates one of the problems of fee collection, at the same time showing one cause of inaccuracy in the data used, namely the attempt by members to avoid their full subscription charges by understating their wage returns. Note the tactful tone of the letter.

The Managing Director
BCM Heating Company
Winnal Close
Winchester
Hants 7th October 1976

Dear Sir

Subsidiary in the West Country

I am advised by our members in the Devon and District Branch that you have a subsidiary company in Devon. If this is so I am sure you will be interested in attending the meeting of the newly formed Devon and District Branch which is meeting in Exeter on 17th January 1977. I will ask our Secretary of the Branch to send you details of the next meeting.

Incidentally if you have a subsidiary I should remind you that under the rules of the Association this should be declared on your wage roll return and the relevant wages of that subsidiary should also be declared as part of the company’s total wage roll. Perhaps this could be put right for the 77/78 declaration.

I am sure you will find participation in the West Country Sub Branch most profitable.
 Yours truly

Donald Edwards (signed)
Secretary
In fact, at the Annual General Meeting in June 1967, steps had been taken to deal with problems caused by delays in payments of subscriptions. The constitution was amended as follows:

(i) if a member fails to render his wages return in time for his subscription to be calculated on it, his subscription will automatically be assessed on the wages figure for the previous year (whether actual or assessed) subject to an increase of 33.3 per cent.

(ii) members who fail to pay their annual subscription by August 30 in any one year will be suspended until their subscriptions are paid.

The Association later stated that these amendments had been effective in dealing with late payments (HVCA, 1968, p.43).

Nevertheless, the process of collecting the annual wage returns appears to have been taken seriously by those concerned. The method of collecting the wage returns (of both office and site labour) of the members of the Heating and Ventilating Contractors’ Association was from accounts certified by the firms’ accountants and formed the basis of the fees paid by members to the association. In folio F420, there is a note as follows: “September 1955, resigned at request of council as unable to complete a wage return covering site labour. Transfer to “Subscribers for Information Only”. March 1958 re-elected.”

In 1977 the HVCA looked into the problem of subscriptions because it was felt that the high rate of inflation penalised those members whose subscription was based on wage rolls calculated over later periods than others. Instead of collecting returns from members in January of each year, they would be collected henceforth on the basis of gross wages paid during the year ending 31 March. However, it was not made clear what difference this would make to members.

In 1971 a dispute arose between a member and the Association when the member refused to have his wages return certified by the firm’s auditors for the purpose of the fee calculation. The member eventually resigned in 1973 (Annual Returns and Payments Ledger). Shortly after, changes were made to the rules and from 1977 onwards an auditor’s signature was no longer required to verify members’ wage returns. Finally, the method of assessing gross wages paid for the purpose of calculating subscriptions was altered. After 1977 when a member failed to submit a wage return a 40 per cent increase would be added to the previous year’s return, instead of 20 per cent as had been the practice (HVCA 1977 p.50). For this reason assessed wage returns have been excluded from the analysis of wage returns in this thesis. In 1989 a new system for calculating membership fees was announced, based partly on wages paid to employees (as before) and partly on turnover and in 1991 this new system was introduced (HVCA 1989 p.40). For this reason it has been possible to obtain turnover data for the period between 1988 and 1997 but not for the period between 1945 and 1979, though, of course, since 1967 turnover data has been given in many annual accounts filed in Companies House.
Appendix 2

The exploratory study

In general, records at Companies House are held on microfiche. A ‘standard’ request provides the microfiche records of a company over the most recent 5 years, including accounts and annual returns, mortgages and general information concerning the firm. For earlier data a ‘weeded’ microfiche request provides the records of the firm since 1973 when the current microfiche system was set up. For data prior to 1973 hard files can be ordered from the archives held in Newport, South Wales. Data for older firms no longer in trade is not held indefinitely, though a small percentage of hard files are sent to the Public Record Office.

In the study a list of 38 firms beginning with letters A and B were sent to Companies House. Of these, 25 weeded files were available on microfiche, eight were available as hard files and five required archive searches. Of the five requiring archive searches, there was no trace of three firms. Weeded microfiches of two firms were requested as well as the hard files of two other firms.

In the event 41 sets of annual accounts of three companies were analysed covering the period 1967 to 1993, with no data available for 1989. Six sets of these accounts omitted the profit and loss account. The data was combined in a number of ways and ratios and time series were derived. The sample was too small for meaningful significance testing but it was clear from the exercise that it would be possible to obtain the necessary data for this period for a majority of firms from records held at Companies House.

Clearly, the accounts of all firms need to carry a health warning, in terms of their accuracy and veracity. Indeed, Wroe (1997 p.16) points out that not only are accounts prepared several months after the year end usually by a professional firm of accountants, but that the purpose of the exercise for privately owned companies is to minimise the firm’s tax bill rather than present an accurate valuation of the firm’s assets and work in progress. Thus, as with any historical accounting data, there is a need to recognise that both witting and unwitting errors can arise.

The study revealed that sufficient accounts data would not be forthcoming prior to the early 1970s, as earlier Companies Acts had not required firms to publish their profit and loss accounts or their balance sheets, although some firms volunteered the information along with their annual returns. These annual returns which firms were required to submit only gave information on directors, and issued share capital. The 1968 Annual Report of the Heating and Ventilating Contractors Association announced the 1967 Companies Act by saying in effect it had abolished the private exempt company and from then on all limited companies were required to provide more information than hitherto to their shareholders, employees and the public generally (AHVDEE, 1968 p.41).

The exploratory study confirmed the following points:

- HVCA data could be used to identify firms at Companies House.
- It was clear that firms did not always file complete accounts, or at any rate their accounts have not all survived in complete form.
• Firms' accounts frequently require interpretation before figures can be recorded for research purposes.

• Occasionally errors could be found in the actual accounts.

• For small firms expenditure on vehicles and property mortgages are often viewed as capital spending or investment, when in fact they are owners' perks or tax avoidance measures.

• It was found to be possible to collect annual accounts at Companies House from 1967 to 1996, though data prior to 1973 are not available on microfiche and are often incomplete. Nevertheless this provided an overlap between 1971 and 1979 (9 years) only for the first set of wage return data and 1987 to 1996 (10 years) for the second. While wage return data exists for the period between 1945 and 1967, there is no accounting data, and for the period between 1980 and 1986, accounting data is available but no annual wage returns.

• It was not possible to simply aggregate the accounts data to find a total firm set of accounts. Some entries were missing from some accounts. There was a need to adjust the average to take account of the size distribution of firms.

• Accounts were held for 20 years at Companies House after companies were dissolved because a company could be re-established up to 20 years after its dissolution. After 20 years most files were destroyed. One per cent of files are sent to the Public Records Office. This would be too insignificant a sample to be of use for the present research.

Thus a number of problems concerning data gathering of company accounts were identified. The charges made by Companies House for company searches in 1998 were up to £7 per company for both the standard and weeded microfiches plus photocopying costs, and £6 for sight of the hard file of firms dissolved prior to 1977, if available. Apart from the cost of obtaining sufficient data from Companies House, the non-availability of the information for the early post war years, and following the introduction of the 1985 Companies Act, the time constraint on this research and the difficulty in interpreting the accounts with any consistency led to the practical conclusion that an analysis of the wage returns would in the end be more productive and informative, given the limited sample of company accounts that would have been available compared to the population census of wage returns that had been collected in any case.

In the end it was therefore decided not to use company accounts to establish annual averages and ratios of a random sample of firms. This is also consistent with the population ecology approach of Hannan and Carroll (1992). The number of years in which there was no overlap between wage returns and the accounts, and the substantial amount of work and time involved in obtaining and interpreting the accounts, all lead to the conclusion that an analysis of profits should be the subject of separate research. Consequently, the use of company accounts data was seen as most pertinent as the subject of future research linked to the analysis of wage returns undertaken here.

Nevertheless, it was decided that a survey of the accounts of the members of the Major Contractors Group within the HVCA would be practical, to support or question the trends found in the wage return data. As the Major Contractors Group consisted of 12 to 16 of the largest companies in the HVCA in any one year, they represented a significant share of the output of the industry. In all, 18 firms were included in a long run analysis of the accounts of the members of the Major Contractors Group in Chapter 15.
## Appendix 3  Key to identity numbers of firms in the Major Contractors Group

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<tr>
<th>Key Number</th>
<th>Name of firm</th>
<th>Company for which accounts used</th>
<th>Company number</th>
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<td>Andrews Weatherfoil Ltd</td>
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<td>James Scott Mechanical Electrical Services Ltd.</td>
<td>Ashwell Scott Ltd</td>
<td>00054631</td>
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<tr>
<td>3</td>
<td>Benham Building Services Ltd</td>
<td>Bimec Benham Engineering Ltd</td>
<td>00708672</td>
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<td>4</td>
<td>Brightside Mechanical and Electrical Services Group Ltd.</td>
<td>Brightside YAY Ltd</td>
<td>02124769</td>
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<td>5</td>
<td>CWS Engineering Group</td>
<td>CWS Engineering Services Ltd</td>
<td>03096287</td>
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<tr>
<td>6</td>
<td>Drake and Skull Engineering Co Ltd</td>
<td>Drake and Scull Engineering Ltd Drake and Scull Holdings Ltd</td>
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<td>7</td>
<td>Ellis Mechanical Services Ltd</td>
<td>Ellis Mechanical Services Ltd</td>
<td>00963218</td>
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<tr>
<td>8</td>
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<td>Lorne Stewart plc Lorne Stewart (Southern) Ltd</td>
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<td>Haden Young Ltd</td>
<td>Haden Young Ltd</td>
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<td>Henry Hargreaves and Sons Ltd</td>
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<td>How Group Ltd</td>
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<td>18</td>
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</table>

Sources: Major Contractors Group companies' annual returns and HVCA Annual Reports.
## Appendix 4 Table A (Part 1) HVCA Major Contractors Group members' profits 1955 - 1975

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Source: Company accounts, Companies House.
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Source: Company accounts, Companies House.
Appendix 5  Graphs of profit, turnover and shareholders’ funds of the firms in the Major Contractors Group

The following graphs depict the data of the population of firms found in the Major Contractors Group given in Appendix A. Each firm is shown in Graph A and Graph B. Graph A shows the value of turnover, profits and shareholder funds at constant 1995 prices. Graph B shows the same data indexed where possible such that 1985 = 100.
Notes: Index 1985 = 100.
Firm 2 Graph A

£000s

55 58 61 64 67 70 73 76 79 82 85 88 91 94 97 100

Years

Note: Index 1970 = 100

Firm 2 Graph B

Index values

55 58 61 64 67 70 73 76 79 82 85 91 94 97 100

Years

Note: Index 1970 = 100
Note: Index 1985 = 100
Note: Index 1995 = 100
Firm 5 Graph A

Firm 5 Graph B

Note: Index 1996 = 100
Firm 6 Graph A

Firm 6 Graph B

Note: Index 1985 = 100
Note: Index 1985 = 100
Note: Index 1985 = 100
Note: Index 1985 = 100
Firm 10 Graph A

Profits before tax — Turnover — Shareholders' funds

Firm 10 Graph B

Profits before tax — Turnover — Shareholders' funds

Note: Index 1975 = 100
Note: Index 1985 = 100
Note: Index 1985 = 100
Note: Index 1985 = 100
Note: Index 1985 = 100
Firm 16 Graph A

Firm 16 Graph B

1995 = 100
Note: Index 1990 = 100
Note: Index 1985 = 100