

HOW TO IMPROVE THE NATIONAL INNOVATION SYSTEMS OF CATCHING-UP ECONOMIES?

Urmas Varblane¹, David Dyker², Dorel Tamm¹

¹University of Tartu, ²University of Sussex

Abstract. The article outlines the main directions of the development of national innovation systems in the new EU member states as the catching-up economies coming from the systemic change. Attempts to copy experience of high income economies in building their national innovation systems are not appropriate and adaptation to systemic change specific aspects are needed. Critically important is to increase the learning capacity of the whole society. It requires detection of the major path-dependency problems of national innovation system and implementation of appropriate policy instruments. Dominating linear innovation model based on thinking and policy making should be replaced by the interactive learning based system. Innovation diffusion management and network should be improved. A balanced approach between high and low tech industries is needed. Next to the technological competence the improvements in managerial and organisational competence are requested.

Keywords: national innovation system, catching up, convergence, path-dependency, systemic problems

1. Introduction

After going through the painful process of restructuring during the 1990s the large group of transition countries reached the catching-up stage of economic development, which means that their income level gap compared with rich industrialised countries is going to narrow down. As an example the real income level per capita in Estonia compared with EU-15 average has increased from 31% in 1995 to 52 % in 2005 (Varblane 2006). It is widely accepted that economic development depends on the technical and organizational change brought about by continued processes of innovation (see e.g. UNIDO 2005). Currently the major strength of the catching-up economies is still located in their relatively low production costs. But as those countries move up the development ladder and undertake more complex activities they need to upgrade their technological capabilities and undertake more advanced forms of innovation.

Therefore systemic approach toward the management of innovation processes and the concept of national innovation system has moved into the centre of policy-making in the new EU member states. But often policy-makers have not understood that an innovation system concept could not be transplanted to the other country without adapting it to the local economic, social, cultural and other frameworks. In the case of the new EU member states there exists a common element of path-dependency – all those countries have passed through systemic change and should take into consideration the influences from the past command economy system. On the other hand, the new EU member states are latecomers in the sense of being able to benefit from using innovations worked out by the leading industrialised countries. Therefore the new EU member states are representing an interesting case of potential combination of advantages and disadvantages of being catching-up economies and latecomers at the same time.

It is widely accepted that innovation is among the major roads for firms and nations to remain competitive and follow a sustainable development path. The role of knowledge in generating competitive advantage has steadily increased. The ability to generate new knowledge requires the knowledge-based system of innovation and it presumes the existence of active learning by all actors of the innovation system. Organizations are important actors in the national innovation system and they need to maintain permanent capability to learn and change if they want to survive and develop. The increase of the learning capacity is particularly important for the catching-up economies as they could obtain new technology from other, more developed countries but they have to learn and innovate in order to use new technologies efficiently. As the catching-up countries move up the development ladder and undertake technologically more complex activities they need to upgrade their organisational capabilities as well. Otherwise the lack of soft skills (managerial, organisational) could be among the the most serious barriers of development in those economies.

Therefore the current paper is going to tackle the path-dependency problems in the national innovation systems of the new EU members as the catching-up economies coming from the systemic change. The implementation of the well-functioning learning process in the organisations of the catching-up economies requires detecting of the major lock in problems on the level of national innovation systems and the use of appropriate instruments to eliminate those problems. The structure of the current paper is designed according to this task. The first section opens the development of the concept of the national innovation system, its elements and function. The second section is devoted to the applicability of national innovation system approach in different groups of countries. The next section is opening the advantages and disadvantages of catching-up economies as latecomer economies. The fourth section is going to reveal the major path-dependency related problems in the building up of the national innovation systems in catching-up economies. The concluding section summarises the findings and presents recommendations for using appropriate policy measures.

2. Development of the concept of innovation system

In 1982, C. Freeman from the UK used for the first time the term ‘national system of innovation’ (Freeman 1982, Carlson 2003) and rather similar ideas were developed by B.-A. Lundvall in 1985 in Denmark. The common denominator was the understanding that the innovation process should be treated in a systematic manner. As Lundvall recalls: “It seemed obvious that most of the new knowledge needed for innovation did not come directly from universities and technical research and in many industries not even from research and experimental development but rather from other sources like production engineers, customers, marketing, etc. The problem was to integrate these broader contributions into a concept of the innovation process” (Lundvall et al. 2002:215). Based on those principles Lundvall (1992) defined an innovation system as “the elements and relationships, which interact in the production, diffusion and use of new, and economically-useful, knowledge.”

Those findings were further developed and supported by the results of different empirical works (Lundvall 1992, Nelson 1993). Research group headed by Nelson compared the national innovation systems of 15 countries, finding that the differences between them reflected different institutional arrangements, including: systems of university research and training and industrial R&D; financial institutions; management skills; public infrastructure; and national monetary, fiscal and trade policies. By the late 1990s, OECD had initiated broad comparative country-wide study of national innovation systems (OECD 1997, 2002), which produced support to the ideas of Charles Edquist (2001) and Jack Metcalfe (1998), that national innovation system is a comparative concept – there could not be an ideal national innovation system, which fits different nations with their specific socio-economic, political and cultural background.

Discussing the definition of the innovation system concept, it is important to keep in mind that originally Lundvall distinguished between the narrow and the broad definition of innovation system. Following Lundvall (1992:12) the narrow definition covers only “organisations and institutions involved in searching and exploring – such as R&D departments, technological institutes and universities”. The broad definition covers “parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and adapting” (Lundvall 1992:12). Innovation performance is therefore influenced by the knowledge infrastructure, institutions, demand and supply etc. A broad meaning of the national system of innovation presumes that innovation is seen as a continuous nonlinear cumulative process involving not only radical and incremental innovation, but also the diffusion, absorption and use of innovation. The dynamic properties of the system—robustness, flexibility, ability to generate change and respond to changes in the environment are also listed among its most important attributes (Johnson et al. 2003).

The idea about a systemic approach to the study of innovation process was rapidly accepted among scholars. Quite soon it was understood that innovation

system concept need not be limited to national boundaries and several other complementary approaches were subsequently developed, including regional, sectoral and technological innovation systems. The ‘technological systems’ focusing on innovations in particular techno-economic areas was worked out in Sweden by the working group headed Bo Carlsson (Carlsson, Stankiewicz 1991, Carlsson 1995 1997). The notion of ‘sectoral systems of innovations’ was launched in 1997 (Breschi and Malerba 1997). In order to emphasize the importance of regions in the process of innovative activities, the regional innovation systems concept was developed (Cooke 1992, 1996). In general the innovation systems concept has created an impressively rapidly growing stock of research with approximately 1000 publications (see overview in Carlsson 2003).

Innovation systems work through the introduction of knowledge into the economy, which requires active learning by all actors of the innovation system. Lundvall (1988:362) noted the role of learning in binding together production and innovation in the national system of innovation and as the promoter of dynamism in a system. According to Lundvall’s views the national systems of innovation are the learning systems of national economies (Lundvall 1992, 2002, 2003). The efficiency of these learning activities and, hence, the performance of the innovation systems depends of economic, political and social infrastructures and institutions. But in the national innovation system framework institutions are not organisations, but they are understood as the rules of the game. Organisations are the actors that interact. From this perspective, innovation is a matter of interactive learning (Edquist et al. 1998). It also depends on past experiences (so-called path-dependency or lock-in) as they are reflected in the tangible and intangible aspects of the structure of production and on values and policies.

3. Applicability of the national innovation system approach in developing and catching-up economies

The innovation system approach was worked out using experiences of high income societies, with strong accumulated knowledge base, well-functioning market system, developed institutional and infrastructure support of innovation activities. In addition the innovation system model was worked out for the countries, which developed under conditions of moderate growth. The situation of catching-up economies is rather different. They have much lower income level and less accumulated knowledge. On the other hand, they possess extremely high dynamism, which sets special requirements also to the innovation system. In addition, the foreign direct investments in the current catching-up countries are playing much more important role than in the rich industrialised countries applying the national innovation system concept. Therefore the relationships between globalisation and national/local systems need to be further researched. Based on the above presented differences and following the whole logic of innovation systems approach, it is not possible to automatically transplant an

innovation system concept worked out on the basis of the technology of frontier countries such as Scandinavia or UK, to the catching-up economies in Europe or in South-East Asia.

Gregersen et al. 2001 and Johnson et al. 2003 proposed that when applied to the developing countries, the focus ought to be shifted in the direction of system construction and system promotion. However, the majority of applications of the innovation system framework to development attempt to transpose a well-functioning innovation-system model based on developed countries into developing countries (see discussion in Arocena and Sutz 2003). Such an approach tends to overlook the specificity of the local institutional context and its inadequacy in fostering learning and innovativeness in firms (Parto et al. 2005). For example, in the innovation systems literature, there is relatively little analysis of institutions acting as obstacles to innovations. But it is commonly the case in the catching-up new EU member states. Therefore instead of copying the adaptation of the innovation system, a different approach is needed in those countries. In order to meet the challenge of adaptation the innovation system for development processes, the interpretative alignment framework was suggested by Kim and von Tunzelmann (1998) as the 'alignment' of different levels of interaction at different territorial scales of governance, i.e., sub-national, national, and supra-national. They propose 'alignment' of different levels of interaction at different territorial scales of governance, i.e., sub-national, national, and supra-national. Their work presented an example how the development of Taiwanese or South Korean IT industries may be explained through the role of policies that have been oriented to the alignment of external relations, the national innovation system and the local technological system.

4. Advantages and disadvantages of latecomers

The following section is trying to figure out specific aspects of the catching-up process, which are relevant in designing national innovation systems for latecomer economies. Among the first systematic attempts to analyse the catching-up process were work of Gerschenkron (1962) about the late 19th century German and Russian steel industries. He argued that late-comer firms have several advantages against firms from the frontrunning countries. They could acquire and use the modern technology at much lower costs by transfer agreements, inward investment and the recruitment of skilled people. In addition the leading firms and countries had already created a growing world market so that the catch-up firms did not have to face all the uncertainties, costs and difficulties of opening up entirely new markets (see detailed analyses in Freeman 2002).

But Bell and Pavitt (1993) pointed also to the weaknesses in Gerschrenkron catch-up theory. It is not sufficient for the catching-up country simply to install large plants with foreign technology – technological capacity is also needed. It requires wide implementation of active learning policies. Hence they brought in a

wider perspective – the latecomers also need a properly working innovation system.

Gerschenkron's theory of latecomer advantages was further developed by Abramovitz (1994), who agreed about the outlined potential for catch-up by latecomers, but suggested that exploitation of the potential is not an automatic process. He proposed that the differences in the countries' abilities to exploit this potential might be explained with the help of two concepts: technological congruence and social capability. The first concept signified the degree to which the leader and the follower country resemble in areas such as market size, factor supply, etc. The second concept points to the capabilities that the developing countries have to acquire in order to catch up, especially the improvement of education and business infrastructure (see discussion in UNIDO 2005). A widely accepted concept in the literature in this context is 'absorptive capacity' defined as "the ability of a firm to recognise the value of new, external information, assimilate it and apply it to commercial ends" (Cohen and Levinthal 1990: 128).

Further Christopher Freeman (2002) linked the findings of Abramovitz about technological congruence and social capability with the ability to make institutional changes. He expressed it as follows: "The huge divergence in growth rates which is so obvious a feature of long-term economic growth over the past two centuries must be attributed in large measure to the presence or absence of social capability for institutional change, and especially for those types of institutional change which facilitate and stimulate a high rate of technical change, i.e. innovation systems" (Freeman 2002:191–211). Recent developments in East-Asia have clearly indicated what an important role is played by the institutional changes. Those countries have successfully introduced the mechanisms of the necessary institutional change required for bridging the 'learning divide' or the 'technological divide' (Arocena and Sutz 2003).

Several authors have also pointed out the importance of geographical and cultural proximity to leading technology nations for the successful catching-up process. Freeman (2002) brings an example how Britain was caught up and overtaken by European countries and overseas countries with British and other European immigrants. The most successful catch-up countries in East Asia have been geographically and also partly culturally close to Japan, which has played an important role as the source of innovation diffusion into those economies.

Perez and Soete (1988) also indicated the potential disadvantages of latecomers. They attacked Gerschenkron's ideas and convincingly showed that scale economies are industry-specific and technology-specific. In many industries design and product development costs are much more important than scale economies in production. Perez and Soete (1988) stressed that the effective catching-up process in technology requires science and technology infrastructure as the costs of imitation could be rather high in the absence of such infrastructure.

Still, the main idea raised by Gerschenkron about imitation as the major latecomer advantage could be seen as a valuable input into the reasoning about the cornerstones of innovation system for the catching-up economies. Imitation is

usually easier and less costly than innovation. A very big gap in technology enhances the potential for a rapid catch-up process. But it is only the potential. Only those latecomer economies succeeded, which created a wide diffusion process of innovations (UNIDO 2005).

The experience of some East Asian countries compared with Latin America has clearly shown the importance of the technology diffusion management. Two major directions of technology diffusion are through the market-induced imitation and organizationally-induced technology transfer. But as Matthews (1999) explained – such a framework fails to fit the reality of the achievements of East-Asian latecomer firms, which have integrated into the high technology industries. Instead of passive diffusion, they implemented an active model of the technology diffusion management, which leveraged those innovations and quickly turned into technological capabilities and competitive products. Particularly strong has been the East Asian innovation system in building institutions needed for latecomer economies lacking resources and advantages other than temporary cost advantages. It was aimed to identify the resources that are most available and most enabling leverage. Instead of establishing typical R&D support institutions suggested by the experience of high income economies, they developed a whole network of institutions for technology diffusion and also organisational capabilities management.

The creation of such an institutional framework means that firms do not have to leverage and learn on their own, and that the results of earlier experiences with collaborative dissemination can be used to improve the outcomes. This process was called ‘economic learning’ and it follows the reasoning of Lundvall (2003) about the learning being the central element of the national innovation system. Matthews has introduced a special term to describe the institutional framework in East Asia as a “national system of economic learning”. (Matthews 1999)

But experiences of the East-Asian latecomers could be not copied automatically by the EU catching-up economies, as during the last decades the conditions for catching-up changes have become more demanding about the technological congruence. Fagelberg (2005:535) showed how the radical change in technology requires much higher absorptive capacity from the catching-up economies.

5. Problems in building up national innovation systems in catching-up economies as the reflection of path-dependency

The following section analyses the problems around the building of the national innovation system in a specific group on latecomers – catching-up economies in Eastern Europe. In addition to the latecomer advantages covered in the previous section, they share the common history of coming from a totalitarian system with planned economy which has affected the whole logic of building up the national innovation system. Many researchers believe that a large part of the inefficiencies and ineffectiveness of national innovation systems may be related to

path-dependence and lock-in situations, such as characterized by evolutionary and historical economics (see Niosi 2002). Therefore the first and common problem in the building up of national innovation systems in catching-up economies could be the path-dependency. Path-dependence processes are characterized as phenomena whose outcomes can only be understood as part of a historical process. But those outcomes are not necessarily optimal.

In the case of the catching-up new EU members, the path-dependency should be first of all examined already on the level of a whole system of innovation. The change in the late 1980s was clearly a systemic change, where the majority of components of innovation system changed, but at different speed. Some components were easier to change than others. For example the replacement of fixed assets was executed within a limited number of years, but the institutions' guiding economic transactions such as trust could be introduced only gradually within decades. It created obvious misfits between the components of the innovation system. In addition, in many cases the analyses of different strategic development documents in the catching-up new EU member states creates an impression that the policy makers do not want to see the current situation objectively. Wishful thinking type of behaviour and neglecting path-dependency is very dangerous, because the proposed action plans are inadequate and not implementable. Radosevic (2006) has proposed that the very low involvement of researchers in the analytical support of preparing strategic documents could be an important factor explaining this attitude.

The following part of the section outlines the major problems in the building up of national innovation system as the reflection of path-dependency:

- 1) underestimation of the role of public sector in the national innovation system
- 2) dominating role of the linear innovation model and neglecting demand
- 3) confrontation between high- and low-tech industries
- 4) overvaluation of the role of foreign direct investments
- 5) lack of social capital and network failures
- 6) weak innovation diffusion system and low motivation to learn

5.1. Underestimation of the role of public sector in the national innovation system

The fundamental consequence of the command economy in catching-up economies is a widely spread understanding that implementation of free market and minimisation of the role of state will automatically lead to success and rapid economic and social convergence. This reasoning is a clear indication of the movement from one extreme situation with heavy interventionism to another end of the pendulum of ultraliberalism in the converging economies. Tunzelmann has convincingly indicated that the market-based systems are not sufficient to induce semi-automatic sustained growth, and development process is not linear but multidimensional and multilateral (Tunzelmann 2003, p.1). Recent UNIDO report concluded: "Public policies have played a fundamental role in these processes and

remain today at least as central to national economic development prospects as they have been in the past, particularly with regard to competence-building, including investment in education, training and research institutions..." (UNIDO 2005)

Even in the case of accepting the role of public policy in the innovation system, the catching-up economies often pursue imitation without analysis. "In many countries, policy-makers are simply doing similar things to what has been done previously in other countries or in the same country" (Edquist 2001:19). Examples include the many national technology programmes in the field of information technologies, new materials and biotechnology. A consequence is that variations in national characteristics between countries are often not taken into account.

Another problem area is the negative attitude toward the need of planning in catching-up economies as the reflection of the past. Joining the EU and the request to prepare several mid-term planning documents of using EU structural funds, has been an important factor in changing this attitude. But the need to coordinate the allocation and use of EU structural funds has moved ministries of finance into position of superpowers in the majority of catching-up economies. They become decision-makers in various fields of economic and social development and the negotiating power of other governmental institutions becomes rather limited. But the development of a well-functioning innovation system could be seriously hindered if the approach is completely driven by monetary decision. An innovation system approach should be the vehicle to reduce contradictions between the growing need to focus on the long term competence building in the economy as a whole, and the current short run monetary approach. Therefore catching-up economies badly need to establish organisations that are able to provide analytical support for the medium and long run development problems and are free of direct political pressure. It is highly relevant in order to improve the policy-making competence. The need for the growth of importance of planning and practical skills is equally important on the firm level.

5.2. Dominating role of the linear innovation model and neglecting demand

Already Hanson and Pavitt in their early comparative paper about the R&D and innovation in command and capitalist economies identified an extremely strong bias toward linear innovation model in the communist block countries (Hanson, Pavitt 1987). Under the central planning system the linear innovation model was a convenient tool for coordinating innovation processes (Radosevic 2003). The whole technology development was concentrated into R&D institutes performing fundamental research, which had mainly a military purpose (Freeman 2006). At the following stage, applied research institutes transformed basic research results into useable production technologies and products. Firms were passively waiting for technology to be developed in upstream institutes and they had no incentive to adapt or utilize new technologies (Watkins, Agapitova 2004:40).

As a logical consequence of the above described dominance of the linear model, the command economy system did not cultivate a demand for technology

by the enterprise sector. The demand was replaced by planning authorities (GOSPLAN in Soviet Union). As a result the enterprise sector was divorced from both the supply and demand for technology (See Watkins, Agapitova 2004, p. 41). It resulted in the extremely low mechanisms of variety generation and selection (Högselius 2005).

After the systemic change in the early 1990s the role of linear innovation model still remained the prevailing innovation model for the policy-makers in transition economies. It has taken the form of the mystification of the role R&D, which reflects the misunderstanding about the mechanistic relationship between increased R&D spending and higher per capita GDP. R&D and innovation are often used as synonyms among the policy-makers in catching-up economies. The higher the expenditures on R&D, the higher is the innovativeness of society expected to be. Unfortunately this fetishism of R&D has been cultivated also in many recommendations given to the transition countries from various consultants and even in the EU recommendations. Indirectly this attitude is also supported by various rankings, scoreboards and other comparative tools, where due to the lack of other appropriate measurement variables the R&D expenditures and similar indicators are playing the central role.

The majority of the new EU member states are such small countries that even in case of increasing their relative R&D expenditures to the level of world leading countries, the domestic research potential is extremely limited. It could not alone solve the problems of upgrading the technological capability and productivity of the main economic sectors of those countries. A rapid increase of R&D expenditures without significant reforms in the structure of R&D spending would be a misallocation of resources. The experience of Finland, Ireland and Korea revealed that the increased R&D spending and GDP per capita goes together with the growing share of private sector R&D. But firms in catching-up economies often do not work on the technology frontier and hence they do not feel a need for R&D as the productivity growth does not require R&D. Instead, they should be at first helped to move closer to the productivity frontier through the innovation diffusion system and afterwards they start to invest into R&D.

In addition the role of R&D in catching-up economies is sometimes misunderstood. Next to the generally accepted role as the initiator of science push type of innovations the national R&D activities in small catching-up economies should be used in the role of maintaining an adequate knowledge base and together with supporting networks should support the knowledge diffusion process.

5.3. Confrontation between high- and low- tech industries

Due to the dominance of the linear model of innovation among policy-makers in catching-up economies, the opinion that the development of science push type of industries could solve all problems, is widely spread. In strategic documents of catching-up economies the major focus has been on the intention to create new high-technology industries – biotechnology, material technology and ICT (Radošević 2006). Policy-makers tend to believe that high-tech industries are syno-

nymous with the high value added, high wages and rapid growth. Creating high technology industries will automatically help to generate competitiveness and wealth. But the attempt to allocate the majority of resources into the creation of high-tech sector should not be executed at the expense of the support to the competitiveness of the much bigger part of the so-called low-tech economy, which is producing the essential share of production and employs the majority of people. It is important to understand that technology policy plays a different role in rich industrialised and catching-up economies. In the first group the main aim is to produce technologies and in the catching-up economies, to absorb technologies and find new areas of use for new technologies.

The conclusion of the EU-funded PILOT project emphasised that future industrial development in Europe does not depend on making a choice between high-tech and low-tech industries (PILOT 2005). The link between the two groups of industries was convincingly revealed. For example the so-called low-tech industries are crucially important as customers of high-tech sectors in developed economies. It means that the continued viability of the high-tech sector is inevitably linked with the on-going vitality of low tech industries; this is a symbiotic relationship that is often overlooked (PILOT 2005).

Consequently, the policy-makers in catching-up economies, where low-tech or traditional sectors are playing a relatively more important role than in old EU members should focus on the processes of innovation and creativity within firms in all sectors, not just high-tech firms. Otherwise a dual economy might emerge with low wage and low productivity traditional sector providing the majority of employment and GDP, and a small high-tech sector that is relatively isolated from the rest of the economy. A balance should exist between two groups of economic sectors. The Finnish and Swedish examples in the wood and paper industry show how a rich natural resource endowment was used as the foundation on which to build competitiveness and wealth, based on specialization in knowledge-intensive, high value added activities (Viitamo 2001). These examples indicate that the competitiveness is achieved by using high-tech technologies in different segments of mature medium- and low-tech industries.

5.4. Overvaluation of the role of foreign direct investments

The majority of the new EU member states are extremely dependant on the foreign direct investments. The intent of governments was to use FDI as the major mechanism on technology transfer and connection with the global networks and therefore to shift the responsibility for innovation to the foreign investors. This policy has certainly produced considerable short-term gains during the restructuring period. But recent findings cause suspicion about the long-term impact of FDI on sustainable growth. The productivity analyses of export-oriented foreign subsidiaries in Estonia indicated that FDI threatens to lock Estonia into the low cost producer status (Vahter, Varblane 2006).

Inward FDI does not necessarily help the local firms to establish links with foreign customers. Foreign-owned firms often produce mainly for export or for

other subsidiaries abroad. Without specific joint public private initiatives to support local supplier networks, FDI does not automatically provide the local supplier with skills and competence up to international norms. Therefore the innovation system should support the creation of links between foreign and domestic firms. But this process is hindered due to the inadequate capacities of local firms, which make them unattractive to foreign firms. Innovation system should work against the situation, where foreign firms come to use only the low-cost advantage, which means heavy emphasis on increasing the capabilities of local firms. The host country needs to learn to become cumulative. “So long as the principal learning processes are largely confined to the home country of the multinationals such long-term accumulation of knowledge in the converging economies is likely to be restricted” (Tunzelmann 2003:12). Local firms do not have the capacity to learn from foreign companies operating in their neighbourhood. Only the strong local knowledge foundation creates long-term attractiveness of new EU members to the foreign investors. This could help to bring dynamic MNC into those countries whose competitive advantage rests on their strong knowledge basis. It encourages an exchange of knowledge and improves the knowledge base of firms in catching-up economies.

5.5. Lack of social capital and network failure

Current literature has raised the idea about causality between social capital and the speed of economic development, and demonstrates that the existence of social capital has allowed the sharing of knowledge and learning that led to the rapid growth (Putnam 1995). Lack of social capital did not permit latecomer economies to catch up. Lack of trust is a serious barrier to the development of innovation system in economies with the command economy past. Trust cannot be built up immediately – only through repeated routines where all participating actors will benefit in the long run leads to the social capital. The past of the transition period with the political and macroeconomic instability and radical system change has pushed actors to reduce uncertainty and avoid or at least minimize interactions with other actors inside the innovation system. The lack of trust leads to the network failure in converging economies – an argument raised by Tunzelmann (2003). After examining the networked systems he argued that the basic failing in transition countries is not so much ‘market failure’ or ‘government failure’, but pervasive ‘network failures’ (Tunzelmann 2003). These arise due to the absence of required networks or because of weak coordination between the work of different networks. Due to the network failure the method of ‘learning by interacting’ is not working properly in the innovation systems of catching-up economies. Tunzelmann identified three types of failures: the network relevant to a particular resource flow is missing; the network is present but anti-developmental (e.g. ‘nomenklatura’-based) and the networks for different resource flows are mutually inconsistent (Tunzelmann 2003:4). Network failure argument is heavily connected with the following group of problems about the weakness of diffusion in the system of innovation.

5.6. Weak innovation diffusion system and low motivation to learn

Considering the previous discussion we could conclude that the success of catching-up economies largely depends on the capability and willingness of the actors of national innovation system to search, adapt, utilise knowledge produced outside those countries. In this process they need to have skills – to understand the knowledge, be able to use it and to adapt it for creating new knowledge. Nonaka (1991) has indicated that learning about the new technologies requires a significant level of absorptive capacity in order to be able to diffuse technologies produced elsewhere. But the knowledge they need is often not available in codified form. Since effective learning involves both tacit and formal components a key task is to capture and codify – to make learning explicit (Nonaka 1991).

But information about the innovations and technologies is not free and widely available, particularly for small firms. The majority of firms in catching-up economies, however, are small and therefore a mechanism about the awareness of available innovations and access to the relevant channels of communication should be organised (management of diffusion of innovations – in Taiwan or Korea). It will require building up the network of institutions for innovation diffusion management. This system should help to avoid a situation that firms are not able to identify which technologies they need and may therefore use inappropriate technologies. But in the context of latecomer economies with the command economy past, the technology transfer is really a problem of learning.

Many authors have drawn attention to the importance of developing learning capabilities in organisations. Organizations as an important element of the innovation system need to learn and change if they are to survive (Bessant 1999). The critical aspect for the catching-up economies is to increase the learning capacity of the whole society. As Lundvall remarks – ‘rapid learners are winners’ (2002). Hence the future of the societies depends on the success to implement learning (technical, managerial etc.) in organisations. It is highly important to recognize that learning is not automatic – there must be motivation to enter the learning cycle. This is one of the major problems of innovation system in catching-up economies to encourage the understanding that learning is necessary. Here again it is important to conquer the path-dependency in thinking. But in case of high-speed catching-up process (e.g. in Baltic countries) the lack of external stimulus to change becomes also a serious issue. As long as the current business model has produced permanent rapid growth, it is difficult to persuade the actors of the innovation system (not only firms, but also policy-makers, nonmarket institutions) to seriously take up the learning cycle.

Figure 1 is based on the World Bank study, which analysed the technological ability of firms to innovate and their internal willingness to change in Korea. It could be used in order to analyse the situation in catching-up economies. Firms in Figure 1 are distributed into four groups based on the degree to which they are aware of the need to change and the degree to which management is aware of what should be changed and how to go about changing it. At the lowest level are firms without any capacity for technological change and which do not feel any need for

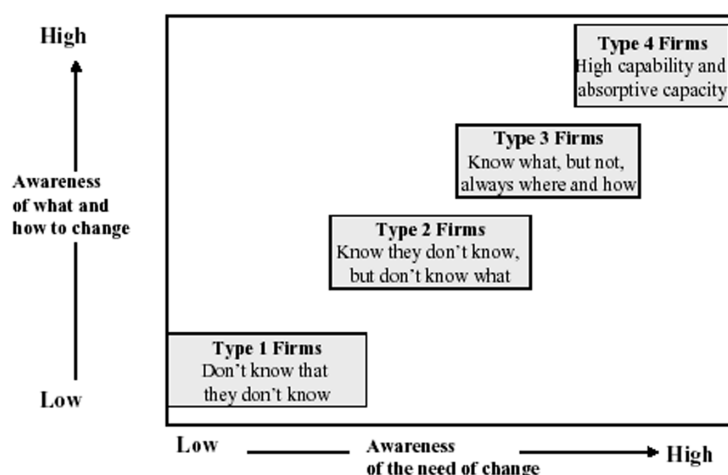


Figure 1. Classification of firms by their technological capability and motivation to change (based on World Bank 2002).

change. That is exactly the case of many firms in a rapidly growing catching-up economies like Estonia. Firms do not need to change because the current business model seems to be good enough.

The task of innovation system in this case should be to move firms up the ladder described in Figure 1. It requires activities in two directions. Firstly, to encourage firms to improve their capacity to absorb technologies from abroad and innovate by providing access to different sources of technologies. Secondly, to improve the internal motivation of firms to change, which requires providing data for firms about their relative position comparing with the best practises in the world.

The advantages of catching-up economies as latecomers described above have created a short-term success, which is reflected in the very low motivation to create learning capabilities. In addition firms often fail to learn because they are isolated and lack support for key stages in the process. Practical evidence suggests that learning can be supported by structures, procedures to facilitate the operation of the learning cycle. It should be an important function of the properly working innovation system. For catching-up economies from Eastern Europe it is also important to remember that innovation system functions successfully, when the learning process is sustainable and could produce long-term high rates of return. Fransman (2000) in his commentary on learning-success stories of East Asia has mentioned: "It is not enough to demonstrate that firms have learned; not even enough to demonstrate that they have achieved internationally competitive outputs. Important too are the longer term rates of return that these learning processes provide since in general it is rates of return rather than rates of learning that drive capital markets, which are a key component of the selection environment of firms" (Fransman 2000:224). In general it means for catching-up economies that market should accept the direction of learning.

6. Policy recommendations and conclusions

After the presentation of the major problems in building up national innovation systems in catching-up economies, the following policy recommendations could be outlined.

- 1) Acknowledge the need to implement strategic long-term oriented approach to the innovation system building instead of short-term financial objectives.
- 2) Linear innovation model should be replaced with the balanced interaction-based approach. Innovation should not be equalised with R&D and much broader focus is needed on all levels of the society, with the understanding that non-R&D dimensions of innovation are equally important for catching-up economies.
- 3) Discrimination of low tech industries allocating the majority of resources into creation of the high-tech sector is not an appropriate policy for catching-up economies. Instead they should be seen in symbiotic partnership – continued viability of the high-tech sector depends on the vitality of low-tech industries.
- 4) Much more attention should be given to the development of the system of absorption and diffusion of knowledge produced both outside and inside of the catching-up economies. On the firms level it requires activities in two directions: firstly, encourage motivation of firms to change; secondly, support the process of building absorptive capacities of the firms. Networking needs to be improved.
- 5) Sustainability of economic development could not be achieved relying only on the innovation activities of foreign investors and their global networks. Integration of local firms into networks of foreign investors should be supported. Selection must be used by FDI policy in catching-up economies.
- 6) Human capital development is important. But investments into the education system and particularly into higher science and engineering educational institutions should be coupled with the growth of employment opportunities requesting those skills.
- 7) Lack of managerial and organisational skills is a very important barrier of innovation in organisations (even more than better access to modern technology) and should not be overlooked.
- 8) Appropriate technology policy methods for catching-up countries could be worked out only after a general audit of technological absorption capacity of the whole population of firms. The results of audit and benchmarking should be widely used inside the national innovation system in order to encourage the motivation to learn.
- 9) Technological path-dependency could be used by catching-up economies not as a threat but as an opportunity. The lock in position in the field of technology could mean that the resistance to change is weak and offers an opportunity to skip the whole generation of technology and introduce new solutions.

Acknowledgments

The authors acknowledge the financial support from the EU 6th framework project CIT5-CT-028519 “U-Know”, the Estonian Ministry of Education target funding T0107 and the Estonian Science Foundation grants 5840 and 6493.

Address:

Urmas Varblane
Faculty of Economics and Business Administration
University of Tartu
Narva mnt 4-226
51009 Tartu, Estonia
E-mail: varblane@mtk.ut.ee

References

- Abramovitz, M. (1994) “Catch-up and convergence in the postwar growth boom and after”. In *Convergence of productivity – cross-national studies and historical evidence*, W. J. Baumol, R. R. Nelson, and E. N. Wolf, eds., Oxford: Oxford University Press.
- Arocena, R. and J. Sutz (2003) “Knowledge, innovation and learning: systems and policies in the north and in the south”. In *Systems of innovation and development*, 291–310. J. E. Cassiolato et al., eds. Cheltenham Edward Elgar Publishing.
- Bell, M. and K. Pavitt (1997) “Technological accumulation and industrial growth: contrasts between developed and developing countries”. In *Technology, globalization and economic performance*. D. Archibugi and J. Michie, eds., Cambridge: Cambridge University Press.
- Bessant, J. and D. Francis (1999) “Using learning networks to help improve manufacturing competitiveness”. *Technovation* 19, 373–381.
- Breschi, S. and F. Malerba (1997) “Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries”. In *Systems of innovation: technologies, institutions and organizations*, 130–156. C. Edquist, ed. London and Washington: Pinter.
- Carlsson, B. and R. Stankiewicz (1991) “On the nature, function, and composition of technological systems.” *Journal of Evolutionary Economics* 1, 2, 93–118.
- Carlsson, B., ed. (1995) *Technological systems and economic performance: the case of factory automation*. Boston: Kluwer Academic Publishers.
- Carlsson, B., ed. (1997) *Technological systems and industrial dynamics*. Boston: Kluwer Academic Publishers.
- Carlsson, B., S. Jacobsson, M. Holmén, and A. Rickne (2002) “Innovation systems: analytical and methodological issues”. *Research Policy* 31, 233–245.
- Carlson, B. (2003) “Internationalization of innovation systems: a survey of the literature”. SPRU, Paper for the conference in honor of Keith Pavitt: What Do We Know about Innovation? Brighton, U.K. 13–15 November.
- Chaminade, C. and C. Edquist (2005) “Innovation policy and innovation systems”. CIRCLE Electronic Working Paper Series, 2.
- Cohen, W. M. and D. A. Levinthal (1990) “Absorptive capacity: a new perspective on learning and innovation”. *Administrative Science Quarterly* 35, 1, 128–152.
- Cooke, P. (1992) “Regional innovation systems – competitive regulation in the new Europe”. *Geoforum* 23, 3, 365–382.
- Cooke, P. (1996) “Regional innovation systems: an evolutionary approach”. In *Regional innovation systems*. H. Baraczyk, P. Cooke, and R. Heidenrieck, eds. London: London University Press.

- Edquist, C., ed. (1997) *Systems of innovation: technologies, institutions, and organizations*. London: Pinter.
- Edquist, C., L. Hommen, B. Johnson, T. Lemola, F. Malerba, T. Reiss, and K. Smith (1998) *Innovation systems and European integration. The ISE policy statement - the innovation policy implications of the 'Innovation systems and European integration' (ISE) research project*. Linköping, Sweden
- Edquist, C. (2001) "Innovation policy – a systemic approach". In *The globalizing learning economy*. D. Archibugi and B.-A. Lundvall, eds. Oxford: Oxford University Press.
- Fagerberg, J. and M. M. Godinho (2005) "Innovation and catching up". In *The Oxford handbook of innovation*, 514–542. J. Fagerberg, D. Mowery, and R. Nelson, eds. Oxford: Oxford University Press.
- Fransman, M. (2000) "Commentary". In *Technology, learning and innovation experiences of newly industrializing economies*, 216–225. L. Kim and R. R. Nelson, eds. Cambridge: Cambridge University Press.
- Freeman, C. (1982) "Technological infrastructure and international competitiveness". Draft paper submitted to the OECD (cited by the help of B. Carlson 2003).
- Freeman, C. (2002) "Continental, national and sub-national innovation systems—complementarity and economic growth". *Research Policy* 31, 191–211.
- Freeman, C. (2006) 'Catching up' and innovation systems: implications for Eastern Europe. In *The knowledge-based economy in Central and Eastern Europe. Countries and industries in a process of change*, 13–30. K. Piech and S. Radosevic, eds. London: Palgrave, Macmillan.
- Gerschenkron, A. (1962) *Economic backwardness in historical perspective*. Cambridge, MA: Harvard University Press.
- Gregersen, B. and B. Johnson (2001) "Learning economy, innovation systems and development". Paper prepared for the ESST Converge project "Strategies and policies for systemic interactions and convergence in Europe – Converge". Aalborg.
- Hanson, P. and K. Pavitt (1987) *The comparative economics of research development and innovation in East and West: a survey*. Chur: Harwood Academic Publishers.
- Högselius, P. (2005) *The dynamics of innovation in Eastern Europe: lessons from Estonia*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
- Johnson, A and S. Jacobsson (2001) "Inducement and blocking mechanisms in the development of a new industry: the case of renewable energy technology in Sweden". In *technology and the market: demand, users and innovation*. R. Coombs, K. Green, A. Richards, and V. Walsh, eds. Cheltenham: Edward Elgar.
- Johnson, B., C. Edquist, and B. A. Lundvall (2003) "Economic development and the national system of innovation approach". Paper presented at the first Globelics conference, Rio de Janeiro, November 3–6.
- Kim, S.-R. and N. v. Tunzelmann (1998) "Aligning internal and external networks: Taiwan's specialization in IT". *SPRU Electronic Working Papers Series* 17. Brighton: SPRU.
- Lundvall, B. Å. (1985). *Product innovation and user-producer interaction*. Aalborg, Aalborg University Press.
- Lundvall, B.-A., ed. (1992) *National systems of innovation: towards a theory of innovation and interactive learning*. London: Pinter Publishers.
- Lundvall, B.-Å., B. Johnson, E.-S. Andersen, and B. Dalum (2002) "National systems of production, innovation and competence building". *Research Policy* 31, 213–231
- Lundvall, B.-Å. (2003) *National innovation systems: history and theory*. Aalborg: Aalborg University Press.
- Mattews, J. A. (1999) "From national innovation systems to national systems of economic learning: the case of technology diffusion management in East Asia". Paper submitted to DRUID Summer conference National Innovation Systems, Industrial Dynamics and Innovation Policy, Rebild, Denmark, June 9–12.
- Metcalfe, J. S. (1998) "Evolutionary economics and creative destruction". Routledge: London and New York.

- Nelson, R. (1993) *National innovation systems: a comparative analysis*. New York: Oxford University Press.
- Niosi, J. (2002) "National systems of innovations are 'x-efficient' (and x-effective). Why some are slow learners". *Research Policy* 31, 291–302.
- Nonaka, I. (1991) "The knowledge creating company". *Harvard Business Review* November/December, 96–104.
- OECD (1997) *National Innovation Systems*. Paris.
- OECD (2002) *Dynamising National Innovation Systems*. Paris.
- Parto, S., T. Ciarl, and S. Arora (2005) "Economic growth, innovation systems, and institutional change: 'a trilogy in five parts'". *MERIT-Infonomics Research Memorandum Series* 21.
- Pavitt, K. (1997) "Transforming centrally-planned systems of science and technology: the problem of obsolete competencies". In *The technology of transition*, 43–60. D. Dyker, ed. Budapest: Central European University Press.
- Perez, C. and L. Soete (1988) "Catching up in technology: entry barriers and windows of opportunity". In *Technical change and economic theory*, 458–479. G. Dosi et al., eds. New York: Pinter.
- PILOT (2005) "*Low-Tech*" *Industries: Innovativeness and Development Perspectives. A Summary of a European Research Project*. H. Hirsch-Kreinsen, D. Jacobson, and P. Robertson, eds. Dortmund.
- Putnam, R. D. (1995) "Bowling alone: America's declining social capital". *The Journal of Democracy* 6, 1, 65–78.
- Radosevic, S. (2003) "Patterns of preservation, restructuring, and survival: science and technology policy in Russia in the post-Soviet era". *Research Policy* 32, 1105–1124.
- Radosevic, S. and A. Reid (2006) "Innovation policy for a knowledge-based economy in Central and Eastern Europe: driver of growth or new layer of bureaucracy?" In *The knowledge-based economy in Central and Eastern Europe. Countries and industries in a process of change*, 259–279. K. Piech and S. Radosevic, eds. London: Palgrave, Macmillan,
- Tunzelmann von, G. N. (2003) "Network alignment and innovation in transition economies". Paper presented at the conference: Innovation in Europe: dynamics, institutions & values. Roskilde University, May 8–9.
- UNIDO (2005) *Industrial development report 2005. Capability building for catching up. Historical, empirical and policy dimensions*. Vienna.
- Varblane, U. and P. Vahter (2006) "An analysis of the convergence process in the transition countries". In *Estonia, the new EU economy. Building a Baltic miracle?*, 19–46. H. Hannula, S. Radosevic, and N. von Tunzelmann, eds. Ashgate.
- Vahter, P. and U. Varblane "Which firms benefit more from inward foreign direct investment?". Manuscript.
- Viitamo, E. (2003) "Knowledge-intensive services and competitiveness of the forest cluster – case of Finland". *ETLA Discussion Paper* 845.
- Watkins, A. and N. Agapitova (2004) "Creating a 21st century national innovation system for a 21st century Latvian economy". *World Bank Policy Research Working Paper* 3457.
- World Bank (2002) "Korea: how firms use knowledge, part A: firm level innovations in the Korean economy". Research report.