Can East European Countries Innovate?

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by

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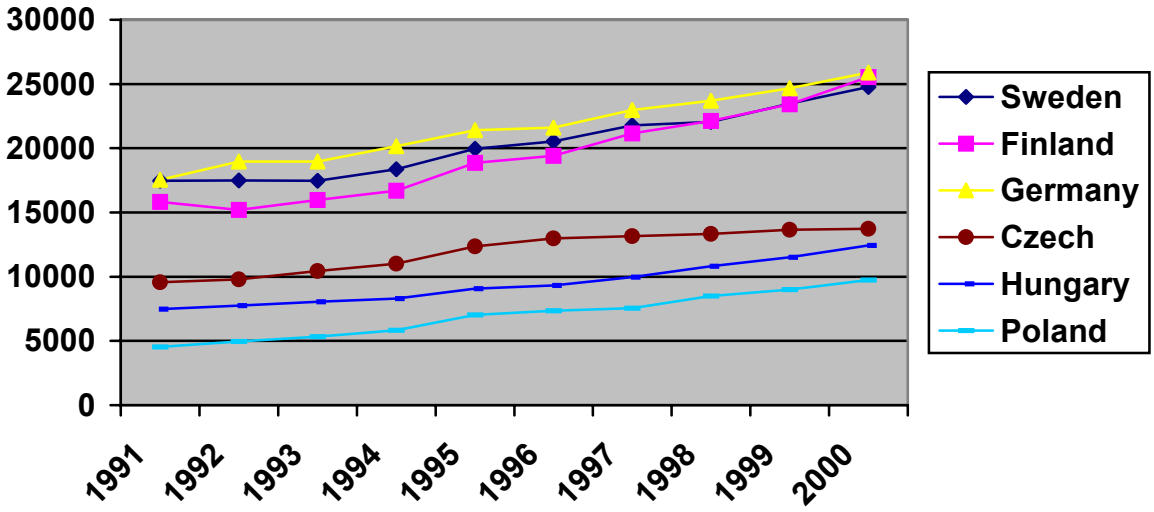
1. Introduction

The generation and exploitation of new technologies, processes and products – i.e. innovations – is today widely regarded as the principal driving force in all long-term socio-economic development. The future of countries, industries and firms is therefore likely to be largely determined by their capability to generate and exploit technological change and other innovations. This is true also for the post-socialist countries of Central and Eastern Europe (CEE). Research within the emerging discipline of 'transition economics' and related fields, however, has so far tended to focus only indirectly on the dynamics of innovation in the new market economies in Eastern Europe. The main interest has instead been in reforms related to macroeconomic stabilisation, trade liberalisation, and enterprise privatisation, and in economic performance in terms of GDP growth, productivity, and trade. These variables are, of course, important, but in the globalising learning economy, it may be even more important to assess reforms related to systems of innovation, and to study performance in terms of innovative strength.

As a matter of fact, there is reason to ask to what extent firms and other organisations in the Eastern countries of today's Europe do at all have the ability to innovate. Whereas, from the perspective of GDP growth, CEE can in general be seen to 'catch up' with the West (figure 1), there is a widening gap between East and West with respect to the underlying issue of innovative output (as exemplified in terms of patents in figure 2), suggesting that CEE is 'falling behind'. One interpretation of this is that transition to capitalism has so far been associated with decreasing rather than increasing innovative capabilities, and that the Eastern economies are becoming locked into a pattern of growth based on low value-added activities related to the exploitation of low-wage labour. If this is true, it would be an alarming result from the perspective of CEE governments, since public policies in the CEE countries contain a strong commitment precisely to the establishment of advanced innovation-driven economies with strong systems of innovation and R&D bases, where education, science and technology would represent the main driving forces of socio-economic change. Drawing as far as possible on their problematic but advanced industrialised and technified Soviet-era pasts and taking

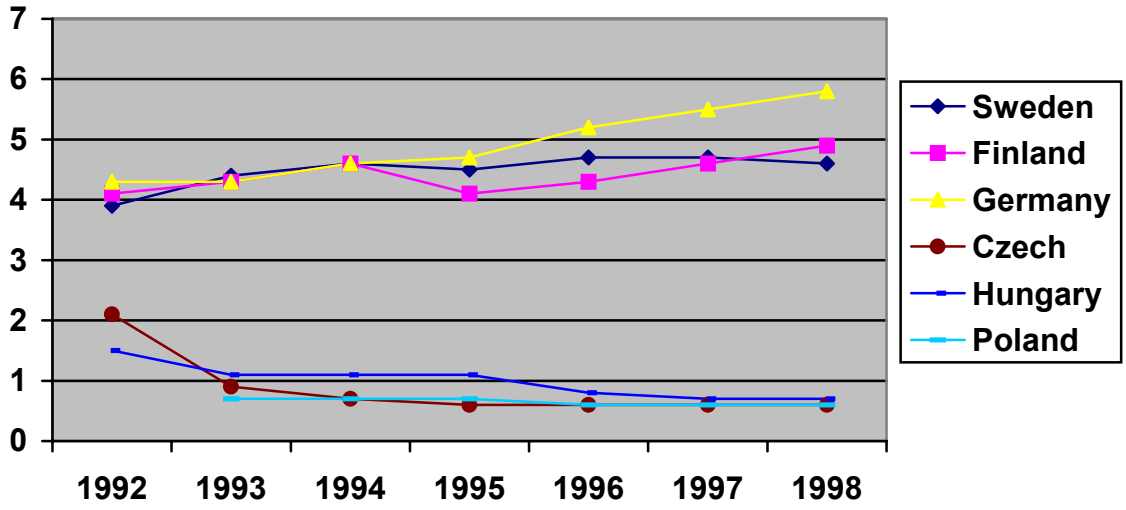
advantage of the recent establishment of open capitalist systems, East European countries have set out to establish themselves among the most advanced European economies. There is not seldom a strong belief in these countries that this can be achieved within a foreseeable future.

Figure 1. ***GDP per capita in East and West (USD, current prices and current PPPs).***



***Source*: OECD (2002).**

Figure 2. ***Inventiveness coefficient (resident patent applications per 10,000 inhabitants).***



***Source*: OECD (2001a).**

Measuring innovative capabilities in terms of patenting can, however, only give a first rough indication of innovative strength. In this paper I therefore set out to assess in further detail to what extent the Eastern countries of today possess innovative capabilities. I do this by reviewing the existing empirical evidence on East European innovation, which so far forms a meagre body of literature. One of the most striking aspects of this literature is the contradictions between different studies, leading to a whole spectrum of conclusions, stretching from very optimistic to very pessimistic, with respect not only to the *future*, but, somewhat more unexpect-

edly, also the *present*, of the CEE countries. In short, there is a surprising disagreement among authors about what firms are actually doing in Eastern Europe. As I will argue, this is a result both of the differing research methodologies applied, and of a general lack of empirical evidence on innovation in the East. The lack of empirical evidence is a problem, as it has led to a policy debate that is largely based on transplantation of Western experiences onto economic environments that but differ too radically from the West. While there is scope for learning from Western countries, the argument is here that the Eastern countries may also profit substantially from understanding their own innovative capabilities and the mechanisms that characterise their systems of innovation. Such an understanding does hardly exist today.

The paper is structured as follows. I first discuss the historical heritage of the post-socialist countries in terms of the innovative capabilities that they possessed in the socialist times (chapter 2). This forms a suitable point of departure for assessing the post-socialist development (chapter 3). I thereby discuss the contribution of the mainstream 'transition economics' literature (section 3.1) as well as more interdisciplinary approaches in innovation studies and political economy (section 3.2). I review in particular the studies that deal with the role of the new capitalist business sector (sections 3.3 and 3.4) and the role of foreign firms in stimulating the build-up of innovative strength in CEE (section 3.5). I also discuss whether East European innovation today can be regarded as 'creative' or 'imitative' (section 3.6). I then take up several cases of successful innovation at the sectoral and firm levels in the East (chapter 4). In the final chapter, some conclusions are drawn and suggestions for further research formulated.

2. Could the socialist countries innovate?

Technological change and innovation in the Cold War era constituted paramount societal concerns equally within capitalist and socialist civilisations. In both these worlds was technology seen as the ultimate key to civil and military progress, and technological achievements became a criterion along which the level of societal development was to be measured and evaluated in the ideological struggle. At the same time, however, technological and innovative activities in East and West were only weakly *connected* to each other. Technologies, organisations, and institutions in East and West developed according to radically different logics, and the interactions among these elements across the East-West interface were almost negligible in comparison to the interactions within the Eastern and Western worlds themselves. Although the Iron Curtain and institutions such as COCOM[1] did not fully prevent ideas and artefacts from being transferred – in both directions – across the East-West divide, their principal impact was undeniably to reinforce a separation and differentiation in terms of innovation, and environments for innovation, in the socialist and capitalist worlds. This meant that socialist and capitalist systems of innovation could not be seen simply as variations on a common theme. Rather, they worked according to fundamentally different logics. These differences and their implications will be clarified in this section.

The reality of the Cold War stimulated in itself an unprecedented growth of Western studies of East European innovation, as it was considered important to assess technological and economic progress in the Soviet bloc and compare the performance of science and technology systems in socialist economies to that of the corresponding systems in capitalist economies. It is not within the scope of this section to give a full account of these investigations, but the

[1] COCOM, i.e. the 'Co-ordinating Committee on Multilateral Export Controls', was created after World War II as an inter-governmental organisation that during throughout the Cold War imposed restructions on exports to Eastern Europe. Since its Paris meeting in July 1990, these restrictions have gradually been abolished (Sadowski, 2001).

main conclusions and insights resulting from them are important for understanding the process of transformation and reorientation from socialism to capitalism and should therefore be clarified. I have chosen not to go into detail with regard to the differences *within* the socialist and *within* the capitalist worlds. The variants of socialist and of capitalist systems of innovation forms a research area in itself, but as will be argued, even the most radical attempts at reforming innovation in Eastern Europe prior to 1989 must be considered as minor in comparison to the dramatic transition from socialism to capitalism that was to take place in the 1990s. The section therefore rather aims to clarify the main differences in the ways innovation was generated and exploited in socialist as opposed to capitalist systems of innovation during the Cold War.

From an East-West perspective on innovation, one of the most interesting studies on this subject is the explicitly comparative analysis by Hanson and Pavitt (1987) on the characteristics of research, development and innovation in East and West. Building on the emerging modern insights from studies on innovation, they suggested a *systemic* perspective to understanding the differences between innovation in East and West. They concluded, in general, that the East European systems of innovation, including those which were undergoing 'market socialist' reform in the 1980s, so far showed a very weak performance, and that this weak performance was closely linked to the *central planning* of innovative activities. Surveying the existing literature on the subject, Hanson and Pavitt pointed, above all, at the *fragmentation* of the innovation system as inhibiting vital learning processes, especially inter-organisational learning. They also identified strongly *linear* characteristics of the East European innovation models, which in the 1980s still persisted despite a strong consciousness about the problems associated with such models and numerous attempts to reform the innovation systems in this respect. Further, referring to evolutionary insights into the economics of innovation, Hanson and Pavitt pointed at the critical lack of *variety* and redundancy and of appropriate *selection* environments.

These overall characteristics of innovation under socialism should be somewhat further commented and put in relation to developments in Western and newly industrialising countries. From a systemic perspective, an important consequence of central planning of innovation was that the relationships between actors were not allowed to emerge and evolve in any spontaneous way, i.e. based on the ideas and needs of the actors themselves. This was because the very emergence of organisational structures and networks, similarly to technological priorities and product ranges, was subject to central planning. In the West, too, relationships between and within innovating organisations are recognised as extremely difficult to build and to manage, but in the centrally-planned systems of the Eastern bloc, an artificial separation of different organisational units from each other was *consciously* created and enforced. Actors were highly specialised in a functional sense, with separate organisations responsible for different stages of the innovative process. Thus in the Soviet system, which was largely adopted by most of the other Eastern countries, the Academy of Sciences with its hierarchies (and to a smaller extent the system of higher education) was the main producer of basic research, while more mission-oriented R&D was carried out by branch R&D organisations and project-design and product-design bureaux. Similarly, there were also specialised construction and installation organisations, which were typically more prominent in socialist than in capitalist systems of innovation. To the extent that R&D was carried out *in-house* in the Western sense, i.e. within production enterprises themselves, it was strongly limited to routine tasks such as testing, or incremental adaptations necessary to make technologies developed externally work (Hanson & Pavitt, 1987: 22f.).

These separate organisations, with their responsibilities for different stages of the innovative process, found it hard to and were not encouraged to interact directly with each other. Buyers and sellers seldom met, and partnerships between organisations had to be approved by central authorities, which typically also decided who was to cooperate with whom (Hanson & Pavitt, 1987: 29). It was often regarded as sufficient to transfer knowledge and ideas between different units in highly codified forms, notably through blue-prints and physical capital. Important relationships and feed-backs were therefore typically missing, and inter-organisational learning, which plays such a crucial role in the modern economy, was severely hampered. In particular, the Eastern countries faced serious problems with respect to the integration between *R&D* and *production*. This was and is a well-known problem also in Western systems, but whereas in the West R&D is to a great extent an in-house activity and therefore carried out in relative proximity to other activities, Soviet-style R&D was almost exclusively extramural (i.e. firm-external) and thus often carried out at both organisational and geographical distance from production units.

In an interesting way, the commitment to central planning also meant that the organisation of innovation did not necessarily take into consideration that different industries might require different organisational forms and different institutional set-ups. In studies on innovation in capitalist market economies, it has been convincingly shown that the nature of technologies tend to strongly influence the organisation of innovation and thereby give rise to sector-specific patterns (Pavitt, 1984; Malerba, 2002). Innovation in the automotive industry is in capitalist systems thus likely to be organised in a very different way as compared to innovation in biotechnology, in banking, or in scientific instruments. In capitalism, innovation thus follows different logics in different sectors, whereby the differences largely on the features of the specific technologies. In centrally-planned systems of innovation, in contrast, sectoral patterns appear to have emerged not in response primarily to the nature of *technologies*, but rather in response to ideological and other *institutional* considerations. In practice, this meant that sectoral differences hardly emerged at all, as the ideologically preferred type of organisation rested almost exclusively on a scale-intensive pattern. Small firms, which play so vital roles in capitalist economies, were not allowed to emerge to any significant extent and could therefore hardly play any active role in socialist systems of innovation. It should be noted, however, that this was not a consequence of central planning itself, but rather of the ideological preferences of the planners. With a different ideological view or with a more modern understanding of the process of innovation, sectoral patterns may have emerged in a different way in the centrally-planned systems of innovation.

The most important consequence of the absence of small firms in socialist systems was probably the lack of ‘specialised suppliers’. These are of key importance in capitalist systems of innovation, contributing crucially to the development and diffusion of pervasive capital goods technologies, from machine tools, to control instrumentation, computer-aided design, robots, software, etc. (Hanson & Pavitt, 1987: 15). Innovation in these technologies have been considerably driven by strong interactions between small supplier firms and the users of the technologies (von Hippel, 1988). In Soviet-type systems these key technologies were, in accordance with the ideological preferences, supplied by large organisations. Similarly to other firms, these large suppliers found it very difficult or even impossible to interact in a meaningful way with their customers, and user-producer interaction was therefore minimal. The tradition that grew up around this pattern implied that customers did not turn to suppliers for problem-solving and up-grading of processes and products. More generally, producers did as a rule not turn to *any* other organisations.

Also with respect to the evolutionary considerations of mechanisms of *variety* generation and *selection*, socialist systems of innovation differed considerably from capitalist ones. In capitalist economies, any organisation may be a source of diversity creation in that it introduces new ideas and actions. In Soviet-style systems, however, this function was strongly limited to the planning authorities and perhaps the Academy of Sciences, which was extremely influential. Other organisations – in particular the production units – found it too difficult and hardly worthwhile to try to make reality of the ideas that might exist. When they did try to, they were not allowed to channel their ideas into the innovative process, neither in-house nor with respect to linkages with relevant external organisations – be they suppliers, customers, research institutes, etc. Instead, they had to turn to the central authorities. The resulting meagre feedbacks from own ideas and the depressive wall of bureaucracy that was thus raised between inspiration and innovation effectively eliminated most of the 'intrapreneurial' spirit in socialist organisations. In general, *entrepreneurial activities* were hardly an issue at all, as already hinted at above in the discussion of small firms. In contrast to capitalist systems of innovation, new ideas generated in socialism were seldom allowed to lead to start-ups or spin-offs for economic exploitation of the ideas. Rosenberg (1994) has discussed this further in terms of the lack of *freedom to experiment* in socialist economies.

The stagnation of diversity creation outside R&D organisations was further reinforced by the absence of strong selection mechanisms. Technological and product alternatives were not allowed to emerge in parallel with each other and compete; instead, it was seen as an important task of central planning to select among alternatives at a very early stage. *Redundancy*, in the form of organisations working on technologies with the same or very similar purposes, was equated with an unnecessary waste of resources and was thus strongly discouraged. This resulted in a dramatically decreased variety and made the socialist systems extremely fragile through the resulting dependence upon *very few technological trajectories* in comparison to what is typical in capitalist systems. Moreover, *competition* could only be a political process defined by the negotiations between proponents of different technologies and products. In contrast to capitalist economies, the market hardly played any role in the competitive process in socialist systems of innovation.

Moreover, as a consequence of the predominance of 'soft budget constraints' (Kornai, 1980), the threat of bankruptcy was much weaker in Soviet-type systems than in capitalist economies; not being able to cover costs did in the socialist context not necessarily mean that anything had to be changed in an organisation, since it was always possible to appeal to superior organisations higher up in the hierarchy that could bail it out of its financial difficulties. The threat of losing status and bonuses meant that managers still did have incentives to prevent such situations, but the softer budget constraints under socialism appears to have considerably reduced the willingness to respond to problems by engaging in innovative activities, as there was no capitalist whip that forced them to seek to upgrade processes and products. 'Defensive' and 'imitative' innovation strategies, which are so widespread in the capitalist economies (see Freeman & Soete, 1997, ch. 11), did therefore hardly exist at all under socialism.

Connected to the 'soft' budget constraints was also the *slow diffusion* of innovations through the economy. The enormous efforts in terms of personnel and financial resources devoted to 'pushing' scientific discoveries and technical inventions through the different stages of the innovative process was not matched by any 'pull' from production enterprises. The latter were – for good reasons – often reluctant to change, and the whole way of thinking about innovation was different from typical capitalist technology-based firms, deeply devoted to survival and expansion through Schumpeterian competition. Survival in socialist systems was rather

an issue of making existing things work – and this was already difficult enough in East European economies. Innovation, in contrast, was typically something imposed from a distant outside, and the overall experience was that the novelties thus introduced were bound to bring with them enormous new problems in connection to their introduction, rather than any improvements. Thus, the very concept of 'innovation' had *within enterprises* often a clearly negative clang, although at the same time it was *politically* almost equated with the very progress of socialism.

With regard to the *connections* between Western and Eastern systems of innovation, the most important research area in the Cold War period was the study of *technology transfer* in an East-West perspective. For example, Sandberg (1989) studied how and to what extent Soviet-style innovation systems were capable of 'learning from capitalists' through technology transfer projects. The major results of this and other studies were typically that imported technologies never acquired a dynamics of their own, but worked as static enclaves in the centrally planned economy. For example, modernisations were made only with new support-package deals, and diffusion to other sectors than the military or space industries were minimal. In view of the picture of socialist systems of innovation as outlined above, this is hardly surprising.

In the Soviet industrialisation drive in the 1930s, inspiration from and imitation of Western technologies played a crucial role. At the time of the Bolshevik revolution, Russia as well as other East European countries had been far behind in industrial development relatively to Western Europe, and foreign sources of knowledge and technology thus played important roles, just as they had done for the somewhat earlier industrialisation of Scandinavia. While the new states created in Central and Eastern Europe after World War I built their industrial development largely on stronger and more direct relationships to the West (including considerable amounts of FDI), the Soviet Union built up an enormous R&D system initially concerned precisely with screening foreign technology and copying it (Hanson & Pavitt, 1987: 24). This strategy was strengthened by World War II, which played an enormous role for the transfer of technology to the Soviet Union from Germany in the form of war trophies.

It is an interesting question to what extent the 'imitative' character of the Soviet R&D system later turned more 'creative', with the generation and exploitation of genuinely Eastern technological trajectories. There is no consensus about this in the literature, but there are a number of examples that seem to strengthen both the view that Soviet technology largely continued to imitate Western achievements as well as the view that a number of creative areas did emerge and evolve, with varying success (see e.g. Amann, 1986).

Successes of Soviet and East European achievements in innovation can certainly be traced without much difficulty through Western licensing-in of technologies developed in socialist systems of innovation and through the patenting activities of Eastern countries in the West. During the 1970s, for example, US companies acquired 126 licences from the USSR and Eastern Europe (Amann, 1986: 14). In the early 1970s, Soviet and East European patenting in the US and West Germany also grew strongly (the rate of growth was in fact exceeded only by very few countries), but then declined. Hungary, however, continued to show strong growth in US patenting also in the 1980s (Hanson & Pavitt, 1987: 62).

In contrast to patenting by Western countries, patenting in the capitalist abroad by socialist countries was pursued with the goal to strengthen the above-mentioned licensing-out of technologies, rather than to the direct export of goods (Radosevic & Kutlaca, 1999: 96). However,

the 126 Soviet licenses documented for the 1970s clearly appear a meagre result from this strategy of exporting technological knowledge. Although they indicate in an interesting way that East-West technology transfer was not a strict one-way street, it is clear that the examples of transfer of socialist technologies to the capitalist world are more to be regarded as exceptions (Amann, 1986: 14). This is clearly reflected by the fact that the value of socialist imports of licences widely exceeded that of licence exports (Hanson & Pavitt, 1987: 79).

To sum up this section, it can be seen that most authors agree in their overall view that socialist systems of innovation were generally weaker in their generation, exploitation and diffusion of innovation than most capitalist systems of innovation. Today, however, the main interest is not primarily the relative quantitative performance of socialist and capitalist systems. Rather, it is much more important that socialist systems worked and developed according to a completely different set of logics than capitalist systems. Transformation and reorientation is precisely about the difficulties of altering inherited behaviours at the level of organisations, industries and the whole economy. Many of the peculiarities that have been observed in the post-socialist context and that in Western eyes appear enigmatic and contradictory, can be understood better if the past, as referred to here, is taken seriously into account.

3. Can post-socialist countries innovate?

3.1. Transition economics: tracing innovative capabilities through macro-economic variables

Following the collapse of the socialist regimes in Eastern Europe, a new research field emerged in studies of the CEE economies, usually referred to as 'transition economics'. Within this discipline, however, the issue of innovation has seldom been dealt with explicitly, and building innovative capabilities has seldom been addressed as a problem to be researched in its own right. Instead, Western-like innovative economies are usually expected to emerge in CEE as a more or less automatic response to appropriate reforms. Dynamic innovation systems are expected to emerge as the long-term result of *macroeconomic stabilisation*, *trade liberalisation* and *enterprise privatisation* (often referred to in transition economics as the 'holy trinity'). It is generally assumed that opening up foreign trade and attracting foreign direct investment will function as effective channels of technology transfer that causes radical productivity growth, spills over into the domestic economy and together with entrepreneurial activities gives rise to dynamic and creative domestic innovation. This may or may not be linked to already existing competencies in the former socialist countries. With the right economic-institutional conditions, catch-up will follow in any case. In line with traditional catch-up theory and new growth theory, the opening up of the economy enables the transition countries to catch-up economically without investing as heavily into R&D as the already advanced countries, as it is much cheaper to build economic competitiveness on imported technology, which has already been developed elsewhere (e.g. Gerschenkron, 1962; Gomulka, 1990). According to this view, it is therefore not a problem that R&D expenditures and patenting activities remain at very low levels in the Eastern countries. Gradually, when approaching the Western technological level, Eastern enterprises will begin to invest more heavily into R&D, take out more patents and thereby catch up with the West not only in terms of GDP and wage levels, but also in technology and innovation. The widening gap observed in figure 2 in the introduction is thus natural and temporary.

Following this line of reasoning, the transformation of innovative activities themselves need not be investigated explicitly. What matters is rather the effects of capital flows and institu-

tional reforms upon economic performance as measured in terms of variables such as productivity growth and export patterns. For example, a common research strategy has in recent years been to estimate the links between foreign direct investment and the performance of domestic firms in terms of productivity and output. The results of these and similar studies vary. For example, Konings (2001) found a negative overall effect of FDI on the performance of domestic firms in Bulgaria and Romania and no effect at all on domestic firms in Poland, indicating that the expected positive effects on productivity of foreign investors as agents of technology transfer is typically more than outweighed by the negative effect of competition from foreign-owned firms, destroying the potentially emerging local capacity to innovate. In contrast, Sinani & Meyer (2002) identified considerable productivity growth resulting from spillovers from technology transfer associated with FDI in Estonia. FDI is in their view thus an important contributor to the overall productivity growth observed in the Estonian economy. In the Estonian manufacturing sector as a whole, production can be seen to have increased by 7.6% annually between 1994 and 1997, despite the fact that employment in the same period decreased by 3.3% per annum (Hernesniemi, 2000).

However, whether or not FDI has an effect on productivity, it is doubtful whether this provides any insights into the issue of *innovation* in East European firms. The reason is that productivity growth is not necessarily a good indicator of innovative performance. On the one hand, with the new freedom to import technology from and build linkages to the West, it is not surprising that almost all firms acquire new machinery which may dramatically increase production efficiency. But on the other hand, this does not necessarily lead firms to *innovate*, in the sense of dynamically seeking to upgrade process and product quality beyond relatively non-creative 'learning-by-doing'. While learning-by-doing is clearly a vital element in the process of economic change, further, genuine innovation is unlikely to be detected by analysing productivity growth.

An alternative set of indicators that have traditionally been used to assess the transformation of East European innovation are related to *international trade* performance. While sectoral patterns of trade of post-socialist economies show a strong stickiness to inherited patterns from the communist era, interesting changes can also be seen to have occurred since 1989. In a trivial way, sectoral *trade balances* thereby give a rough indication of the sectors and subsectors in which the Eastern countries are developing a competitive edge. Similarly, particularly competitive sectors can be identified by comparing a country's market share in foreign markets in that sector with the country's average market share at an aggregate level. Research using these indicators usually arrives at the conclusion that East European countries have not yet achieved any competitive edge in innovation-intensive sectors, i.e. sectors in which investment into innovation are particularly high as a share of sales. For example, Hernesniemi (2000: 10), focusing on the case of Estonia, concludes that the Estonian competitive edge in exports lies in very traditional sectors like wood industries and furniture production, textile and clothing industries and foodstuff industries, and to some extent in inorganic chemicals.

A somewhat more interesting indication of technological achievements is obtained through the analysis of 'unit values', defined as the ratio of export value to physical weight. This is taken as a proxy for the value-added of exports; if the unit value of a country's exports exceeds that of its imports in a certain sector, the value-added content of exports is assumed to be higher than that of imports. This is then likely to reflect a quality advantage of exported goods over imported ones. The evolution of unit values over a longer period of time can then give a rough indication of technological change in a country. For example, Lankhuizen (2000: 22-24) applies this reasoning to the Baltic states, with the conclusion that unit values are

lower for exports than for imports in most product categories and that the pattern is hardly improving through the mid-1990s. Unit values of exports are particularly low in categories of technological intensity such as office, accounting and computing machinery, telecommunications and sound equipment, and optical, medical, measuring and control equipment. Following this argument, the Baltic states thus perform better in sectors where innovation is minimal.

However, similarly to studies on productivity growth, the problem with using trade statistics as a proxy for innovation is that it does not tell us anything about the more dynamic and creative aspects of firms' activities with respect to the innovative process itself. Whereas annual increases in productivity and exports (though perhaps not leading to a competitive advantage) may give interesting indications of the extent to which new process and product technologies have been incorporated into the domestic economy, the most important questions remain unanswered. It would be very interesting, for example, to know whether local firms (and other organisations) in the Eastern countries learn to handle foreign technologies in ways which lead them to come up with subsequent product and process improvements. It would also be valuable to know whether the new (especially foreign-acquired) technological knowledge to any significant extent has induced the formation of new firms – for example, through spin-offs from larger firms and other organisations. Further, from a demand-side perspective, an important question is whether and to what extent new technologies have induced any local demand for *other* (new) goods and services (including demand for research) and thus boosted the innovative activities of domestic firms and other organisations (including universities). Productivity and trade statistics do not provide any insight into these issues.

3.2. Historical approaches: Have the inherited capabilities been saved, destroyed or transformed?

Changes prior to 1989

The socialist countries had in fact been well aware of the problems in their systems of innovation since long. As early as 1960s there were discussions in the USSR in which critics pointed at the inadequate linearity and fragmentation of the system and, fully in line with modern innovation theory, at the need to strengthen the links between different kinds of organisations, in particular between R&D and production. Cooper (1982) has provided a detailed account of the numerous attempts at reforming the Soviet innovation system. However, despite the awareness of problems and considerable efforts to deal with them through various organisational and institutional changes, the main characteristics of the centrally planned innovation system, as outlined in section 2 above, seem to have persisted, and the attempts at correcting the perceived shortcomings mostly appear to have failed. In any case, there is hardly any evidence of actual improvements in the performance of East European innovation systems prior to 1989; the overall trend is instead a continuing decline in both generation and diffusion of innovation, which largely follow the general economic trend towards stagnation (e.g. Tournemine & Muller, 1996).

In a few countries – in particular Hungary, and later Poland – more far-reaching changes took place. For example, the setting-up of small enterprises was seriously encouraged and enterprise-level cooperation with capitalist countries was allowed. These experiments and reforms certainly made the later transition to a capitalist market economy easier, but there is no evidence that they had any significant impact on innovative capabilities. Since budget constraints remained soft, the engagement in innovative activities was still hardly seen as a way of survival. Similarly, managers had to remain in good standing with the Ministry of Industry or

their local authority, reducing the *de facto* effect of a relatively more independent decision-making of enterprises. Hanson and Pavitt (1987), in their survey, concluded that the emerging reforms would probably have to be embedded to a much higher extent in other systemic changes which could allow, for example, competition to work as a driving force, with the acceptance of duplication of innovative activities (i.e. redundancies; see above), and strong incentives and penalties in favour of both innovation and imitation.

Such major systemic changes, however, implied a totally new way of thinking that was largely impossible to accept from a socialist point of view. From this perspective, it is clear that the collapse of socialism itself following the events in the years around 1990 was a radical turning point. In comparison to the earlier reforms, the transition to a capitalist economic system was a revolution that opened up previously unacceptable perspectives on the ways in which innovation could be made to act as a driving force in societal development. Instead of seeing innovation from a collective point of view as an instrument in the ideological struggle and a tool for progressing towards a higher societal stage, the capitalist view now opened up new perspectives, with innovation largely being seen as the decentralised and uncoordinated weapons of firms in their struggle against each other, that is, innovation as an individualist strategy for survival. However, this revolution could not conceal the fact that the transformation of innovation still had to the take as its point of departure the existing socialist systems of innovation. This has turned out to result in enormous difficulties, as will be discussed below.

The transformation of the inherited R&D complex

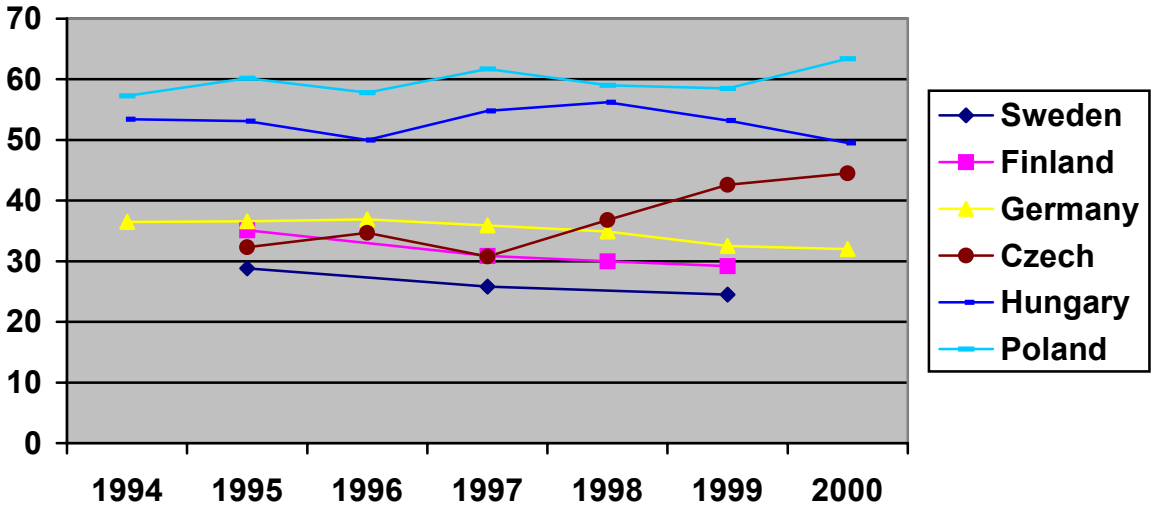
Above it was noted that in socialist systems of innovation, innovative activities were typically carried out in separate organisations that were external to production enterprises. However, the delivery of R&D 'products' from the extramural R&D organisations were predestined for specific companies; such linkages were, as already discussed, imposed from above through central planning rather than – as in Western contract research – negotiated between buyer and seller in a decentralised way. R&D organisations therefore had a secured market for their services. Transition to a decentralised capitalist system implies, at least in theory, that the imposition of a market for R&D results from above is suddenly and entirely removed and that the R&D organisations have to face both an imploding overall market as well as competition from other domestic and, above all, foreign players.

The existing empirical evidence on the actual effects of these radical changes indicate that the farewell to socialism has as a rule led to a dramatic collapse of large parts of the inherited R&D system (e.g. Radosevic, 1997a). In particular, organisations engaged in applied R&D have not been able or allowed to adapt to the new situation, and the base for their funding by the state has usually been withdrawn. Estonia and Latvia have here been pointed out as extreme cases of shut-downs, as a large part of the R&D complex in these former Soviet republics had been subordinate to military ministries; the market for their R&D services was therefore totally eliminated (Dyker & Radosevic, 1999). Organisations involved in basic research, i.e. Academies of Sciences and universities, have faced a relatively more continuous transition in most countries, although also for these organisations the financial resources and employment have decreased considerably. After 1989 hopes were raised about possibilities of strengthening East European academy-industry links (Dyker & Radosevic, 1999), but with the almost total disappearance of organisations in the spectrum between basic research and production enterprises, this is obviously contradictory to the actual prospects. However, there is hardly any actual evidence on the extent to which basic research in the surviving R&D complex has developed any connections to the emerging business sector; it is only indirectly

through the weak innovative performance of the new business sector that the missing links to basic research can be assumed to persist (see further sections 3.3 and 3.4 below).

In general, the R&D complex in East European countries has thus been radically downsized. Nevertheless, public research institutes and universities typically continue to carry out a majority of formal R&D. While in Western countries it is typical for the public sector to contribute with around one third of total R&D expenditures, while private firms contribute with two thirds, the situation is typically the opposite in Eastern Europe, where government-financed R&D amounts to up to two thirds of total R&D expenditures (see figure 3). From a historical point of view, this is hardly surprising, since nearly all innovative activities were extramural in socialist systems of innovation, i.e. R&D and innovation were not carried out by production enterprises. The interesting aspect of the post-socialist development, however, is that there are no clear indications that the pattern has been changing since the early years of transition. If there is any trend at all, it is one towards an *increasing* role of government-financed R&D (in Poland and the Czech Republic).

Figure 3. ***Government-financed R&D as a percentage of total R&D expenditures.***



***Source*: OECD (2001b).**

As a matter of fact, the public research sector in the Eastern countries is typically of a comparable size to that of Western countries. The main issues to be faced by the inherited R&D complex is thus hardly related to the quantitative *size* of research efforts in terms of expenditures and personnel. The most important problems to be dealt with rather relate to the relevance and competitiveness of the research carried out, an issue which is directly linked to the relationships between R&D organisations and the business sector. Similarly, the links between R&D organisations and other public bodies are likely to be of key importance. The overall challenge is to integrate the inherited R&D complex into the difficult societal context of transformation and reorientation.

Similarly, it is stressed in the (meagre) literature that the eliminated part of the inherited R&D systems also represents potentially valuable competencies that has to be integrated in other ways with the emerging capitalist economy. This inherited expertise has to redeployed relatively quickly in order to prevent 'unlearning' (Radosevic, 1997a). It is not clear however, to what extent this potential is actually being caught up by other (existing or newly founded)

organisations, or is rather being lost through scientists finding employment in non-scientific activities or abroad.

The problem of inherited competencies

Pavitt (1997) has suggested that the inherited socialist competencies became obsolete with the systemic change in the East, implicitly indicating that they are replaced by a diffusion into the East of Western competencies. Bitzer (2000) has gone further and suggested that the socialist knowledge-base and the socialist technological trajectories have not significantly influenced post-socialist innovation. On the other hand, scattered evidence do point at examples of successful exploitation of Soviet-era competencies in the post-Soviet period. The empirical evidence does so far not allow to draw any deeper conclusions about the role of inherited technologies and competencies, and even less so about the explanations of the observed pattern. In general, however, it can be seen that inherited competencies that do matter in the post-socialist context tend to be embodied in *individuals* rather than in *organisations* (Radosevic, 1997a; 1997b).

In addition, and perhaps more important, Soviet-era history is embedded not only in technological trajectories and competencies, but also in organisational forms and institutional structures. It has thus been suggested that, for example, the formal or informal *reintegration* of socialist networks following their legal split-up (see above) may in fact play important roles in stimulating innovation. These networks may be able to play a constructive role in the transformation and reorientation of the inherited systems of innovation, for example, by creating a critical threshold demand for R&D or by creating subcontracting networks (Radosevic, 1997b).

A synthesis of these findings would imply that a large share of the competencies accumulated in the socialist systems of innovation are becoming obsolete under post-socialism, but that, at the same time, the very ways in which knowledge is accumulated in today's East show unmistakable traces of the socialist innovation system. The problematic missing link between university research and industrial innovation, as discussed in the preceding section, should be seen in this light. This evolutionary aspect of surviving organisational and institutional characteristics is particularly evident in a systems perspective, since the process of innovation is here seen as involving not only technology, but above all strong linkages between technological, organisational and institutional change (e.g. Nelson, 1994; Malerba, 2002).

3.3. Has the emergence of a capitalist business sector stimulated new innovative capabilities?

From the perspective of enterprises, the sudden introduction of a capitalist economic system with totally decentralised decision-making implied that innovation was suddenly not anymore something that was enforced from outside. Companies were suddenly free to choose their suppliers and partners. It is not clear from the existing literature whether for existing enterprises this actually resulted in any dramatic change in inter-organisational linkages; probably the most important changes have occurred in connection to privatisation, especially if the buyer was a foreign investor, since the strategy of the latter is typically precisely to integrate the Eastern enterprise into its existing network. This is supported by the observation that privatised firms are in general more strongly networked internationally than state-owned firms (Radosevic, 1999b). Domestically, on the other hand, it is typically large state-owned and internally-privatised firms which are the strongest in inter-organisational collaboration. This is

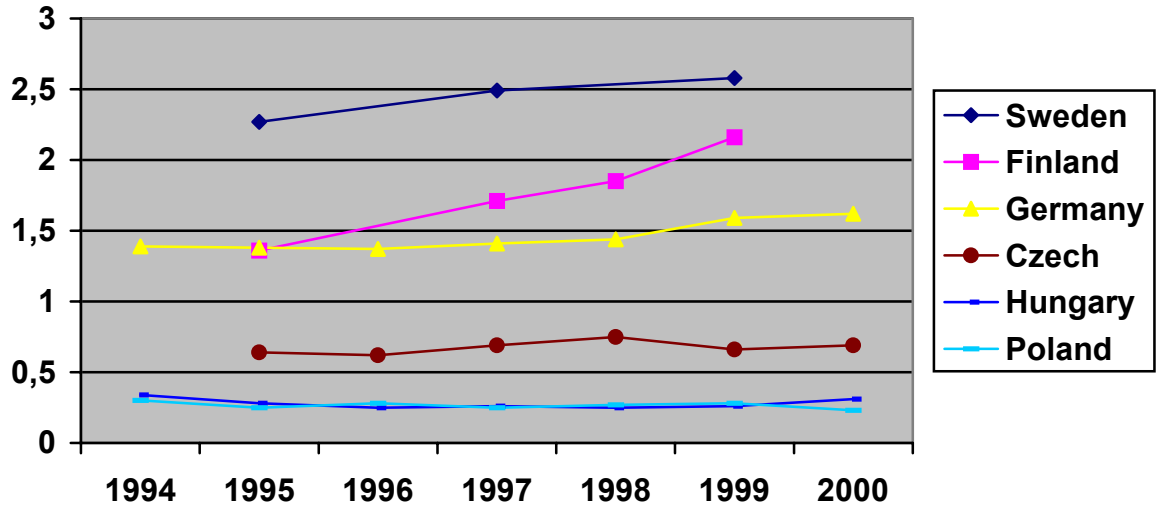
hardly surprising from an evolutionary perspective, as it is usually a question of linkages that have survived from the old system, though perhaps in new disguise. Even in cases where, as was common in the early phase of transition, large enterprises were split up into a number of smaller units, these have often been seen to reintegrate in various ways under post-socialism. In some cases this has involved the reintegration also of R&D institutes into the 'new' conglomerates (Dyker & Radosevic, 1999; Radosevic, 1997b).

There is hardly any data for the emerging inter-organisational linkages of small and medium-sized companies. However, these companies were in the first half of the 1990s hardly involved in innovative activities at all (Radosevic, 1999b). Many analysts argue that small and medium-sized firms in Eastern Europe have a much too low level of technological competency and are too static technologically for contributing in any significant way to building innovative strength in Eastern Europe (Gabor, 1997; Dyker & Radosevic, 1999).

Innovation surveys in East European countries indicate that a much smaller share of firms in these countries are innovative in the sense of having introduced new products or processes in recent times (for an overview see Radosevic, 1999b). This is so despite the new possibilities to import machinery, whose introduction by the generous definition of the Oslo Manual represents an innovative activity (OECD, 1997). A plausible hypothesis that is in line with these results is that technological activities, to the extent that they occur, are strongly skewed towards downstream non-R&D activities like testing and standards, as these are now critical for exports (Radosevic, 1997a; 1999a). This type of activities resemble the limited inherited capabilities of socialist production enterprises, whose innovative activities were typically concentrated exactly to adaptations related to the (in itself often difficult) 'introduction' (*vnedrenie*) of innovations 'already developed' extramurally. This would indicate a continuity in the 'style' of innovation.

Traditional measures in terms of R&D expenditures gives a rather pessimistic picture of the innovative efforts in the East European business sector. As already discussed, the public sector continues to carry out a majority of R&D, and there is no indications that Eastern firms are catching up with the West in terms of R&D investments (figure 4).

Figure 4. ***R&D investment by firms in East and West (percentages of GDP).***



***Source*: OECD (2001b).**

In terms of output, measured in terms of the resident patent applications, we have already seen (figure 2 above) that there is even a *widening gap* between East and West. Sweden, Finland and Germnay submit between 7 and 10 times more patent applications domestically as compared to the Czech Republic, Hungary and Poland. In terms of US patents, this gap is dramatically wider. The only CEE economies with any significant US patenting activity are Slovenia, Hungary and the Czech Republic, and even for these countries the gap to Sweden, Finland and Germany is between 13 and 73 times. While the Western countries have globalised the exploitation of their innovations by dramatically increasing their US patenting activities, CEE economies have not been able to follow this trend. Mickiewicz and Radosevic (2001: 23) conclude from similar data that the international relevance of the innovative activities that take place in Eastern Europe remains limited.

Table 1. ***US patents granted per 10,000 inhabitants.***

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Sweden	0.94	0.82	0.84	0.90	1.03	1.10	1.09	1.52	1.74	1.96	2.18
Finland	0.67	0.74	0.60	0.66	0.75	0.88	0.91	1.22	1.35	1.26	1.49
Germany	0.97	0.93	0.88	0.85	0.84	0.87	0.89	1.17	1.21	1.32	1.45
Czech*	0.03	0.02	0.01	0.02	0.02	0.01	0.02	0.03	0.03	0.05	0.03
Slovakia	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00
Hungary	0.09	0.09	0.06	0.05	0.05	0.04	0.03	0.05	0.04	0.04	0.06
Poland	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Slovenia	0.00	0.00	0.02	0.06	0.03	0.07	0.04	0.10	0.07	0.09	0.11
Estonia	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.03	0.01
Latvia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Lithuania	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Romania	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bulgaria	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
Russia**	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02

*** Czech patents are counted as the sum of Czech and Chechoslovakian patents.**
**** Russian patents are counted as the sum of Russian and Soviet patents.**

***Source*: US Patent Office.**

3.4. Sectoral patterns

Figure 2 and 4 as well as table 1 above give only a very rough indication of the innovative activities of East European firms. This is because R&D investments in a formal sense and patenting activities do not necessarily cover all innovative activities, but also because I have so far referred to innovation at the macro-level of the economy. A somewhat more detailed picture emerges if we move down to the level of specific sectors. It is thereby of particular interest to look at industries characterised by high rates of growth, such as electronics, computers, pharmaceuticals and aerospace. Figure 5 shows the private R&D investments in these industries.

Figure 5a. ***R&D investments by firms in the electrical-electronic industry (percentages of GDP).***

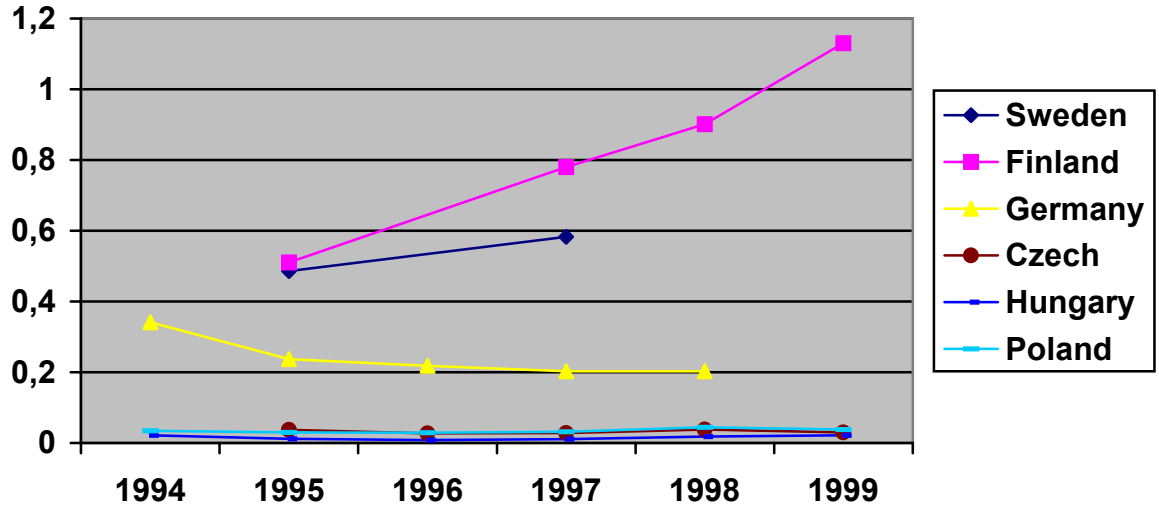


Figure 5b. ***R&D investments by firms in the office machinery and computer industry (percentages of GDP).***

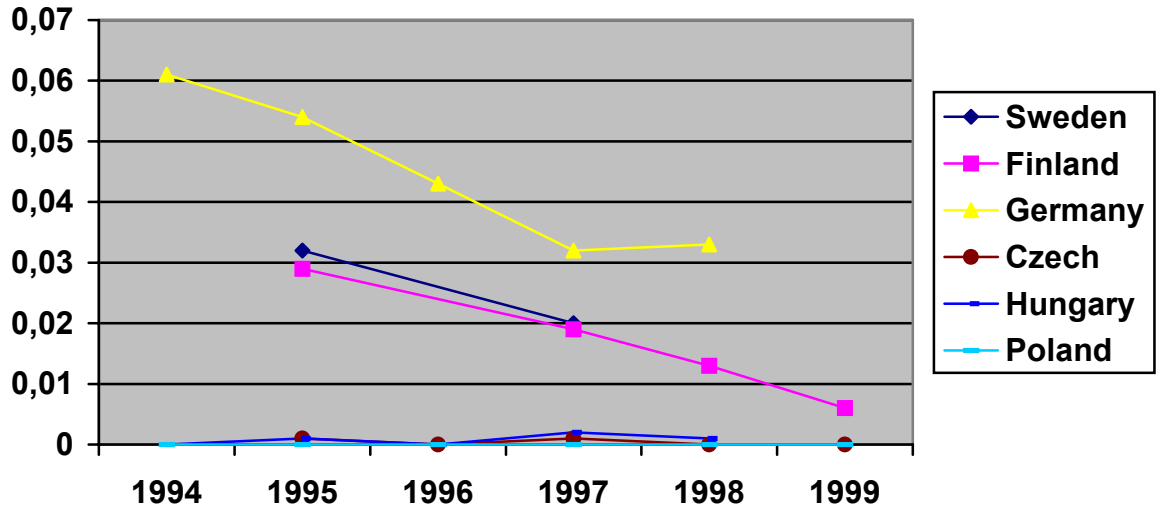


Figure 5c. ***R&D investments by firms in the pharmaceutical industry (percentages of GDP.***

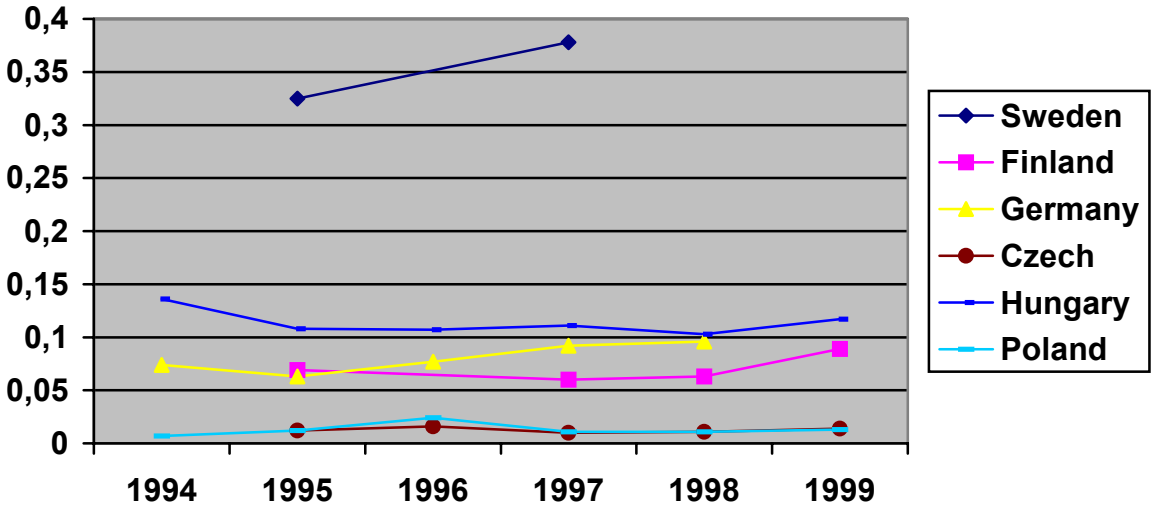
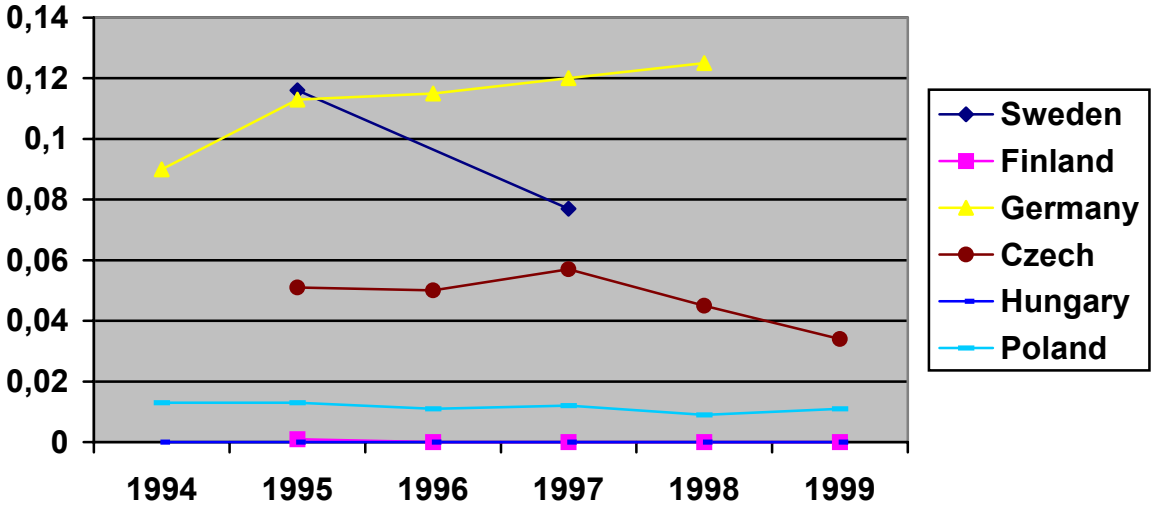


Figure 5d. ***R&D investments by firms in the aerospace industry (percentages of GDP).***



***Sources*: Based on OECD (2001a; 2001b).**

In the electrical-electronic industry and in the office machinery and computer industry, it can be seen that the private innovative efforts of the post-socialist countries are almost negligible. The gap between East and West is here even wider than at the aggregate level of the economy as a whole. In the case of computers, the Eastern countries can actually be seen to follow the overall European trend of stagnating investments into computer R&D (which, instead, is increasingly dominated by the United States and Japan). As for the electrical-electronic industry, however, the East European trend is *not* typical for the overall European development. The sectoral statistics indicate that Eastern Europe has not to any significant extent been able to exploit innovation along the mobile telephony and internet trajectories (which form the basis for the phenomenal growth of Nordic R&D in the electric-electronic sector).

The sectoral statistics are somewhat more interesting in the case of pharmaceuticals. While Poland and the Czech Republic do hardly innovate at all in this sector, the Hungarian pharmaceutical industry is about as innovation-intensive as typical EU countries. As a matter of fact, no other OECD country comes close to Hungary in terms of its specialisation in pharmaceuti-

cal R&D, which in Hungary accounts for almost half of the country's total private R&D investments.

In the aerospace sector, Hungary is not active at all, but both Poland and in particular the Czech Republic perform substantial research and development in this sector. This may indicate that the inherited innovative capabilities from the socialist era have *not* become obsolete with the transition to capitalism. This would also be in line with Shaw's (1996) argument that the Soviet era aerospace industry formed an 'enclave of competence' where, in contrast to other industries, innovative capabilities were allowed to accumulate in a fruitful way, thereby making the aerospace sector better prepared for the transition to capitalism..

3.5. Have foreign firms contributed to building innovative strength in Eastern Europe?

Great hopes have been raised in Eastern Europe since 1989 with regard to the potential roles that Western firms can play in the rebuilding of the economy. In theory, foreign direct investment has thereby been seen as a powerful vehicle also for rebuilding innovative capabilities under post-socialism. Foreign investors are expected to bring with them modern technologies that increase productivity and inspire further innovation. Through the pressure of competition, domestic firms are also expected to be forced to invest into new technology and innovative activities, thereby enforcing a pattern of Schumpeterian competition and growth in the former socialist countries.

As already discussed, such a view needs certain corrections if it is to correspond to a modern understanding of the innovative process and of the accumulation of innovative capabilities. Much of the research that has dealt with the role of FDI follows, however, the mainstream approaches referred to in section 3.1 above, focusing on innovation only through indirect indicators such as productivity growth and trade performance. While these indicators have so far led to rather contradictory conclusions about the innovative performance of post-socialist economies, deeper research based on case studies of specific firms mostly indicate that foreign investment is as a rule *not* associated with any rebuilding of technological and innovative capabilities in Eastern Europe (e.g. Farkas, 1997; Geenhuizen, 2001). The only obvious exceptions are the new R&D centres and software development departments that have been established directly by multinational firms in some of the CEE countries (notably Hungary). This phenomenon is further discussed in section 4 below.

The with respect to *collaborative ventures* between East and West resembles that of FDI activities. Collaborative ventures have been seen to be almost exclusively based on *manufacturing*-related agreements, typically related to subcontracting. Eastern firms are predominantly incorporated into the networks of Western firms at the *lower* stages of the industry value-added chain. When cooperative agreements have been related to technology, they have not been concerned with the development of new products or processes, but rather with adjustments such as adaptations to local conditions (Sadowski, 2001). These results are broadly in line with other research indicating that with transition, a trend towards labour- and resource-intensive industries has been emerging in the Eastern countries.

In addition, foreign firms appear to have further *reinforced* the already problematic decoupling of R&D from production, as cooperation in R&D typically has been seen to take place between the R&D complex of multinationals and Eastern research institutes, while business enterprises are integrated separately as manufacturing units. There has thus been almost no

technological cooperation involving innovative activities between Western investors and Eastern production enterprises (Sadowski, 2001).

Hopes have also been raised for the potential of *foreign funding* to save the inherited research capabilities. Available data, however, indicate that foreign funding has contributed only very marginally to R&D funding in Eastern Europe (OECD, 2001b).

3.6. Is East European innovation 'creative' or 'imitative'?

The Oslo Manual (OECD, 1997), defines every new product or process which is 'new to the firm' as an innovation. Such a definition of innovation easily gives rise to confusion when it comes to assessing East European innovative capabilities. Following the opening up towards the West, a virtually infinite number of 'new' products and processes were introduced in Eastern firms, thereby contributing to the often phenomenal productivity growth rates discussed in section 3.1 above. From a more dynamic perspective, however, the very introduction of Western processes and products is in itself not so interesting. Instead, the crucial issue is to what extent East European firms are able to follow up their technological up-grading through their own innovative activities. In other words, we would like to know whether the new technologies have come to function as bases for further, internally driven change (cf. Bell, 1997).

One way to go beyond the Oslo Manual is to distinguish between *creative* and *imitative* innovation. This distinction goes back to Deutsch (1944), who used the terms 'initiative' and 'imitative' innovation, and Schumpeter (1947), who suggested to distinguish between 'creative' and 'adaptive' *response*. Schumpeter associated the latter with the imitation of an already existing innovation (i.e. without improving it), while the former was seen as a 'new combination', i.e. a genuine innovation. I here define creative innovation as the *first application of a new combination* and imitative innovation as its *subsequent application*. Schumpeter stressed that the new combination (first application) 'need not be spectacular or of historic importance', though it has to be something genuinely *novel*, i.e. must not exist anywhere else in the world. The only exception would be two innovations that are identical but are made independently of each other. Creative innovation, which is of particular interest, is thus equivalent to a (radical or incremental) innovation which is *new to the world*.

With the distinction between creative and imitative innovation, the question of whether or not innovation occurs can be reformulated to the question of whether Estonian innovation is mainly 'imitative' or 'creative' and whether 'creative' innovation at all occurs. It is argued here that this leads to a more realistic and qualitative understanding of what is actually happening in Eastern Europe. The introduction of Western machinery in Eastern firms in the early years of transition can thus be seen to correspond to imitative innovative activities. In contrast, creative innovation occurs when, for example, imported technologies are used as the basis for the development of new products and processes (which do not yet exist anywhere else in the world) in the Eastern firms themselves.

With the relatively large number of foreign investment projects in the Eastern countries, it is not surprising that we observe a large number of product and process technologies in Eastern Europe that are new to these countries, but there are strong reasons to suspect that these creations, though fulfilling the definition of 'innovation' in the Oslo Manual, are largely imitative rather than creative innovations. It may be argued that imitative innovations in this sense might be necessary as a starting point for many creative innovative activities. However, as

they do not automatically or necessarily lead to creative innovation, it is not enough to observe the amount of imitation if we are interested in the extent to which creative innovation occurs.

This is an issue which has not been addressed at any length so far for the case of the Eastern countries. The only study dealing explicitly with the issue of creative versus imitative innovation is Sandberg's (1999) analysis of Polish environmental technologies. Sandberg concludes that 'creative innovation' is 'still a phenomenon to hope for rather than to detect at present in Poland'. Geenhuizen (2001), with a somewhat similar interest but distinguishing between 'static' and 'dynamic' learning, finds that prospects for 'dynamic learning' in the context of foreign investment in Eastern Europe still appear to be very limited. Similarly, Sadowski (2001), in his study of cooperative East-West ventures, concludes that cooperative agreements are associated with a decreasing rather than increasing innovative capacity in Eastern firms, at least in technology-intensive sectors. This is in line also with Radosevic's (1997a; 1999a) argument that R&D activities in Eastern firms are strongly skewed towards downstream non-R&D activities like testing and standards, as these are now critical for exports.

4. Learning from success stories

From the preceding sections, based on earlier research carried out on the subject, a relatively pessimistic view emerged with respect to innovation in post-socialist Eastern Europe. In general, studies that focus explicitly on innovation (e.g. Sadowski, 2001; Farkas, 1997; Sandberg, 1999; Geenhuizen, 2001) tend to be much more pessimistic than analyses that use economic growth and productivity increases as indicators of change (e.g. Paasi, 2000; Lankhuizen, 2000; Sinani & Meyer, 2002). This is hardly surprising in view of figures 1 and 2 in the introductory section, where it was shown in a simple way that the East European catch-up in terms of GDP is not mirrored by any similar trend in R&D and patenting. In particular with respect to patents, a widening gap can be observed between East and West. The overall tendency has thus been that economic growth in post-socialist Eastern Europe, though in itself often impressive, is not driven by innovation, and that there have so far not emerged any dynamic, 'creative' innovation systems in the post-socialist countries.

However, exceptions from this rough pattern can certainly be found.
Indications of exceptional cases are given, for example, by the above indication that R&D expenditures in the Hungarian business sector are strongly concentrated to pharmaceuticals, where the former socialist country shows an innovative effort at the level of the EU average. A case study of the innovation dynamics in the Hungarian pharmaceutical sector would be of considerable interest. However, existing studies so far concentrate on the aggregate level of the economy as a whole rather than on specific sectors.

Högselius (2002) has argued that another exception from the overall negative pattern of East European innovation is formed by the telecommunications sector in Estonia. In this case, the build-up of substantial creative innovative capabilities seem to be closely linked to Estonia's strong relationships to the Finnish and Swedish telecommunications clusters. It may even be argued that a joint Nordic-Baltic sectoral innovation system is emerging in telecommunications. The Estonian capabilities are thereby concentrated to the service sub-sector, where the former Soviet republic now draws on a small but unusually advanced market and on the cooperation between public agencies and domestic and foreign private firms for the development of new advanced telecommunications services. Well-known large Nordic firms such as Ericsson, Nokia and Telia-Sonera see Estonia as a suitable test market for new services, which are

thus introduced in the East before being launched in the West. Shah (2002) has observed the same phenomenon with respect to Vodafone's activities in the Czech Republic.

Although innovative capabilities seem to be almost totally missing at an aggregate level, they may thus be found at least sporadically at the level of specific *industries*. Even more common are, not surprisingly, the existence of creative innovative capabilities at the *firm-level*. It is not difficult to find examples of East European firms that have actually succeeded in generating and commercialising advanced innovations. Most examples thereby tend to refer to the ICT sector and in particular software development. In Hungary, an interesting case is *GraphiSoft*, a start-up originally established already in the socialist era and which has become known as a niche producer in 3D drafting software for architects, which is now marketed in 80 countries and used by over 65,000 architects world-wide (Radosevic, 2002). Another internationally known company, also Hungarian, is *Recognita*, which is a spin-off from a public research institute and whose optical character recognition software is sold in 25 countries (ibid.). Dyker (1996), giving further cases of successful innovators in Eastern Europe, has suggested that East European software and computer firms could function as a 'bridgehead' to the global economy for the CEE economies.

In addition, innovation often takes place within subsidiaries of multinational companies in the East European countries. One interesting example is Electrolux, who introduced value-added activities in Hungary as early as 1992, letting a team of local engineers work on refrigerator insulation technology. This was followed by the transfer of product development from Denmark to Hungary in 1996 (Linden, 1998: 263). More typical examples, however, are the software and R&D departments of firms such as Ericsson and Siemens in Budapest (Radosevic, 2002). These departments may, on the one hand, serve to support the domestic telecommunications networks, whereby they are integrated in a natural way into the systems of innovation in the Eastern countries. But the departments may also, on the other hand, serve the global development of products and processes within the multinational companies themselves, whereby there is a risk that the innovative capabilities developed in the East remain isolated islands of competence without further connections in the domestic system of innovation. It is not clear which of these is the most dominant tendency.

5. Conclusions and implications.

A problematic but at the same time very important conclusion that can be drawn from the discussion in this paper is the fact that there is a persistent disagreement among authors not only about the prospects for future socio-economic development in Eastern Europe, but also about what kind of economic activities are actually occurring in these countries. No one doubts that a rapid economic development is taking place in the East, but many authors doubt that East European firms are involved in any genuinely innovative activities to any significant extent, i.e. more than as exceptional cases. With respect to future prospects it is, on the one hand, often taken more or less for granted that the Eastern countries will converge with the West in terms of GDP and living standards. On the other hand, it is also seen as self-evident that such a catch-up requires the establishment of knowledge-based economies in which science, technology and innovation form the very heart of progress. However, most of the existing micro-economic evidence suggest that the East suffers from a severe lack precisely of those capabilities that are required to establish such innovation-driven economies in Eastern Europe – i.e. the ability not only to produce already existing goods and services, but to generate *new* and *improved* advanced products and processes.

A useful dichotomy that can help understand the problem of this situation is Bell's and Pavitt's (1997) distinction between 'production capacity' and 'technological capabilities', the former referring to capital goods, knowledge and labour skills to *produce*, and the latter to skills, knowledge and institutions that make it possible to generate and manage *change* in technology. Bell and Pavitt argue that production capacity may be used as a basis for building technological capabilities, but that this has become an increasingly difficult and demanding task in a world of complex and science-based technologies. This makes an active innovation and learning policy absolutely necessary – in firms as well as in government and supporting institutions – if production capacity is to stimulate the emergence of innovative capabilities. However, the existing empirical evidence that directly addresses the problem of innovation suggests that the Eastern countries have so far *not* been able to draw to any significant extent on its newly established capitalist production capacity (based on foreign investments and Western technologies) to accumulate their own innovative capabilities. Moreover, there are no signs that this trend is changing.

In summary, the following can be concluded with respect to the present stand of knowledge on the transformation and reorientation of East European innovation:

- Quantitatively, it can be seen that R&D expenditures and patenting remain at very low levels. The structure of R&D spending shows strong continuities with the socialist system to the extent that almost all R&D is carried out extramurally. The most interesting and encouraging exception is the Hungarian pharmaceutical sector;
- Qualitatively, innovation in post-socialist Eastern Europe has so far been predominantly imitative and not creative. Technological activities in firms are skewed towards downstream non-analytical and non-R&D activities like testing and standards;
- Cooperation with foreign partners have been mostly associated with *decreasing* technological capabilities rather than with rebuilding them;
- It has so far been extremely difficult to reorient the enormous inherited research capacities towards the market economy context. The research system has been dramatically down-sized in all Eastern countries since the events in the years around 1990;
- The extent to which inherited competencies have played a role in post-socialist innovation remains subject to debate. Some authors argue that the inherited competencies have become totally obsolete, while studies of, for example, the aerospace sector suggest that this might not be the case everywhere.

The studies that have so far contributed to these results have focused both upon the transformation of the inherited socialist R&D complex, thus concentrating on the destinies of R&D organisations, and upon the problems faced by business enterprises, stressing the non-emergence of new innovative capabilities in the private sector. The extent to which the socialist heritage can be relevant for the post-socialist context has been widely discussed. At the centre of the debate has in general on the one hand been the *reasons* behind the poor performance of post-socialist systems of innovation, and on the other hand the potential *policies* that could be applied to strengthen innovation in the Eastern countries.

A striking aspect of the existing literature is the almost total absence of research focusing on the actual emergence of innovative strength in the Eastern countries – particularly in terms of creative innovation. Rather than building on empirical evidence of innovation in real-world Eastern Europe, policy analyses have therefore come to rely on theoretical reasoning that is connected to the *non*-emergence of innovative strength, *missing* competencies and linkages,

failures of markets and governments – in short, there are almost no references to the innovative process itself.

If a more dynamic understanding of the transformation and rebuilding of innovative strength in the Eastern countries is to be arrived at, there is a need to formulate a framework that can be used to study innovation as a real-world process that *does* occur, rather than as a process that *should* occur. It is here argued that such a framework, in contrast to studies dealing with explorations and explanations of the *non*-emergence of innovation, could enable much more meaningful insights into the problem of East European innovation and its reorientation towards the West. In particular, the evidence of success stories point at a potential to move down from the aggregate to a sectoral level of analysis. While there clearly does not exist any East European country which in its entirety can be labelled 'innovative' in a creative sense, there do exist industries in which innovative capabilities seem to be emerging in interesting but so far unexplored ways. At the same time, the sectoral level is also clearly more interesting than case studies of single firms, as sectoral innovation systems incorporate the innovative dynamics both in and between firms as well as the complex interactions between technologies, organisations and institutions. Sector-level studies might thus be a fruitful way to understand East European innovation not only in terms how whether and to what extent it occurs, but above all in terms of its dynamics, i.e. the ways in and forces through which the activities of firms and other organisations lead to innovation and the accumulation of innovative capabilities.

From a methodological point of view, the radically contradictory conclusions with respect to the present stand of East European innovative strength suggest that methodological diversity is to be encouraged. While formal theories have already developed with respect to many problems within, for example, 'transition economics', it is not at all clear what the general qualities of the innovative process in these extreme conditions actually are. The continuing debate has in this paper been referred with respect to, for example, the unclear role of inherited competencies in post-socialism and the influence of foreign investment on the accumulation of innovative capabilities. Nelson and Winter, in their seminal work on evolutionary economics (1982), argued that in such circumstances, i.e. where there is considerable debate among researchers about very fundamental questions, the traditional formal theorising by economists and others in terms of formal modelling and regressions would have to be complemented by what they called 'appreciative theorising'. From a methodological point of view, this can be interpreted exactly as the opening up for alternative and totally different approaches and paradigms of research. In the case of East European innovation, this means that attempts by economists to construct formal models and carry out advanced regression analyses may have to be complemented by totally different approaches, such as historical narratives or ethnographic studies of organisational transition. Formal models, as Nelson and Winter argued, are to be seen as useful only when they are not in contradiction with results gained from totally different approaches.

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