DIVERGENCE OR CONVERGENCE

IN

RESEARCH AND DEVELOPMENT AND INNOVATION

BETWEEN 'EAST' AND 'WEST'?

by

Slavo Radosevic

Chapter for the book Brzezinski, H and Fritsch, M (eds): ***Innovation and Technical Change in Eastern Europe. Pathways to Industrial Recovery*****, Edward Elgar, Cheltenham, 2000**

Research which formed the basis for this chapter was funded by the EC TSER programme. I am grateful to Keith Pavitt, Michael Fritsch and participants of the Fifth Freiberg Symposium on Economics for valuable comments. Any errors remain my responsibility.

1. INTRODUCTION

In socialist economies the institutional setting of R&D and innovation activities (RDI) was entirely different from that in capitalist countries (Hanson and Pavitt, 1987). During the last 7 years ex-socialist economies have significantly transformed their basic economic mechanisms in areas of ownership structure, market organization, financial system, foreign trade liberalization, and of enterprise organization (see EBRD 1994, 1995 and 1996). Within that context our concerns is whether RDI activities of PSE have converged into a market economy model or whether their RDI still differ in their basic features? Are RDI between 'East' and 'West' converging or diverging in the post-socialist period? Do PSE possess a certain innovation features which make them still distinctively different from the RDI model of market economy or they are converging towards it?
In the second part we analyse specific elements of convergence (divergence) between the RDI activities of 'East' and 'West'. Comparative elements which form the analysis are those developed by Hanson and Pavitt (1987). In the third part we summarise elements of convergence / divergence in RDI and offer some explanations for still strong divergences in RDI. In the fourth part we develop two hypothetical scenarios regarding the future of RDI in PSE: a full convergence scenario with the market economy model and the scenario that takes into account evolutionary, especially path dependent features, of post-socialist transformation. Our conclusion is that RDI in PSE have in many elements converged towards the market economy model of RDI. Elements of divergence are that enterprises have not yet become the main agents of innovation; R&D is still externalised with significant problems in its management due to the role of state as owner who cannot simultaneously exercise a cash flow control function in R&D, and the new gaps which have emerged in RDI where applied and strategic R&D are absent from the spectrum of innovation activities. These differences result in weak innovation capabilities of post-socialist enterprises. RDI in PSE will eventually achieve the features of 'designated future' or 'hypothesised end-state' as specified by Hanson and Pavitt (1987). However, once RDI settle within the *general* features of the market economy model the most interest will focus on what are the innovation properties *specific* to eastern European capitalism(s)? These specific features of CEE capitalism are outlined in the fourth part. The conclusions summarise the main arguments.

2. ELEMENTS OF CONVERGENCE AND DIVERGENCE BETWEEN 'EAST' AND 'WEST'

Questions that we want to deal with assume that there are certain fundamentals of the market economy in the innovation sphere which make it distinctively different from a socialist economy. Indeed, analysis of Hanson and Pavitt (1987), which we take here as a starting point, assumes that these fundamentals do exist.

Pavitt (1991) and Hanson and Pavitt (1987) find differences in RDI between 'East' and 'West' in the following elements which are relatively weaker or not at all present in the socialist economy:

1. ***The location and funding of R&D, and related technical activities*****.** Given the differentiated, specific and often tacit nature of technology, innovative activities within

enterprises are crucial for generating useful knowledge and products. In socialism these were mainly performed in extra-mural institutions.

2. *Priorities in technological activities (military; development and testing; product vs. process innovations).* Given the uncertainties embodied in innovation activities a diversity of innovative efforts efforts by different enterprises encompassing the entire spectrum of technological activities is more likely to lead to successful innovation. In socialism technological activities were heavily skewed towards military applications, with priority given to research over development and testing, and forcing product over process innovation.

3. *Incentives for innovation and diffusion (incentives for innovation; competition policy).* The prospect of temporary monopoly profits, competition and hard budget constraints (limited budget) are preconditions for innovative behaviour. Soft budget constraint, lack of competition and monopoly deterred innovative behaviour in socialism.

4. *Decentralisation, diversity and pluralism (firms and sectoral patterns of innovations).* Given the differentiated and often tacit nature of knowledge of technologies and markets, decentralised decision making is superior as a mechanism when compared to centralised decision making;

5. *Linkages into the international economy (trade openness; technology transfer channels).* Open markets are likely to sharpen incentives and increase innovative and imitative opportunities. The closed economy weakened incentives to innovate. Lack of exposure to learn from foreign markets and partners slowed down innovation dynamics.

6. *The role of the state.* Given the above characteristics (1- 5) the role of the state in the market economy is one of exercising indirect influence in RDI and much less direct control over innovation processes.

To take this further, we use these characteristics, in somewhat modified form, as a base from which to assess how much post-socialist RDI activities have departed from the characteristics of the socialist RDI as well as how much they have converged towards the market economy model. These elements are summarised in the table below and our analysis follow its structure. For a discussion on these elements in the market economy see Hanson and Pavitt (1987). The reader should bear in mind that these are highly stylised features that do not do justice to the differences that existed among the CMEA countries or to country specific differences in the post-socialist period. However, numerous common post-socialist features in transformation of RDI make our inquiry relevant across a large number of the PSE.

ELEMENTS OF CONVERGENCE - DIVERGENCE IN RESEARCH AND DEVELOPMENT AND INNOVATION BETWEEN 'EAST' AND 'WEST'

	SOCIALISM	**POST-SOCIALISM**
1. **The location and funding of R&D and related technical activities**		

1.a. Financing and location	Investments in R&D are above the average of comparable economies. R&D *for* industry and not *in* industry. Dominantly state budget funding.	Sharp decline in RDI funding to the level of comparable medium income economies. R&D system is still dominantly extra-mural.
1.b. Large users - specialised suppliers link	Lack of specialised suppliers, especially small firms.	Emergence of specialised suppliers, especially small firms
1.c. Basic research - teaching link	Separation of basic research and teaching. Low R&D activities by universities.	Gradual merging of basic research and teaching. Relative increase of R&D by universities.
2. Priorities in technological activities		
2.a. Weapons R&D	Dominantly military oriented R&D	Strong absolute decrease in military R&D
2.b. Development/testing vs. research	Dominantly intermediate (research) outputs	Polarization of R&D spectrum. Relative decline of applied R&D.
2.c. Process vs. product innovation	Dominantly product development	Process development and process efficiency grow in importance
3. Incentives for innovation and diffusion		
3.a. Non-market vs. market incentives	Dominantly political incentives	Increasing complexity of innovation incentives
3.b. Threats to laggards	No exit and no threats to laggards	Exit becomes possible. Weak competition policy
4. Decentralization, diversity and pluralism		
4.a. Decentralization	Business decisions diffused across hierarchy	Business decisions distributed between managers and outside owners
4.b. Diversity among sectors in the nature of innovation	No differences in sectoral innovation pattern	Emerging sectoral diversities in innovation patterns.
4.c. Pluralism in technological activities	Limited pluralism among branches	Pluralism of technological activities. Variety of search efforts.
5. Linkages in the international economy		
5.a. Economic incentives from world markets	Closed system and innovation autarchy	Liberal foreign trade systems
5.b. Public funded R&D cooperation	Very restricted R&D cooperation	Foreign funded research and science cooperation
5.c. Technology transfer	Dominantly import of equipment and licences	Diversified technology transfer channels
6. The role of the state		

6.b. Cash - flow control	Total control of cash-flows	State funding still dominant
6.a. Ownership role	Total control of innovation process	State control mixed with private control. State decides type and pace of privatization in R&D

2.1. The location and funding of R&D

2.1.a. Financing and location of R&D

RDI activities in the socialist systems had two important features that made them distinctively different from RDI in market economies.

First, due to their closed character and weak incentives the share of gross expenditures for R&D in gross domestic product (GERD/GDP) in socialist economies were far above the relative levels of comparable medium-income economies (Radosevic, 1994a), (Auriol and Radosevic, 1996). The closed economy led to R&D whose sectoral and quality structure was removed from the world economy. The R&D system was controlled by agents whose interests were in forced expansion, which led to over-expanded R&D, not expansion by enterprises and consumers. R&D funding predominantly came from the State budget. Even when contracts were made between enterprises and R&D institutes funding was still provided through State channels (Cocks, 1980).

Second, in socialist economies RDI were dominantly oriented towards industry, but was separated from enterprises, and was located in industrial R&D institutes. Elsewhere we described such situation as R&D *for* industry but not *in* industry (Radosevic, 1994b). As a consequence, when compared to the market-economy, socialist economies had higher shares of extra-mural R&D. For example, Meske (1994) shows that the share of non-university R&D in total R&D in DDR was two times higher than in FRG. In the market economy RDI is performed mainly by industrial enterprises while under socialism it was mainly in extra-mural R&D organizations. This led both to numerous weaknesses in links between R&D and industry and to R&D which was not always relevant to industry.

With the break up of the socialist system we would expect RDI in post-socialism to be transformed into intra-mural R&D. However, this transformation turns out to be more complex than originally envisaged for two reasons.

First, with post-socialism came a sharp decrease in R&D funding (see EU, 1994; OECD, 1996). This was not only the result of deteriorating budgetary conditions but also of natural shrinkage of previously over-expanded and non-competitive R&D systems where much so-called R&D was the 'reinventing the wheel' type. Elsewhere we have tried to estimate whether this fall to 'natural' levels of GERD/GDP in PSE will lead to the loss of their distinctive advantage (see Radosevic, 1995).

Second, it was expected that marketization would lead to the integration of R&D into industrial enterprises. However, this does not appear to have happened, or at least not on any significant scale but we still do not have systematic inter-country evidence on this point. Nevertheless, case studies on industrial institutes in Hungary (Mosoni-Fried, 1995), Russia (Lauer-Couderc, 1995), and on eastern Germany (Schneider, 1995) confirm this. Explanations for such a trend come from both the demand as well as on supply side. Inadequate structure of extra-mural R&D under new market conditions in addition to the inability of industrial enterprises to embody technological innovation, led to a situation where

R&D continues to be extra-mural. For example, in Russia for the period 1991-1994 only about one-fifth of industrial enterprise innovation was provided with its own R&D (Glaziev *et al.*., 1996, p.17). In most cases the only option for R&D institutes is 'self-enterprization' or transformation of R&D institutes into industrial or service companies.

2.1.b. Large scale users - specialised suppliers interaction

In the 'West' applied R&D is organizationally integrated with production, whilst a significant proportion of production technology comes from small specialised firms supplying capital goods (Hanson and Pavitt, 1987). In socialist economies applied R&D was organizationally separated from production, with the development of process technologies and associated capital goods being concentrated almost exclusively in large organizations. Such a monostructure created huge inefficiencies and lacked technological dynamics.

The freedom to be able to set up new firms has led to the emergence of specialised suppliers and small enterprises (SMEs). As a result of still patchy growth in the region and relatively bigger gaps in services it is mainly SMEs in services which are booming. The export growth of specialised suppliers' sectors in Hungary and the Czech R. indicates the rise in SMEs specialised suppliers (Guerrieri, 1995; Butlor, 1995). In software, SMEs are taking over the functions of specialised suppliers which before were all performed by large electronics conglomerates (Katkalo, 1993). Nevertheless, the number of SMEs, especially in the manufacturing sector, is still significantly below the EU average (see EBRD, 1995, p.140) which means that this structural gap will continue for some time.

The innovation capability of SMEs in PSE still seems to be very low. As stated by Gokhberg and Kuznetsova (1996, p.15) in Russia 'three times less SMEs in comparison with big ones were engaged in R&D, four times less frequently they purchased results of R&D by contract and two times less frequently acquired know-how. According to the data for 1994, only 3 small enterprises managed to buy licences on use of inventions' (p.15). In the case of Poland innovativeness in SMEs is also lower but not to such an extent as in Russia. In Poland the most innovative are the large and medium-sized enterprises of which 80% introduced some kind of innovation to the market in 1992 while the corresponding share for SMEs was only 46% (Korona, 1994).

Under socialism, the dominant learning path was development from research to production and then to distribution and users. In post-socialism users are becoming an important source of learning, similar to market economies. This is confirmed by data from a Hungarian innovation survey where clients/customers and suppliers of materials, components and equipment stand as the most important source of information for innovation (see Inzelt, 1995).

2.1.c. Basic research - university teaching

Under the socialist system research was separated from teaching and universities were primarily teaching institutions.[1] The share of GERD performed by universities varied in the PSE from 1% in Czech Republic to 14% in Hungary, and especially in basic sciences

[1]This should be taken as a very rough description since in many cases Academy researchers were involved in teaching. In the case of the defence sector the involvement of military universities in research was much more significant.

Academies of Sciences (AoS) were performing the most research. This situation has downgraded research at universities and deprived teaching of close link with research.

In post-socialism universities in some CEECs have improved their relative share of R&D, sometimes even doubling it. In Hungary universities now perform 26.4% of GERD (1994), and in Poland 22.6% (1993) which is similar to shares in OECD countries. However, proportion is still marginal in Czech R (4.5%), Slovakia (4.9%) and Russia (5.9%) (1994) (OECD, 1996). In the long-term, universities are very likely to improve further their position in research. Their funding stability which comes from teaching, when coupled with the increasing opportunities to apply under equal terms for research funding, will enhance their R&D position.

The system of state planning of research has been abolished in all CEE countries which have all re-established freedom of research. Teachers have the right to choose their own research subject. The new system of research funding and management is one in which competitive grants are awarded to individual research projects on the basis of peer review. Although peer review constitutes a break with the centralised funding and management practices of the past it is not a system without problems especially when discrepancies between available funds and number of researchers are huge. (For an extensive discussion on this see Frankel and Cave, 1997).

2.2. Priorities in technological activities

2.2.a. Weapons R&D

The 'Cold War' pushed R&D systems in the 'East' strongly towards military activities. At the end of the 1980s defence R&D spending in the former Soviet Union amounted to some 20% of total defence budget which made some 70% of total expenditure in R&D (OECD, 1994, p.165)(Gokhberg, 1996). Although most of science-intensive civil products manufactured were produced at the defence enterprises there was no full-fledged adaptation of military technologies to civil purposes. In addition, as pointed out in OECD (1994) technology flow from military to civil industries was insufficient to create a normal civil technological base outside the military sector (p.167).

In the post-socialist period there is a absolute decrease of military R&D. Military R&D spending is levelling off to more normal levels reaching, in the case of Russia, around 10% of total military expenditures, similar to the US. However, quantitative similarities do not reveal the complexity of the situation. Conversion programmes are faced with significant problems among which the lack of civil demand for science-intensive production is the most serious. Despite the limited effects of conversion programs analysts are cautiously optimistic as the process of restructuring, downsizing of defence enterprises and formation of alliances to overcome marketing and finance barriers takes place (For a detailed analysis see Gonchar *et al.*, 1995; and Bzhilianskaja, 1996).

2.2.b. Development and testing activities vs. research:

An over-expanded R&D system and lack of innovation under socialism resulted in mainly 'intermediate' R&D products, like documentation and engineering designs. There were comparatively fewer 'downstream' technological activities like testing, tooling up and incremental process innovations. Most 'R&D results ready for implementation' were waiting

to be 'transferred' to production. With the changes in the supply and demand for technology brought by post-socialism this structure of the R&D and innovation spectrum has also changed. Technological activities are now skewed towards downstream non-R&D activities like testing and standards as these are now critical for exports. The R&D horizon of enterprises has shortened significantly while the demand for technology has shifted towards incremental process innovation, and immediate problem-solving activities. Enterprises have moved towards development activities and abandoned applied R&D.

For example, in the case of Russia, the share of development activities increased from 80.1% (1990) to 90.8% (1994) while the share of applied R&D and basic research activities of enterprises decreased from 18.4% and 1.5% to 9.1% and to 0.1% respectively (Glaziev *et al.*,, 1996, p.17). Although we do not have comparable data before 1989 and after 1989 it seems that the structure of innovation costs of enterprises is becoming in line with the market economy, at least in some countries. An experimental Hungarian innovation survey shows that R&D still comprises the biggest component of innovation cost (48.2%) while relative costs for patents and licences (23.7%), training, tooling and up and trial production (14.6%) and costs for market analysis (3.8%) are relatively high (Inzelt, 1995). The share of product design is relatively low (6.8%).

In parallel to shifts at firm level, the State reduced its funding on those RDI activities that can be justified by the market failure argument (*cf*. basic science). As a result the whole R&D community has shifted towards basic science since it is there that the State support is focused, while the demand for technology has moved towards non-R&D and downstream activities. This has weakened applied and strategic research leading to polarization of the R&D spectrum. By this we mean that relatively applied research is shrinking while basic research and the development/testing part of the R&D spectrum is being relatively reinforced (Radosevic, 1994b). For example, in the case of Russia, the share of applied R&D in the value of R&D institutions projects has been continuously falling from 32.7% (1989) to 22% (1995) (Gokhberg, 1996, table 13, p.43).

2.2.c. Process and product improvements

Under socialism the technological emphasis was much more on product development. This was consistent with a system that was 'forcing growth' and which neglected user needs and cost concerns.

This product innovation bias is changing in the post-socialism as user needs and cost considerations have become pivotal for market survival. Export requirements are increasing the emphasis on quality considerations (for example, ISO 9902 standards). Cost considerations play an even more important role as these economies are most often competing in low cost market segments.

Innovation surveys only partially confirm expected shift towards process innovations. Only the Hungarian innovation survey mentioned above shows that improvement in product quality stands as the most important objective of innovations introduced between 1990-1993 in 71% of the analysed sample of enterprises (Inzelt, 1995). A Russian innovation survey indicates that among innovative enterprises 63% have also introduced new or improved technological processes alongside 80.5% that introduced new or improved products (Gokhberg and Kuznetsova, 1996, table 2). A Polish innovation survey for 1992 indicates that the dominant type of innovation is product innovation whereby the share of significant and incremental product innovations in the total number of innovations introduced amounted

to 54.6% (Korona, 1994). However, the share of process innovations (18.5%), mechanization and automatization of the technological processes (12.3%) and organizational innovations related to technological innovation (14.2%), indicates also strong reorientation towards process innovations. In total, the number of innovations introduced in Poland in 1992 which resulted in energy and material savings, amounted to 20.3% indicating new sensitivity to environment and cost issues (*ibid*.).

In summary, enterprises in the post-socialist context are reorienting their innovation activities according to the changing business environment. They are focusing their innovative activities not only towards product innovations but also towards process innovations. In this respect we can talk about convergence in innovative efforts. However, a more detailed comparison between 'eastern' and 'western' innovation surveys would be needed in order to reach more firm conclusions regarding the direction of innovative efforts and their links with external factors.

2.3. Incentives for innovation and diffusion

2.3.a. Non-market incentives vs. the complexity of incentive structures

Innovation in market economies is stimulated through a large variety of mechanisms for appropriating the benefits of these investments. Patents, secrecy, lead times, learning curve advantages, etc. are all innovation incentive mechanisms derived from the basic tenets of the market economy (Dosi, 1988).

Under socialism incentives were for a long period entirely non-economic (plan or political mobilization). However, the history of personal economic incentives within a basically centrally planned system is long in socialism. Within the framework of the system of production -oriented planning, considerable use was made of personal incentives for both management and workers in order to encourage plan fulfilment (Dyker, 1985). At the shop floor level different systems of 'material incentives', or different bonuses, were introduced in order to enhance individual productivity. Parallel with this, reforms of the R&D system were directed towards replacing central planing with economic incentives which would guide R&D organizations to work autonomously towards the goal of S&T plans (Zaleski *et al.*, 1969, part V.G). Only latterly, especially in Hungary and Poland, were incentives introduced on an economy-wide basis by making enterprises economically independent, and more market based incentives were built-in through different forms of 'market socialism' (Kornai, 1992; Swaan and Lisowska, 1992). However, the mechanisms for appropriating innovation rents were non-existent as technology was considered to be a free good. Under the socialist system, innovation was essentially a non-competitive process, much more dependent on political will and individual decisions than on economic incentives.

Now, with post-socialism and the introduction of factor markets, the incentives and freedom to develop mechanisms for appropriating innovation benefits have been created. In sectors where patents are important the change took place before 1989 in some PSE (OECD, 1995). The protection systems in former socialist countries were based on Soviet type regulations, the so-called 'inventor's system' or 'author's certificates'.[2]

With their reform laws of 1969 and 1972 respectively, Hungary and Poland abolished the Soviet type protection regulation for inventions. Bulgaria, Romania and Czechoslovakia, however, retained the Soviet type system of IPR to the end of the socialist period. The quite obsolete patent systems of these countries with the Soviet system enabled them to modernise patent protection much quicker than has been the case in Hungary and Poland (OECD, 1995). Russia changed from author certificates to patents in 1991 (Gorodnikova, 1996).

In sectors where the nature of innovation protection and incentives is different, various forms of appropriating innovation rents are developing. Lead times, learning curve advantages, know-how, secrecy, etc. are diverse forms of appropriation of innovation rents that enterprises develop in order to build competitive advantages. Operation of these

[2]This system had little to do with the intellectual property in the market economy sense of the word, even if in some respects, for example, the 'technical' aspects of patent procedure or the rule on remuneration of employed inventors it was similar. An author certificate certifies recognition of an application as an invention, its priority and authorship, the exclusive rights of the state to use and take charge of the invention, as well as securing the rights and privileges of the author as specified by legislation. As distinct from the author certificate, a patent certifies the exclusive rights of the author (the patent owner) to the invention (OECD, 1995), Gorodnikova (1996).

incentive mechanisms is dependent on the degree of competition and the existence of temporary monopoly profits based on innovation rents.

Beside these 'normal' appropriation mechanisms the prosperity of enterprises in PSE depends equally on their ability to cope with the uncertain environment. The more uncertain the environment, the more it matters whether enterprises are part of a wider formal (domestic holding or foreign MNC) or informal network ('old boys network', inherited customer - supplier relationships, link with the government). The character of these networks determines the character of incentives - rent-seeking or productive incentives - to which an enterprise is exposed (For analysis along these lines see Kuznetsov, 1997, Grabher and Stark 1997).

2.3.b. The credibility of threats to laggards: competition policy

Innovation incentives are strongly influenced by and dependent on the prevailing incentives in product markets. Competition was completely absent throughout most of the socialist period. With post-socialism it is to be expected that the old monopolistic structures will be either undermined, or broken. This is the case in many countries although, new monopolies, many of which are connected with the presence of foreign investors, are emerging. These are present in sectors like cars or telecoms where governments trade market access for modernisation of sector (see EBRD, 1994).

In post-socialism, competition policy is important as PSE have inherited a very high degree of industrial concentration and vertical integration. This partly explains the problems over implementing anti-monopoly policies. For the time being the best form of competition policy in these countries seems to be foreign trade liberalization and in this respect they are well placed. Foreign trade and foreign exchange systems in 6 out of the 25 PSE, or in all central European economies, are as liberalised as in advanced industrial economies (see EBRD, 1995). Though the enforcement of bankruptcy procedures is weak there is a threat to laggards from foreign competition. This explains the increasing polarization in competitiveness among domestic enterprises which indirectly may foster innovation.

2. 4. Decentralization, diversity and pluralism

2.4.a. Decentralisation

Innovation and technology are essentially firm and network-specific phenomena. Decision making on these matters under socialism was removed from enterprise. Throughout the socialist period there were attempts to decentralise decision-making. In reforming socialist economies, like Hungary and Poland, this process forged ahead. In USSR in the late 1970s there was a certain trend towards decentralization of R&D management through the establishment of branch based funds for S&T development (Glaziev *et al.*., 1996, p.7). Only in 1987 in the USSR did the Law on State-Owned Enterprises give enterprises the freedom to operate on an independent basis but without the incentives and pressure on management to operate economically.

Through privatization enterprises in PSE are re-emerging as the main agents in innovation decisions. This is particularly true for new private firms while less so for privatised firms. The question to what extent privatised enterprises are really independent in this respect is not so simple. So far, privatization has not produced the type of governance structures that are similar to the model of market economy. A substantial proportion of firms still remain in state

hands or are controlled by insiders (see EBRD, 1995, chapter 8). Markets for corporate control do not yet exist even in cases where the outside control is significant, like in Czech Republic. Although privatised firms are interlinked through ownership into a complex web with other organizations (banks, investment privatization funds, other enterprises) they basically make decisions on products, processes, suppliers, customers and prices. None of the PSE has retained comprehensive price liberalization, though, problems of price liberalization are mainly confined to utilities.

2.4.b. Diversity among sectors in the nature of innovation

In the market economy one can find diversity among sectors in terms of sources of innovation, mechanisms of appropriation and types of innovating firms (Pavitt, 1984; Klevorick *et al.*, 1995; Breschi and Malerba, 1997), i.e.:

- *in sources* (R&D, product engineering; design; suppliers; customers)
- *in size and degree of diversification of typical innovating firms*
- *in the means of appropriation of innovation benefits* (Hanson and Pavitt, 1987)

The uniform organization of socialist RDI activities has suppressed natural differences among sectors in terms of innovation patterns. Socialism drastically reduced the organizational diversity of firms which in turn suppressed potential diversity of innovation patterns. A linear model of innovation process was assumed to be natural in all industrial sectors and the feedback coming from users was considered unimportant in all sectors. Whether it was clothing, coal or the electronics industry the organization model of RDI was fairly similar. Users were not a source of knowledge let alone innovation (Popper, 1989). As analysed in Zaleski *et al.*. (1969) there were variations between branches but the real difference was in the defence sector. Users in this sector were competent and powerful and shaped the innovation process.

With the coming of post-socialism the diversity of firm sizes as well as different organizational forms within the same sectors or strategic groups is becoming pronounced. This process is a basic precondition for different innovation patterns (Stark, 1996). Emergence of the diversity among sectors in the nature of innovation; in its sources; in the size and the degree of diversification of firms and in the means by which they appropriate innovation results opens possibilities for much more diversified innovation dynamic. There are four stylised processes of enterprise creation in post-socialism: new enterprise creation ('greenfield'), unbundling of former socialist industrial units; creation of new, durable inter-enterprise networks (eg. industrial-financial groups, post-socialist holding companies), and, transformation of socialist administrations into enterprises (Hirschhausen, 1996). Organizational diversity emerging in post-socialism will induce different innovation patterns. However, we still do not have a sufficiently clear picture of the innovative behaviour of different enterprise forms in CEE to generalise on the effects of this diversity on innovation behaviour.

2.4.c. Pluralism in technological activities

Decentralization brings diversity of innovative patterns across different sectors as well as diversity of technological activities across different enterprises in the same sectors. Wastefulness of diversity in the market economy is actually its main source of dynamic efficiency.

By definition, a central planning system should avoid 'wasteful duplication' (Hanson and Pavitt, 1987). This is one of its basic rationales which holds ground only if the economy is seen in static terms. If seen as an evolutionary and dynamic process with pervasive information uncertainties then duplication becomes justifiable (Grabher and Stark, 1997). In this respect post-socialism abounds by the numerous parallel search efforts which are essential for innovation. Freedom to experiment through different enterprise strategies, and freedom to experiment with new organizational forms will enable the emergence of new innovation trajectories (Nelson, 1995). Parallelism of technology activities is a necessary ingredient of economy's adaptive efficiency.

We should bear in mind that pluralism in technological activities in the market economy rests on numerous market interactions or linkages based on the competitive advantage of alternative suppliers, or on broader supply and demand considerations. In this respect pluralism of technology activities in post-socialism will not develop unless efficient competitive linkages, both between enterprises and the finance and infrastructural sectors, and between different enterprises are not developed or supported (see EBRD, 1996, chapter 7). Pluralism of technology activities in post-socialism will develop only if non-market elements, like institutional systems (legal and information infrastructure), improve.

The situation in this respect differs significantly between central European and ex-Soviet Union republics[3] as well as between central and eastern European economies. Therefore, it is impossible to generalise about the degree of institutional development towards a market economy let alone on its link to technology pluralism. What is obvious in practice is that there is enormous diversity of search efforts, especially through local entrepreneurship, but this does not necessarily produce diversity in terms of technologies (see Gabor, 1996., on this point in case of Hungary).

2.5. Linkages with the international economy (trade openness; technology transfer channels)

2.5.a. Economic incentives and signals coming from the world market

The closed character of socialist economies created RDI activities which were far removed in structure from the world economy. As pointed out earlier, trade and investment openness of the central European PSE stand quite well when compared with advanced market economies (EBRD, 1995; World Bank, 1996). The current trade and investment openness of PSE are exemplified in the radically changing competitiveness of R&D capabilities of specific sectors. The best example is the electronics sector that in its original form was wiped out in a matter of months. Dominantly imitative technology effort in the socialist period has revealed its poor competitiveness. As a result of enterprise closure the value of R&D also contracted but the human capital from this sector is now in excess supply. In countries where outflows of personnel from R&D could not be absorbed by the economy R&D operates as a sort of social safety net (Radosevic, 1994b). However, this is not the case in all sectors. For instance in sectors like electronics and software, where new demand is looming large in all PSEs, the sector is being rebuilt through SMEs or joint-ventures. The economic openness has pushed into motion selection mechanisms of 'creative destruction'. Instead of imitative R&D which

[3]For a discussion on the differences between central European and ex-Soviet Union republics with an emphasis on the Ukraine see Hirschhausen, 1996.

was developed on a large scale competitive R&D and technology may emerge in some areas (Dyker, 1996).

2.5.b. R&D cooperation

The openness of science systems is one of the key factors of innovation. In the last 10-15 years this has been further reinforced through increasing international (Luukonen *et al.*, 1992) and inter-institutional collaboration in science (Katz and Hicks, 1995).

In socialist times any science communication was very restricted. For example, only 15% of researchers in the Romanian Academy of Sciences have authored papers in international journals (Eisemon *et al.*, 1996). Closed science systems led to science output with very little knowledge about new research methods. In general, with the exception of fields like physics, chemistry and biomedicine the cognitive principles governing the work of researchers during socialist times differed from those of their foreign colleagues (see Kereva *et al.*, 1993).

With post-socialism trade openness and free communications have induced new forms of technology and R&D *co*operation. The Hungarian innovation survey shows that R&D *co*operation with foreign suppliers, clients and customers ranks among the highest as a source of innovation (Inzelt, 1995). From a system of very controlled and limited R&D *co*operation, which was re-inforced by CO-COM regulations, PSE are developing different forms of public R&D cooperation primarily driven through foreign funding (INTAS, Copernicus, Soros, etc.). One effect of this has been that the presence of researchers in foreign publications has increased significantly in the post-socialist period (see Haveman, 1996) indicating increasing openness of science systems and wider spread of international R&D networks in post-socialist countries.

2.5.c. Technology transfer mechanisms

As much as R&D systems of socialist economies were over-expanded and closed so were technology transfer mechanisms below the level of comparable economies. The dominant technology transfer mechanisms were import of equipment, licences and turnkey transfer (Hill *et al.*, 1993). Licences were usually not renewed, turnkey transfer was rare and only occurred in the case of large projects.

The opening of these economies led to diversification of technology transfer channels to foreign direct investments (FDI), cooperative agreements (strategic alliances) and subcontracting (Radosevic, 1997). In none of these mechanisms have PSE yet reached the levels of many comparable economies. Their trade, production and technology integration opportunities are far from being exploited.

The mere existence of these mechanisms does not imply that the PSE will become technologically integrated into the world economy (Radosevic, 1996b). However, the post-socialist situation creates opportunities for catching-up through FDI, subcontracting and other forms of integration at the level of production networks that some of these countries will exploit better than others.

2.6. The role of the state

In a market economy the state exercises its control on RDI through S&T policy which includes basic research and education, standards, regulations and support of technical change in specific sectors.

The role of the State in RDI under socialism was all encompassing. The State was not only involved in R&D activities but also in technology transfer from industrial institutes into enterprises. As enterprises were not business, but only production units, there was an extensive need for external mediation across different levels of socialist hierarchies.

To understand the role of the State in RDI in post-socialism it is important to distinguish between its role as the owner and as the cash flow controller in the R&D system.[4] Control rights are the rights to make decisions on how to use the assets. Cash flow rights are the rights to earn benefits and pay costs that result from a particular use of the assets. The ownership structure is inefficient when control rights are dissociated from cash flow rights. In market economy RDI the problem of dissociation of cash-flow from control rights does not exist as the institutional structure of the R&D makes these functions clear. Institutional sectors in market economy are: enterprise R&D, university R&D, government R&D and private non-profit research organizations. However, in post-socialism the distinction between these two categories becomes blurred as the State is unable to exercise its cash flow control function but has retained its ownership function (control rights). This has created several transitional phenomena in the R&D system, like hybridization of R&D institutes, 'quasi spin-offs' and spontaneous privatization, which are present in all PSE, and which dilute the effectiveness of R&D (see Radosevic, 1994b, and 1996).

2.6.a. Ownership role

PSE have followed different paths in their privatization of R&D institutes. The responses have ranged from very quick privatization of R&D institutes, which were treated as any other enterprise (*cf*. Czech R), to prolonged subsidy of R&D institutes and reluctance to enable their privatization (*cf*. Romania). In these latter cases, despite still formal control rights of the State, the real control is shared between the State and management through different forms of quasi-spin offs and spontaneous privatization (Radosevic, 1996). In many respects this is basically a continuation of the process that started with the introduction of cooperatives attached to R&D institutes, and which enabled workers to earn additional income through contract activities.[5] However, in post-socialism conflicts in control are often so big that survival strategies at the institute level are unrelated to the nominal status of the organization.

2.6.b. Cash flow control

Government R&D funding policies in the PSE range from sudden cuts in funding to gradual decreases. Funding criteria (project vs. institutional funding), evaluation procedures (peer review vs. negotiations) and budgetary conditions differ increasingly across different PSE (Frankel and Cave, 1997; Radosevic, 1996). In economies where public funding suffices more for subsistence than for normal R&D work, the cash flow control function is in the hands of management and employees. This situation has created a rich array of survival

[4]For this distinction in the case of Russian privatisation see Boycko *et al.* (1995).

[5]In Russia the number of R&D co-operatives has increased from 2100 in 1989 to 10400 in 1990 (Katkalo, 1993). In Hungary, also, different forms of intra-entrepreneurship were developed where such groups were basically subcontracting units of other organisations (see Balazs, 1995).

strategies at the institute level whose common effect is a further increase in the range of activities and types of clients (Laure-Couderc, 1995; Webster, 1996; Bernstein and Lehrer, 1995). In countries where the State has capability to implement evaluation and selection criteria for funding it has managed to retain the R&D management function.

3. ELEMENTS OF DIVERGENCE IN RDI AND INNOVATION IN POST-SOCIALISM

An overview of the specific features of RDI in socialism and post-socialism compared to the model of RDI in a market economy shows that there are strong processes of ***convergence*** of post-socialist RDI with the market economy RDI. Common elements and similarities lie in:

- rise of specialised suppliers;
- increasing links between basic research and education;
- 'normalization' of R&D priorities or decreasing bias towards military R&D;
- more balanced relationship between process and product innovation;
- an increasing variety of innovation and diffusion incentives characteristic for market economy;
- in increasing competition;
- increasing diversity of sectoral innovation patterns;
- pluralism of technology search efforts;
- integration of these countries with international R&D cooperation;
- diversification of technology transfer channels.

Not all these elements exist in post-socialism in their developed form. They should be seen as emerging elements of convergence of the post-socialist with the market-economy RDI model, which has developed to different degrees in different PSEs.

Our analysis shows that post-socialist RDI activities also have important elements of still persistent or temporary ***divergence***. These differences are in the following:

- ***enterprises have not yet become the main agents of innovation due to a multitude of factors among which corporate governance and demand constraints are the most prominent ones;***

- ***still externalised R&D or a situation where enterprises have not integrated previously externalised R&D capacities.***

- ***pervasive problems in R&D management due to the role of the state as owner who cannot simultaneously exercise the cash flow control function in R&D, especially in industrial institutes;***

- ***new gaps in RDI where applied and strategic R&D are absent from the spectrum of innovation activities.***

These elements of divergence are the result as well as the cause of the weak innovation capability of post-socialist enterprises. They are a combination of still present socialist features (externalised R&D and lack of enterprise R&D) and of post-socialist features (privatization and governance problems which deter enterprises from 'deeper restructuring',

including restructuring of industrial R&D institutes). The result is weak technological effort with new gaps in RDI.

3.1. Weak innovation capability and elements of divergence

An overview of research into enterprise behaviour in post-socialism indicates very little 'deep restructuring' that involves substantial new investments, including R&D (EBRD, 1995). Induced by hard budget constraints the dominant type is intra-firm restructuring with strong labour shedding and with the introduction of some new technology. These patterns are common across different types of ownership. Only privatization with dominant outside ownership, especially FDI, appears to generate deeper restructuring (*ibid*., chapter 8).

Innovation surveys of Russia, Poland and Hungary conform to this picture from the innovation perspective. The Polish innovation survey shows that about 61% of enterprises introduced some kind of innovation into the market in 1992 (Korona, 1994). In Russia the situation is significantly worse as there were only 22.4% of enterprises that introduced any kind of innovation.[6] Of the total number of enterprises only 18% introduced new or improved products and 14% introduced new technological processes (Gokhberg and Kuznetsova, 1996, p.9). This indicates very low technological innovation activities on average in Russian enterprises, an indication further supported by the fact that only 0.7% of Russian enterprises bought licences on the use of inventions (*ibid*., p.13).

When enterprises are so weak in innovation they continue to rely on externalised R&D perpetuating their dependence on external sources of technology and R&D. For example, since the beginning of transition in Russia only 5.4% of total enterprises, or 24.2% of those that introduced some innovation, have been performing in-house R&D (Gokhberg and Kuznetsova, 1996). Low or even decreasing demand for domestic technology when coupled with significant competitiveness problems of domestic R&D resulted in the only viable option for R&D institutes - to marketize themselves mainly by turning themselves into non-R&D organizations.

Instead of being an asset to transformation the over-expanded and externalised R&D became burden on public policy. Solutions by developing bridging functions through technology centres and parks, university - industry links, etc. have very limited effects and are basically reinforcing patterns of technology transfer for which there is not yet effective demand (see Webster, 1996). Instead of forcing stand alone bridging functions policies are neglecting significant scope for supporting intra-organizational restructuring and in-house bridging and technology transfer capabilities. This is further aggravated by ambiguity about the public/private nature of R&D which has produced ambiguity in terms of the privatization of R&D (see Radosevic, 1996).

In conclusion, the remaining elements of institutional divergence in RDI should be seen more as symptoms of transformation crisis and difficulties, than organizational characteristics which are conducive to technology development. At the core of these differences is the (in)ability of post-socialist enterprises to articulate demand for technology.[7]

---

[6]Gokhberg and Kuznetsova (1996) consider this as rather low when compared with the late 1980s when this indicator fluctuated within the range of 60-70% by enterprises of the ex-USSR (p. 5). However, realistic assessment should take into account the different nature of innovation before and after changes.

[7]If we take into account comparatively high development of human capital in CEECs then supply side constraints carry much less weight in explaining their weak innovation capability.

3.2. Demand and supply for technology in post-socialism: some explanations

The innovation survey for Poland indicates the lack of financial resources, very high bank interest rate and tremendous uncertainty of market opportunities as the most important obstacles to innovation activities (Korona, 1994). Also, from the Hungarian innovation survey 80 out of 110 responding firms consider the lack of financial sources as 'very significant' or 'crucial' factors hampering innovation (Inzelt, 1995). This explanation contradicts the EBRD (1995) conclusion that enterprises in PSE have accumulated significant financial assets, and hence the financial constraint explanation for low investment and weak innovation capability does not hold.[8]

An alternative explanation is that it is more the contraction of demand for investment goods that led to a decline in investment than the lack of finance (see EBRD, 1995). There have been significant sectoral and geographical shifts in patterns of demand in PSE towards services at the expense of industry. These are accompanied by shifts in relative prices towards services, raw materials and intermediate goods. Prices of finished goods, like textiles, and of machine-building and electrical/electronics have fallen far behind prices of energy and intermediate goods (see EBRD, 1995, table 4.3.).

The demand explanation also has support from the Russian innovation survey data. The number of innovative enterprises seems to be significantly higher in sectors that enjoy increases in relative prices. These are raw materials and intermediate goods sectors (oil extracting and refining, gas extracting; non-ferrous metallurgy; chemicals). In these sectors the share of innovative enterprises (42-49%) is more than double the national average (22.45%).[9] It seems that in these sectors demand has been translated to a certain extent into a demand for technology. These sectors are also those with the highest share of enterprises that introduced new or improved technological processes (72-78%) as well as those where there is the highest share of enterprises with in-house R&D, about twice the national average of innovation enterprises (Gokhberg and Kuznetsova, 1996, table 2).

Explanations for weak innovation capability in post-socialism that take into account demand on product markets, deserve merit. However, robust explanations should take into account the differences between demand and supply for technology and for products which are not identical. Demand and supply for technology are derived from demand and supply for products and their coupling goes through enterprise, and not through market as is the case with products (see Tunzelmann, 1995, for basic approach along these lines). In this case the explanation for the weak innovation capability of post-socialist enterprises lies in the complexity of, not only market shifts, but also of enterprise organization, which includes governance and control issues.

On the demand side, reduction in the size of enterprises, and how demand for products gets translated within enterprises into demand for technology, play a part in the explanation of weak innovation capability. Whether demand from product markets may be translated into demand for technology depends on whether demand for technology can be articulated. Strategic uncertainties and coordination failures in post-socialism are pervasive. In Russia, from 3803 enterprises that made innovations between 1992-94 59.3% anticipate further innovations in 1995-97. However, from 13,176 enterprises that did not make any innovation

[8]One explanation for this contradiction may lie in the differences between aggregate finance figures and the enterprise structure of financial assets.

[9]The only sector that has a higher share of innovative enterprises and which is a non-intermediate goods sector is medical equipment and pharmaceuticals (47.9%). (Gokhberg and Kuznetsova, 1996, p. 6).

only 7.1% expect to be able to introduce innovation, while most (58.6%) found it difficult to respond on this (Gokhberg and Kuznetsova, 1996, p.8). This shows that strategic uncertainties in the environment are a big obstacle to innovation, which requires stable macroeconomic and institutional context. The differences in the macroeconomic and legal context do play an important role in this respect. While in Russia only innovative enterprises are optimistic about the prospects for further innovations, in Poland about 38% of firms who had introduced no innovation in 1992 declared their willingness to do so in the next 2 years (Korona, 1994).

On the supply side, factors of exogenous supply (focusing devices; induced innovation; S&T breakthroughs) and endogenous supply for technology (technology accumulation) should be taken into account.[10] Changes in factor prices and the increasing cost sensitivity of enterprises have induced enterprises to direct their technology efforts towards issues of energy and material savings, quality, etc. The transformation of supply side factors onto product markets does not result automatically into changes on technology supply within enterprises. As shown by Swaan (1995), using the example of Poland and Hungary, old routines at enterprise level are not responding to changes in incentives due to factors like: regulatory uncertainty; tacit knowledge and learning by example; cognitive structures, hierarchical organization and trust and internal enterprise organization.

In conclusion, explanations for the weak innovation capability of post-socialist enterprises and the persistence of differences in RDI activities cannot be reduced to factors (*cf.* finance) and product (*cf.* demand) markets. They should be looked for in how changes on these markets are transformed into demand and supply for technology. Firms are the only organizations that transform technology into products (Tunzelmann, 1995). Factors of their innovative capability should be looked for, also, in industrial organization and institutional features of PSE. Elements of convergence indicate that in PSE innovation activities have acquired the general features of innovation in market economies as specified by Hanson and Pavitt (1987). The remaining elements of divergence show that this process is not fully finished and they partly explain the low innovation capability of post-socialist enterprises.

4. 'RECOMBINANT PROPERTY' CAPITALISM AND INNOVATION

In section 2 we argued that factors of the weak innovation capability of post-socialist enterprises are closely related to the remaining elements of institutional divergence in post-socialist RDI. How long these elements of divergence will remain 'temporary' depends on the way in which some of the supply and the demand factors for technology, mentioned in the section 2, will be transformed.

If the economics of technical change is any guide, we can expect that in the medium-term enterprises take on the role of the main innovation agents. Technology is a firm-specific and externalised R&D cannot be substitute for in-house R&D (Mowery, 1983). Equally, in a post-socialist economy, the State no longer has the resources to be a central player, imposing specific technology development directions, but can only be either a bad or good facilitator and coordinator of the self-regulation of the innovation process. If the market economy model of RDI is taken as a reference point than the RDI of PSE will settle within the broad features of the market economy, as specified by Hanson and Pavitt (1987). However, this alone will

[10]For this distinction see Tunzelmann (1995).

not ensure technological 'catching-up'. Institutional convergence in RDI does not by itself produce technological modernization.

The institutional convergence in RDI does not tell us much about innovation prospects in eastern European capitalism(s). Once RDI settle within the general features of the market economy, as specified by Hanson and Pavitt (1987), the most interesting question becomes what are its innovation properties. The Hanson and Pavitt (1987) framework does not provide an answer since their objective was not to analyse innovation properties of different market systems, but to compare non-market and market systems in RDI. In order to illuminate this problem two scenarios can be imagined.

The first one of full convergence with the market economy model, while the second tries to take into account evolutionary, especially path dependent, features of post-socialist transformation.

A full convergence scenario assumes institutional transformation towards capitalism based on the clear distinction between the State and the business sphere, and on the important role of the capital market, especially the stock exchange. Tight budget constraints create strong incentives for institutional transformation. However, the scale and pace of privatization are such that only the stock exchange could ensure the necessary mobility of capital. Liberalization of capital flows, cemented further by international cooperative agreements (OECD, EU, GATT), and the role of national states as guardians of market order, ensure permanent pressure on capital mobility. In RDI this leads to the reduction of externalised R&D through strong public budget constraints. The state acts only as an indirect regulator of innovative activities. Tight and developed capital markets have resolved the governance conundrum and enterprises have become the main agents of the innovation process.

In this scenario we simply imposed convergence by assuming that RDI in PSE will eventually reach features of the 'designated future' or 'hypothesised end-state' (Stark, 1996, p.994).[11]

An alternative scenario assumes that the economic process is evolutionary, historically rooted and that the end states are formed through path dependent processes. One of these processes involves shifts in organizational and ownership boundaries of enterprises. On the basis of mass privatization and different forms of inter-enterprise control the current state is the one in which public - private boundaries are fuzzy and where a network of enterprises, rather than individual enterprises, seem to be units for understanding enterprise restructuring. So far, this essential feature of eastern European capitalism(s) is best analysed in the case of Hungary where it is called by Stark (1996) the 'recombinant property' model, meaning that the dominant form is neither private ownership with clearly defined property rights, nor the old form of state ownership, but mixed forms of state/private and inter-enterprise ownership. In its general theoretical form which is relevant to eastern Europe as well as to China it is developed in excellent manner in Peng and Heath (1996).

The mutual state/private and inter-organizational (banks/enterprises/investment funds) ownership is characteristic of other post-socialist countries, too. While in Hungary banks and funds are absent as private owners in the Czech R voucher privatization created ownership structure where investment privatization funds (IPFs) hold 50.7% of nominal stock and they in turn are indirectly owned by major banks.(EBRD, 1995). Russia has so far been dominated by domestic 'insiders' who own 46% of shares (Boycko *et al.*, 1995). However, there are signs that insiders' shares, especially dispersed shares of workers, are being increasingly

[11]Such reasoning is behind much of thinking of EBRD 'Transition reports'.

taken over by outsiders and especially investment funds which are owned indirectly by banks (Bim, 1996). Such ownership patterns are conducive to the rise of financial-industrial groups (FIGs)

FIGs are emerging through their privileged access to different exclusive rights, access to property finance and to state enterprise products (Freinkman, 1995, p.540). They usually comprise banks, trading companies, insurance companies and the voucher investment funds. Indirect ownership of industrial enterprises by banks through voucher investment funds enables FIGs to begin active enterprise restructuring on the basis of mainly internal savings and domestic capital. There are also indications of increasing inter-enterprise managerial coalitions which have started to mutually penetrate the stock of technologically related companies (Bim, 1996, p.33). This may create an ownership structure similar to that of Hungary. Lithuanian mass privatization has also created large scale groupings of companies described as post-socialist holdings (see Hirschhausen, 1995).

So far, Poland is, an important exception to this pattern (except in the case of new private conglomerates) as employee buy-outs through liquidation have been the dominant path of its transformation. However, the Polish programme of mass privatization implemented through 15 National Investment Funds is likely to create mutual ownership structures similar to these in other countries.

The point is that the post-socialist transformation has created groupings of firms, banks and investment funds into conglomerate types of institutions like post-socialist holdings, financial-industrial groups or new private conglomerates.[12] We consider this to be an important feature of eastern European capitalism(s) that will strongly influence its dynamic efficiency and innovation properties?[13] How will the semi-autonomous status of individual enterprises, whereby shares of one enterprise are typically held by another enterprise, be reflected in specific innovation patterns? Could these groupings impede 'creative destruction' and function only as risk-spreading devices or could they be promoters of technological change? If 'policies and practices aimed at restructuring in such context should target not the isolated firm but *networks* of firms ' (Stark, 1996, p.1009) then how are industrial R&D institutes treated in this process? How are technology functions (industrial engineering; quality management; design; incremental innovation) being redistributed within holdings? These are issues which have not yet been researched and about which we can only attempt to generate hypotheses.

Post-socialist holdings may mobilise larger resources and create 'patient money' for long-term technological development. They may be seen as a response to pervasive market

[12] These organisational forms are not unique only to the emerging eastern European capitalism but also apply to Japan (*kereitsu*) and some late industrialising countries, like Korea (*chaebols*) and Latin America (*groupos economicos*). It is important to bear in mind that the underlying factors of their creation are not only transition specific (*cf.* privatisation) but also developmental. Amsden and Hikino (1995) claim that conglomerates are inherent feature of most latecomer industrialisers as they compensate for the lack of organisational capabilities in technology development. In this respect, these patterns in CEE should not be considered as anomalous but as natural. Probably, technological factors are not the only explanatory factors. Financial and political factors also play an important role.

[13] Here we abstract from a possibility that there may be a few types of eastern European capitalism with different innovation properties. Trade evidence shows already polarisation between countries like Hungary and the Czech Republic and Bulgaria and Romania (see Landesmann, 1996). While the first group has trade patterns which are not typical of developing countries, with a high share of engineering and a rising share of R&D and specialised supplier goods, the latter have trade exports dominated by labour intensive goods.

failures, primarily in the financial system as the supply of finance and restructuring agents cannot be provided through outside finance or from the market. Indeed, the limited role of outside investors is a pervasive feature of all PSE and, as pointed out in EBRD (1995), 'it will take a long time before the financial sector shows the strength (typical for advanced industrial economies) necessary to generate and allocate savings effectively' (p.99). This is especially relevant to the capital goods sector which is important for R&D and technology capabilities. In the context of poor financial markets industrial-financial groupings may compensate for these dizadvantages of institutional environment.

By nature, conglomerates are risk-spreading and may actually improve risk-taking. However, they can also impede creative destruction and inhibit the development of new design capabilities. They may turn into rent seekers and inhibit innovation in related parts of the economy.

The concentration of finance within specific business groups may constrain allocative efficiency of investments by limiting investment to those industrial groups that have both sufficient gross savings and profitable investment opportunities. This may undermine investment and innovation opportunities for stand-alone enterprises which do not possess internal savings and which cannot rely on outside finance.

5. CONCLUSION

On the basis of Hanson and Pavitt's (1987) characterization of the basic features of research, development and innovation (RDI) in socialist and market economies we analysed how much post-socialist economies (PSE) have assimilated in RDI the general features of market economy. Post-socialist RDI activities are in many of their elements converging towards a RDI of market economy. However, they still possess some socialist features (externalised R&D) as well as some peculiarly post-socialist features (ownership) which maintain their difference from the market economy model of RDI. The remaining elements of divergence are that: enterprises have not yet become the main agents of innovation; R&D is still externalised, with significant problems in its management arising from the State as owner being unable simultaneously to exercise a cash flow control function in R&D, and new gaps have emerged in RDI where applied and strategic R&D are absent from the spectrum of innovation activities. These differences are symptoms as well as factors of weak innovation capabilities of the post-socialist enterprises.

The remaining elements of institutional divergence in RDI should be seen more as symptoms of transformation crisis and difficulties than organizational characteristics which are conducive to technology development. At the core of these differences is the (in)ability of post-socialist enterprises to articulate demand for technology. Whether these features are temporary remains an open question. Our conclusion is that RDI in PSE will eventually achieve the features of 'designated future' or 'hypothesised end-state' as specified by Hanson and Pavitt (1987). However, once RDI settle within the *general* features of the market economy model the most interesting question becomes what are the *specific* innovation properties of the emerging eastern European capitalism(s)? Many of the specific innovation features of CEE capitalism originate from the specific ownership and control patterns which resemble certain features of conglomerates in latecomer economies.

In our analysis we abstracted from significant national differences. However, one of our conclusions is that it is the *specific* innovation properties of the emerging eastern European

capitalism(s) that increasingly matter. This highlights the importance of national differences in the process of post-socialist transformation. In RDI, national differences among PSEs are significant in terms of the degree to which R&D was extra-mural or intra-mural; in terms of the previous openness of the economy and the degree to which R&D systems were Soviet-like, in terms of importance of R&D in higher education and the role of Academies of Sciences. Differences between specific industrial sectors were equally widespread and are now further reinforced through differences in the post-socialist period. Elsewhere we analysed these inter-country differences through R&D (Auriol and Radosevic, 1996) and US patent data (Radosevic and Kutlaca, 1997).

The evolutionary nature of this process, in which, as argued by Grabher and Stark (1997), legacies, linkages and localities are producing a diversity of organizational forms, indicates that different innovative properties of specific PSE capitalism's should be already in operation. Unfortunately, our understanding of national differences in terms of technology and innovation is still rudimentary. It is relatively better in terms of restructuring processes in institutional part of R&D but we are still a long way from understanding how different industrial sectors and their innovative behaviour are linked to post-socialist institutional transformation. Individual studies on industrial innovation on specific CEE countries have not yet been systematically overviewed and analysed. One of reasons for this is that conceptual and methodological problems in analysing innovation differences between countries and sectors are much more significant than when analysing the emergence of diverse organizational forms. Capabilities are linked with organizational forms but this link is not straightforward and their investigation requires detailed case studies based on very specific sectoral expertise. An understanding of the organizational forms of different emerging eastern European variants of recombinant capitalism is not sufficient for an understanding their dynamic or innovation features.

6. REFERENCES:

Amsden, A.H. and Hikino, T. (1994), 'Project Execution Capability, Organisational Know - How and Conglomerate Corporate Growth in Late Industrialisation', *Industrial and Corporate Change*, Vol.3, No.1, pp.149–72.

Auriol, L. and Radosevic, S. (1996), *R&D and Innovation Activities in CEE Countries: Analysis Based on S&T Indicators*, Paper presented at the Conference on the Implementation of OECD Methodologies for R&D/S&T Statistics in CEE Countries, Room document No.13, Budapest, 6-8 November, OECD, Paris.

Balazs, K. (1996), 'Academic Entrepreneurship and their Role in "Knowledge" Transfer', STEEP Discussion Paper, No.37, SPRU

Bernstein, D. and Lehrer, J. (1995), 'Restructuring of Research Institutes in Russia: The Case of the Central Aero-hydrodynamic Research Institute', in (BCC) Bonn International Centre for Conversion, *Conversion of the Defence Industry in Russia and Eastern Europe, Report 3*, April, p.4451.

Bim, A. (1996), *Ownership, Control Over the Enterprises and Strategies of Stockholders*, IIASA Working Paper - 96 - 050, May, Laxenburg.

Boycko, M., Schleifer, A. and Vishny, R. (1995), *Privatising Russia*, Cambridge MA: MIT Press.

Breschi, S. and Malerba, F. (1997), 'Sectoral Innovation Systems: Technological Regimes, Schumpeterian Dynamics, and Spatial Boundaries', in Edquist, C. (ed.), *Systems of Innovation: Technologies, Institutions and Organisations*, Pinter/Cassel, London and Washington.

Butlor, M. (1995), *EU Trade with Eastern Europe - Applying Pavitt's taxonomy: Statistical Background*, SPRU Masters Programme, January, mimeo.

Bzhilianskaja, L. (1996), 'The Transformation of Technological Capabilities in Russian Defence Enterprises', with special reference to dual-use technologies, STEEP Discussion Paper No.31, SPRU.

Cocks, P. (1980), *R&D Planning and Management in the Soviet Union*, Stanford University.

Dosi, G. (1988), 'Sources, procedures and microeconomic effects of innovation', *Journal of Economic Literature*, 26 (3), pp.1120–71.

Dyker, D.A. (1985), *The Future of the Soviet Economic Planning System*, Croom Helm, London.

Dyker, D.A. (1996), 'The Computer and Software Industries in the Eastern European Economies - A Bridgehead to the Global Economy', *Europe-Asia Studies*, Vol.48, No.6, pp.915–30.

EBRD (1994), *Transition Report 1994*, European Bank for Reconstruction and Development, London.

EBRD (1995). *Transition Report 1995: Investment and enterprise development*, European Bank for Reconstruction and Development, London.

Eisemon, T.O., Davis, C.H., Siseti, I.I. and Gaillard, J. (1996), 'Reforming Romania's national research system', *Research Policy*, Vol.25, No.1, January, pp.107–31.

EU (1994), *The European Report on S&T Indicators 1994*, EC, Report EUR 15897 EN, Luxembourg

Frankel, S.M. and Cave, J. (1997), *Evaluating Science and Scientists: An East - West Dialogue on Research Evaluation in Post-Communist Europe*, Central European University Press, Budapest.

Freinkman, L. (1995), 'Financial-industrial Groups in Russia: Emergence of Large Diversified Private Companies', *Communist Economies & Economic Transformation*, Vol.7, No.1, pp.51–66.

Gabor, R.I. (1996), 'Too Many, too Small: Small Entrepreneurship in Hungary - Ailing or Prospering?', in Grabher, G. and Stark, D. (eds.), *Restructuring Networks in Post-Socialism: Legacies, Linkages, and Localities*, New York, Oxford University Press.

Glaziev, S., Karimov, I. and Kuznetsova, I. (1996), 'Innovation Activity of Russian Industrial Enterprises', in *Russian Applied R&D: Its Problems and Promise*, IIASA, Economic Transition and Integration Project, Laxenbourg (forthcoming).

Gokhberg, L. (1996), 'Transformation of the Soviet R&D System', in *Russian Applied R&D: Its Problems*, IIASA, Economic Transition and Integration Project, Laxenbourg.

Gokhberg, L. and Kuznetsova, I. (1996), *The First Results of Innovation Activity Survey of Industrial Enterprises in Russia*, CSRS, Moscow, mimeo

Gonchar, K., Kuznetsov, Y, and Ozhegov, A. (1995), *Conversion of the Post-Soviet Defence Industry: Implications for Russian Economic Development*, Bonn International Center for Conversion.

Gorodnikova, N. (1996), 'Methodological Notes and Statistical Tables', in Gacs, J., Peck, M. and Gokhberg, L. (eds.), *Russian Applied Research and Development: Its Problems and Promise*, IIASA Research Report, Laxenburg (forthcoming)

Grabher, G. and Stark, D. (eds.) (1997), *Restructuring Networks in Post-Socialism: Legacies, Linkages, and Localities*, Oxford University Press, Oxford.

Guerrieri, P. (1994), *Technology, Structural Change and Trade Patterns of Eastern Europe*, Paper presented at Workshop 'Research Cooperation with Countries in Transition', Six Countries Programme Conference, Vienna, 2 December.

Hanson, P. and Pavitt, K. (1987), *The Comparative Economics of Research, Development and Innovation in East and West: a Survey*, Chur, Harwood Academic Publishers.

Haveman, F. (1996), *Changing publication behaviour of East European scientists and the impact of their papers*, Humboldt University, Berlin, mimeo

Hill, M.R. and Hay, C.M. (1993), *Trade, Industrial Co-operation and Technology Transfer: Continuity and Change in a New Era of East-West Relations*, Avebury Ashgate Publishing, Aldershot.

Inzelt, A. (1995), 'For better understanding of the innovation process in Hungary', STEEP Discussion Paper, No.22, SPRU

Katkalo, V. (1993), *Institutional Structure and Innovation in Emerging Russian Software Industry*, School of Management, St. Petersburg University, May, mimeo.

Katz, S. and Hicks, D. (1996), 'Science Policy for a highly collaborative science system', *Science and Public Policy*, Vol.23, No.1, February, pp.39–44.

Kereeva, D.N., Rozhkov, S.A. and Shaposnik, S.B. (1993), 'The impact of Soviet Publications on the Development of World Science: Analysis of Bibliometric Indicators', *Studies on Russian Economic Development*, Vol.4, No.1, February, pp.32–8.

Klevorick, A.K., Levin R.C., Nelson, R.R. and Winter, S.G. (1995), 'On the sources and significance of interindustry differences in technological opportunities', *Research Policy*, Vol.24, No.2, March, pp.185–206.

Kornai, J. (1992), *The Socialist System: The Political Economy of Communism*, Clarendon P, Oxford.

Korona, G. (1994), *Innowacje techniczne w przemysle w `1992 r.*, Glowny Urzad Statystyczny, Warsaw.

Kuznetsov, Y. (1997), *Learning in networks: enterprise behaviour in the former USSR and contemporary Russia*, World Bank, mimeo

Landesmann, M. (1996), *The Pattern of East-West European Integration: Catching Up or Falling Behind?*, WIIW, Vienna, mimeo.

Laure-Couderc, M. (1995), *The situation of the Former Research Units in Russia*, CERNA, Ecoles des Mines, Paris, mimeo.

Luukonen, T., Persson, O. Silverston, G. (1992), 'Understanding Patterns of International Scientific Collaboration', *Science, Technology, & Human Values*, Vol.17, No.1, Winter, pp.101–26.

Meske, W. (1994), 'The Restructuring of the East German research system - a provisional appraisal', *Science and Public Policy*, Vol.20, No.5, October.

Mosoni-Fried, J. (1995), 'Industrial Research in Hungary: A Victim of Structural Change', *Social Studies of Science*, Vol.25, EASST Special Issue.

Mowery, D. (1983), 'The relationship between intrafirm and contractual forms of industrial research in American manufacturing, 1900–1940', *Explorations in Economic History*, Vol.20, pp.351–74.

Nelson, R.R. (1995), 'Recent Evolutionary Theorising About Economic Change', *Journal of Economic Literature*, Vol.33, March, pp.48–90.

OECD (1994), *Science, Technology and Innovation Policies: Federation of Russia*, Vol.II, Background Report, Paris.

OECD (1995), *Protection of Intellectual Property rights in Central and Eastern European Countries: The Legal Situation in Bulgaria, CSFR, Hungary, Poland and Romania*, Paris

OECD (1996), *S&T statistics in the partners in transition countries and the Russian Federation*, OECD/GD(96)56, Paris

Pavitt, K. (1984), 'Sectoral patterns of technological change: towards a taxonomy and a theory', *Research Policy*, Vol.13, pp.343–73.

Pavitt, K. (1991), *East-West Differences in National Systems of Innovation: Some Implications for Reform*, Paper prepared for the Workshop II at the Conference 'Economies in Transition: Science, Technology and Innovation Policies', Vienna - Bratislava, OECD, 4–6 March.

Peng, M.W. and Heath, P.S. (1996), 'The growth of the firm in planned economies in transition: institutions, organisations, and strategic choice', *Academy of Management Review*, Vol.21, No.2, pp.492–528.

Popper, W.S. (1989), *Modernising the Soviet Textile Industry: Implications for Perestroika*, The RAND Corporation, R-3779, Santa Monica.

Radosevic, S. (1994a), *Eastern European S&T Capabilities in Transition: A Preliminary Assessment of Effects and Prospects*, STEEP Discussion Paper, No.14, SPRU

Radosevic, S. (1994b), *Restructuring of national systems of innovation in eastern Europe: between restructuring and erosion*, Paper presented at Six Country conference, Vienna, December.

Radosevic, S. (1995), 'Eastern European Science and Technology Capabilities in Transition: A Provisional Assessment of Effects and Prospects', *The Economics of Transition*, Vol.3(4), pp.459–78.

Radosevic, S. (1996a), 'Restructuring of R&D Institutes in Post-Socialist Economies: Emerging Patterns and Issues', In Webster, A. (ed.), *Building New Bases for Innovation: The Transformation of the R&D System in Post-Socialist States*, Anglia Polytechnic University, Cambridge.

Radosevic, S. (1996b), *Alliances in the dynamics of 'deep integration' of Central and Eastern Europe into a global economy: research issues*, Paper presented at the MERIT workshop on cooperative agreements in CEE, 17. June 1996

Radosevic, S. (1997), 'Technology transfer in global competition: the case of economies in transition', in Dyker, D.A. (ed.), *The Technology of Transition: Science and Technology Policies for Transition Countries*, Central European University Press, Budapest.

Radosevic, S. and Kutlaca, D. (1997), *Assessing the Basis for 'Catching-Up' of Eastern Europe: An Analysis Based on US Foreign Patenting Data*, Background paper for the TSER DIW Berlin Workshop, 23–24 January 1997, SPRU, Brighton.

Schneider, C. (1996), *Post-Socialism and impact of the economic reforms on industrial research: A Study of Czech and Slovak research institutes in the electro-technical sectors*, ROSES-Paris, mimeo.

Stark, D. (1996), 'Recombinant Property in East European Capitalism', *American Journal of Sociology* **101**(4): pp.993–1027.

Swaan, W. (1995), *Capabilities and Competitiveness of the Hungarian Economy*, Paper presented for the conference 'Hungary: Towards a Market Economy', Budapest, Hungarian Academy of Sciences, 20-21 October.

Swaan, W. and Lissowska, M. (1992), 'Economic Reforms and the Evolution of Enterprise Behaviour in Hungary and Poland during the 1980s', Leuven: Leuven Institute for Central and East European Studies, Working Paper No.4.

von Hirschhausen, C. (1996), 'Industrial Restructuring in Ukraine: from socialism to a planned economy', DIW Discussion Paper No.144, DIW, Berlin.

von Hirschhausen, C. (1996), *Modes of growth of post-socialist enterprises - A theoretical framework and application to five industrial branches*, in TSER Project 'Restructuring and Reintegration of S&T Systems in Economies in Transition', Work Package A: Literature, Statistics and Sources Review, SPRU/DIW/WZB and ROSES

von Tunzelmann, G.N, (1995), *Technology and Industrial Progress: the foundations of economic growth*, Edward Elgar, Basingstoke

Webster, A. (ed.) (1996), *Building New Bases for Innovation: The Transformation of the R&D System in Post-Socialist States*, Anglia Polytechnic University, Cambridge.

World Bank (1996), *World Development Report 1995: From Plan to Market*, Washington DC.

Zaleski, M.E. *et al.* (1969), *Science Policy in the USSR*, OECD, Paris.