Икономически изследвания
Година XVI, 2007, 1

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CHANGING NATIONAL INNOVATION SYSTEMS IN ADVANCED ECONOMIES – LESSONS FOR CATCHING-UP FOLLOWER COUNTRIES

This paper presents the results of a research project undertaken at the Institute for World Economics that focused on changes and institutional innovations in advanced economies' National Innovation Systems. These changes were provoked either by emerging new technologies or by changes in the outside environment that made the reform and the transformation of the institutional system necessary. We tried to identify the factors that provoked changes in the system, as well as the direction of these changes (whether different countries have carried out identical or similar changes). We also investigated the methods, the changes have been accomplished.
The three topics surveyed are the following: institutional centralization; innovation financing; and demand-oriented innovation policy as a complement to the usual supply oriented analyses.
JEL: O31; O32

Economists whose field of specialization is innovation and the economics of technical change as well as economists doing research on competitiveness share a consensus view, namely that the quality of National Innovation Systems (NIS) i.e. the tightness of the linkages, the effectiveness of the system's functioning, the economic embeddedness of the system etc. is one of the most important determinants of a country's competitiveness. The features of the technological development path as well as the actual technological achievements are determined by the quality of the institutions rather than by the amount of money dedicated to R&D, or the innovativeness of a country's engineers.
This consensus view is well demonstrated by a new concept that has quickly spread in economic analyses. Similarly to the term of "revealed comparative advantages" analysts tend to utilize the term revealed institutional advantages in competitiveness analyses[2]. Some researchers compare the various countries' innovation systems with a benchmarking approach and try to establish country ranks in this respect[3].

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[2] Hall, P.A. – Soskice, D.W. [2001]: Varieties of Capitalism: The Institutional Foundations of Comparative Advantage. Oxford, Oxford University Press
[3] See: Porter, M.E. – Stern, S. [2002]: National innovative capacity. In: World Economic Forum. The Global Competitiveness Report 2001–2002. Oxford University Press, NewYork; and European Commission [2002]: Towards a European Research Area. Science, Technology and Innovation. Key Figures 2002, http://www.innovating-regions.org/download/Towards_a_ERA_-_key_figures_2002.pdf

As for the benchmarking methodology, comparing international best practices usually leads to useful and thought-provoking lessons nevertheless it conceals an important fact. National innovation systems are not static institutional arrangements. They are and remain effective if, and only if their institutional composition, as well as the functioning of their individual elements, their incentive systems etc. keep changing as a flexible reaction to changes in the outside environment. The process of change is more complex it cannot be simply described and explained with the well-known phenomena that new priorities emerge, or that new technologies require new institutions. National institutional systems are always related to other economic and social systems like the production system, the regulation system, the financial system etc. In a textbook case, these systems – being tightly related – keep changing at a more or less parallel pace. In the case of co-evolution of technology and institutions complementarities among individual institutional systems generate positive externalities.

Nevertheless, it is more frequent that changes in the outside environment affect individual systems differently. The speed of their reaction to these changes, the speed of their transformation is not uniform, thus the development of one system lags behind that of the other.[4] This hinders the productivity and competitiveness increasing potential of the faster changing, more flexible system. National innovation systems act as "mediators" facilitating the spillover of systemic changes (from one economic or social system of the economy to the other).

Let me give some example to parallel development and also to the case when the development of one economic and/or social system lags behind that of the other. An example to more or less parallel development is the transformation (the greening) of the production technology in the chemical industry parallel to changes in the societies' increasing awareness of environmental values as well as to changes in the countries regulation system, with regulations becoming ever stricter. Another example to the parallel development of technology, institutions and the regulation is the changes in the American system of National Accounts as well as in its generally accepted accounting principles, parallel to the increasing weight of intangible assets both in corporations' investments and in the value creation process. Of course measuring and valuation has not changed yet in all the countries where intellectual capital has gained weight. This makes international productivity comparisons as well as the comparison of other indicators like growth, capital intensity etc. quite difficult and distorts individual national accounts as well.[5]
An example to the development of the national innovation system and of other economic and social systems lagging behind the development of the technology is provided by countries where information technology revolution has produced transformations only in selected systems. Some countries may actively participate in the production of ICT hardware, they may also use ICT in manufacturing and services, but as far as the transformation of social systems induced by information technology revolution are concerned (e-work, e-government, e-learning etc.) they are lagging much behind in this respect. These lags can partially be explained with the relative underdevelopment of the national innovation system.

[4] Freeman [1987] argues that technological change is often very rapid but there is much inertia concerning change in social institutions. Kodama [1995] on the other hand lists many examples of the co-evolution of technology and institutions. (Freeman, C. [1987]: Technology Policy and Economic Performance. London, Pinter Publishers; Kodama, F. [1995]: Emerging Patterns of Innovation: Sources of Japan's Technological Edge. Harvard Business School Press)

[5] See: Corrado, C.A. – Hulten, C.R. – Sichel, D.E. [2006]: Intangible Capital and Economic Growth. NBER Working Papers, No. 11948

A research project undertaken at the Institute for World Economics has focused on changes in advanced economies' National Innovation Systems, provoked either by emerging new technologies or by changes in the outside environment that made the reform and the transformation of the institutional system necessary. We tried to identify the factors that provoked changes in the system, as well as the direction of these changes (whether different countries have carried out identical or similar changes). We also investigated the methods, the changes have been accomplished.

Note, that the transformation of the institutional system is not an easy process. Even in the case of revealed deficiencies, inefficiencies and crises; and even in the case of decision makers' reform commitment, institutional rigidities[6] may prevent changes from coming into effect or may make them short-lived. An interesting example is the long lasting reform process of Russian state-owned research institutions. In spite of the fact that both analysts, politicians and stakeholders have recognized that the excessive fragmentation of the institutions of the Russian Academy of Sciences (RAS) is a disadvantage that may even undermine the performance of R&D and in spite of stakeholders' successive steps to streamline the institutional structure, the process has not advanced much. In 2003 for example, 45 RAS research institutions were closed but at the same time at least as many new research institutes were opened while some existing ones were separated into legally independent bodies.[7]

Let me end this introduction with a telling example that demonstrates that new technologies require new institutions. The U.S. lead in biotechnology commercialization[8] as well as other phenomena of the 'European paradox' (the gap between basic science /academic research/ and technology commercialization i.e. good performance and spectacular achievements in the former field and failures and relatively minor success in the latter) have inspired other advanced economies to initiate institutional changes. A German research project surveyed the country's NIS to find out which institutional elements are responsible for the European paradox. It turned out that dominant part of basic R&D in Germany is carried out by public sector firms, and research results are considered public goods.

The private appropriation of the results of publicly funded research is illegitimate or at least unethical, these results are considered more or less[9] national inventions. This is in sharp contrast with the U.S system where the mental and behavioral attitude of researchers is shaped by institutions like private universities, venture capital firms, and spin-offs. Entrepreneurship and successful commercialization are not only considered valuable in the U.S. but are also promoted with the help of various incentives. The relative poor commercialization performance of biotechnology research in Germany can be explained with technology-specific factors. Biotechnology is a technology based on tight industry-university

[6] See: North, D. C. [1990]: Institutions, Institutional Change, and Economic Performance. Cambridge: Cambridge University Press

[7] Fostering Public-Private Partnership for Innovation in Russia. Paris, OECD, 2005, (p. 61)

[8] Commercialization performance is measured with the number of patents, new products and/or new technology-based startups.

[9] In the case of Germany, the government was entitled to a varying share of revenues generated from publicly funded research.

cooperation, tight links to basic science. Commercialization – more than in the case of any other previous technologies – is carried out by university spin-offs and by new technology based startup firms. While both the American mentality and the American institutional system are highly suitable for the commercial achievements in the field of biotechnology, the German system and mentality are not.
The discovered German institutional specifics have not caused any problems in the case of the commercialization efforts of innovations in the machinery industry, they became a deficiency only with the emergence of this new technology. Lehrer and Asakawa [2004] provide a detailed description of the institutional and mental change – as well as changes in the incentive system – that followed the results of this survey both in Germany and in Japan that has faced similar problems in the field of biotechnology.[10]
This essay will focus on institutional change in three chapters. Chapter one investigates the issue of institutional centralization – currently a hot issue also in the Hungarian NIS. Chapter two also tackles an evergreen question, that of innovation financing and the reform of innovation financing. Chapter three is about the role of demand factors in promoting innovation – given that innovation (economics and policy) studies are usually supply oriented. Chapter four summarizes.

Institutional centralization – a virtue in itself?

Institutional changes are best understandable for both the politicians and the public if they belong to the category of changes in innovation governance i.e. if they become manifest in centralization or decentralization measures. Therefore the instruments politicians employ to accomplish the objective of switching the economy to an innovation-driven development path are often constrained to changes in the governance of innovation, whereby also some public money is also thought to be saved.
Since the necessity of streamlining the structure of basic research is a hot political issue in Hungary as well, we have surveyed whether advanced economies have also faced any problems concerning the governance of innovation and what their solutions were.
It turned out that OECD recently completed a survey on governance issues and summarized the results in a publication.[11] Lessons from the Dutch and the Austrian case studies were particularly relevant for the Hungarian policy decision-makers.
Initially both in Austria and in the Netherlands the decentralized nature of the innovation system was considered highly valuable. Bottom-up project funding dominated the system with a carefully designed division of influence at regional levels. A high degree of institutional independence and the strong involvement of beneficiaries in the steering of funding agencies reduced the risk of wasting too much money for bad projects as well as the risk of excessive political influence. On the other hand it reduced opportunities for strategic priority setting, and increased

[10] Lehrer, M. – Asakawa, K. [2004]: Rethinking the public sector: idiosyncrasies of biotechnology commercialization as motors of national R&D reform in Germany and Japan. Research Policy, vol. 33, No. 6-7
[11] OECD [2005]: Governance of Innovation Systems. Paris OECD

the risk of duplicate research groups. Besides, OECD experts also noted the fragmentation of efforts and of resources in many research domains.
The Dutch science and research community is practically as fragmented as the Hungarian one. There are 13 universities. 18 research institutes belong to the Royal Netherlands Academy of Arts and Sciences, six research institutes to the National Research Council. Besides there are five large technological institutes, four technological top institutes, and 14 institutes that belong to the Organisation for Applied Scientific Research, as well as a number of state-owned research and advisory centers.[12] The situation is similar in Austria and in Ireland as well, namely that too many institutions are involved in agenda setting and in the allocation of funding, which makes the system fragmented and uncoordinated.
The solution for this perceived problem has been in sharp contrast with the reform proposals, politicians are arguing for in Hungary at least in two respects. Firstly, the measures aimed at streamlining the innovation system in these countries have not targeted *the institutions that carry out research*. They did not try to integrate research performers, close some of them and create large integrated units out of selected, previously independent research institutions. They did not intend to close some research institutes belonging to the Academy of Sciences and integrate the researchers of these institutes into university departments. Streamlining and integration aimed at *reducing the fragmentation of the S&T policy institutions* and creating horizontal bodies[13] for strategic priority setting instead of the strongly departmentalized system.
Secondly, the aim of streamlining the system was always that of increasing competitiveness and the efficiency of research and never that of saving some public money. Therefore reform moves have always coincided with the increase of funding. The introduction of new priorities involved minimal reallocation from existing priorities, instead, new resources have been introduced into the system. This minimalized interest conflicts and ensured a relatively smoother realization of the reform. In contrast to this, reform in Hungary is usually driven ahead by fiscal restrictions adopted before the elaboration of any strategic vision.

Innovation financing

Issues related to innovation financing are rarely investigated using a systemic approach in international academic literature. Instead of analyzing the relation between the financial system and the innovation system, the usual question analyses tackle is whether it is bank-based financing or equity financing that strengthens more efficiently the innovation potential of countries or of specific sectors.
Surveying 17 OECD countries and 20 manufacturing industries, Block [2002] argues that industries characterized by high technological opportunity and a focus on product innovation perform relatively better in financial systems with large and liquid stock markets, while the performance of industries characterized rather by

[12] Boekholt, P. de Hertog, P. [2005]: Shaking Up the Dutch Innovation System: How to Overcome Inertia in Governance. In: OECD [2005.a] pp. 179-217 (p.185)
[13] "Horizontalization" included the creation of the position of a chief scientific officer, or the launching of inter-departmental innovation programs, or central funds for the realization of national strategic innovation priorities etc.

process innovations[14] benefits from a more bank-oriented financial system.[15] Using the dichotomy of radical versus incremental innovations Hall and Soskice (op. cit.) make similar arguments. Industries in the case of which incremental innovations (small-scale improvements of existing product lines or processes) are dominant, fare better in countries where the financial market arrangements are dominated by long-term, credit-based financing, by relational banking. Fast-moving technology sectors with radical innovations benefit more from an institutional framework characterized by equity finance. Formulated according to the concepts of the varieties-of-capitalism literature, fast-moving technology sectors fare better in a market-based, shareholder model of corporate governance. This is well understandable, since the availability of equity financing is critical factor for startups being able to become high-growth companies.

Recognizing this, several countries have adopted systematic policy steps aimed at transforming the financial system in order to improve the given country's innovation and technological performance and to support specific high-technology industries. Information technology revolution and the institutional requirements of the new technological paradigm have motivated many countries characterized by a bank-based institutional framework to adopt measures that would shift their countries' financial systems towards equity-based financing. France for example established a new technology oriented equity market (the so-called Nouveau Marché) in 1996, and developed the venture capital industry.[16] The Finnish financial system – traditionally a system with a strong banking sector similar to Germany and Japan – has also been transformed by the end of the 1990s, similarly to other Nordic countries. From a bank-based system it has turned into a stock-market centered system. Stock market capitalization increased rapidly[17] and foreign institutional investors' started to invest actively in Finnish stocks.[18] Venture capital gained weight, promoted partly by public policy measures.[19] Selected signs of institutional convergence can be discovered in Germany as well, such as the introduction of some Anglo-American style of institutions into the financial markets in the second half of the 1990s, or the increasing role of institutional investors, venture capital

[14] Whether an industry is characterized by product innovations and high technological opportunities or rather by process innovations (and relatively lower technological opportunities) is of course the question of the actual life-cycle position of the given industry.

[15] Block, T.H. [2002]: Financial systems, innovation and economic performance. MERIT Research Memoranda, No. 11

[16] Cieply, S. [2001]: Bridging capital gaps to promote innovation in France. Industry and Innovation, vol. 8, No. 2

[17] Average nominal stock market capitalization was 25 % of GDP in Finland between 1991 and 1995 and it rose to an average of 148 % between 1996 and 2000 (68 % without Nokia). For the sake of comparison: in the second half of the 1990s the respective indicator was 51 % in Germany, 68 % in Japan and 142 % in the U.S. Sweden experienced a similarly spectacular increase of stock market capitalization: from 53 % of GDP in the first half of the 1990s to 124 % in the second half. (Source: Hyytinen–Pajarinen [2001]: Financial systems and venture capital in Nordic countries: A comparative study. ETLA Discussion papers No. 774, p. 14)

[18] More than 90 % of Nokia's (a par excellence Finnish company's) shares are owned by foreign investors!

[19] This process was enhanced also by the banking crisis that followed the rapid liberalization of the system in the 1980s. A lending boom in the second half of the 1980s has quickly led to a massive crisis of the banking system necessitating the government's intervention in the early 1990s. See: Hyytinen, A. – Pajarinen, M. op. cit. and OECD [2005]: Innovation policy and performance. A Cross-Country Comparison. Paris OECD

and investment banking.[20] In 1997 Germany also introduced a special segment of the Frankfurt stock exchange for smaller high growth companies, the so-called Neuer Markt to promote equity finance for startups.

When analyzing the relation between changes in the financial system and innovation performance we investigate two issues here: the effects of the increasing role of venture capital and the role of public-private partnership (PPP) programs in promoting innovation.

The case of the USD 100 million venture capital program of Israel (1993-1997) offers some interesting lessons. This program intended to modify the proportions of public and private innovation financing in a creative manner – note that the BERD/GERD[21] indicator is frequently utilized in international comparisons. Israel managed to increase the share of private financing by strengthening the capitalization of the domestic venture capital industry with public funds. Part of the direct public funding of companies' R&D activity has thus become indirect: some companies, e.g. high-tech research-intensive startups receive funding from venture capital companies, and not from the government, i.e. not from the various departments' funds designated for R&D. The other effect of this step was the increase of the funding of technology-based startup firms at the expense of established R&D performing companies. This move was preceded by a systematic survey of the Israeli industries to identify the most promising ones, bound to become engines of growth and technological upgrading. Information and communication technology sector has been identified: an industry, the development of which is driven by new technology-based startups. The surveys emphasized the necessity of institutional change in innovation financing in order to develop this industry. This has led to the described measures of the development of the venture capital industry that focused on new technology-based startups and to the resulting shifts in the BERD/GERD indicator and in the share of startups from overall R&D funding.[22]

The public promotion of venture capital in order to promote new technology-based startups was a highly successful program in Germany as well. Public programs were announced that offered co-investment to, and in some cases provided guarantees for private investment in high-tech sectors. Vitols (op. cit.) reports that with a combination of national and regional programs up to 6 Euros of public money were available to leverage each 1 Euro of private investment in the high-tech sectors.

Another phenomenon of structural and institutional changes in innovation financing is the emergence of PPP programs in this field as well. PPP programs offer complementary resources to innovation financing, but it is not their only advantage. One of their main advantages is that they contribute to the tightening of industry-

[20] Vitols, S. [2005]: Changes in Germany's Bank-Based Financial System: Implications for corporate governance Corporate Governance: An International Review, vol. 13, No. 3

[21] Business Expenditure on Research and Development (BERD) over Government Expenditure on Research and Development (GERD). In advanced economies this indicator is higher than in relatively underdeveloped ones, since in the latter country group business enterprises perform relatively little research, most of the expenditure on R&D programs is financed by public funds.

[22] Avnimelech, G. – Teubal, M. [2005]: Evolutionary Innovation and High-Tech Policy: What Can We Learn From Israel's Targeting of Venture Capital? Paper presented at DRUID 10th Anniversary Summer Conference.

university relations and to the increase of the share of project financing at the expense of institution-financing (block grants) within total innovation financing.
Two short comments are to be made here.
Firstly, project financing versus institutional block grants is not an „either or" question, rather a question of proportions. We cannot claim that in advanced economies competitive project financing predominates or that it is much higher than institution financing. The share of institutional funding in the total income of Czech public research institutions was 41.7 % in 2000, whereas in Finland the respective indicator was 43 %. In the UK universities, institutional funding amounted to 34.8 % of total research funds.[23] For Hungarian research institutes it is particularly instructive that the United Kingdom managed to introduce performance-based criteria for institutional funding. Funds are allocated to research institutions not on the basis of base-year arrangements (inflation adjusted automatic funding) but based on the periodic assessment (peer review) of their strengths. Institutions compete with each other for receiving from a predetermined national amount designated each year for research funding. Like international football teams, they try to hire star researchers, they promise better remuneration for the researcher than he/she actually receives in order to improve the publication record of the institute.[24]
The second comment is related to PPPs' industry-university linkage building effect. PPPs' other beneficial effect is that in this way industry representatives can easier abandon their traditional deeply-rooted belief, which in reality is a myth, that public research institutes' services (especially in the field of social sciences) are free of charge, involving no costs.
Possible PPPs to be introduced in relatively underdeveloped economies include private companies increasing commitment in the development of education curricula and in human resource accumulation which may be manifest in various scholarship and fellowship and research programs aimed at students and lecturers of tertiary educational institutions.
PPPs contribute to demand creation for new technologies (see next chapter). They constitute a cost-effective method of supporting private companies' research efforts and offer more efficient evaluation and monitoring than it is usually the case in purely publicly funded research programs. Governments' role is the identification of programs and potential participants, the elaboration of the incentive framework, the managing of the competitive selection process, monitoring and evaluation (together with the private participants).

Demand-oriented innovation policy

International NIS research has for a long time laid emphasis mostly on supply factors that influence the performance of the system. While innovation economics identifies demand pull factors as well as supply push (technological opportunity driven) elements among the sources of technical change (note that the relative importance of these has long been debated[25]) innovation policy studies and NIS

[23] Source: Governance of Public Research. Toward Better Practices. Paris, OECD, 2003 p. 85
[24] Source: Governance (op. cit. p. 83), and personal interview with an LSE researcher.
[25] See Cohen, W. [1995]: Empirical Studies of Innovative Activity. In: Stoneman, P. (ed.) [1995]: Handbook of the Economics of Innovation and Technological Change (Blackwell, Oxford UK, Cambridge USA) for literature overview, see also the induced innovation literature e.g. Thirtle, C.G. –

approaches have mostly investigated the policies related to the supply factors of countries' technological and innovation potential. The focus of these studies were factors like education, R&D expenditures, and –institutions, bridging institutions and innovation incentives – as determinants of the learning capability and the innovation potential.

Demand factors have also appeared in these studies in the form of user-producer interactions[26] or in analyses of the role of lead users (in a porterian sense – recall Porter's theses on the competitive advantage of nations[27]). Nevertheless the role of demand factors in promoting innovation, in increasing nations' innovation potential has long been considered as secondary in innovation policy studies.

Recently this situation has changed: innovation policy studies tend to pay increasing attention to demand factors. One reason is that today's technologies, in particular information technology and nanotechnology require users' active participation in innovation activity. To be able to absorb the new technologies, to develop its customized applications requires users' investments in co-invention.[28]

Another reason for the increasing recognition of the role of demand in innovation generation is the structural change in the organization of value creation activities. While in the past, most firms used to integrate research and development with other corporate activities (production, marketing, distribution etc.), nowadays, the number of research and development alliances, licensing deals as well as other types of R&D outsourcing arrangements increases at a tremendous pace. A global market for technology has emerged opening new windows of opportunity for selected catching-up economies.[29] This in itself is an issue of utmost importance for innovation and technology policy decision-makers, since differences in the intensity and efficiency of co-invention can in itself partially explain why the rate of technical progress varies among follower countries with identical opportunities to adopt and absorb the new technologies.

The value of individual new technologies differs for the users depending on the costs of adoption, i.e. on the costs and the efficiency of co-invention. If adequate institutions exist that elaborate sophisticated incentives to contribute to the successful adoption of new technologies they may accelerate technological catching-up. If these institutions and incentives are lacking, the probability of falling behind i.e. the probability of technological polarization increases.

One of the main demand-side instruments of innovation policy is public technology procurement. With this instrument policy makers can in principle strengthen domestic entrepreneurship, support domestic firms' innovation activity by reducing the risks of innovation. The strengthening of the "national competitiveness" is however not automatic even if public procurement favors domestic firms. There is ample empirical evidence that national champions are bought up by foreign

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Ruttan, V. W. [2002]: Role of Demand and Supply in the Generation and Diffusion of Technical Change. Routledge.

[26] Lundvall, B.A. [1988]: Innovation as an interactive process: from user–producer interaction to the national system of innovation. In: Dosi,G. – Freeman, C. – Nelson, R. – Silverberg, G. – Soete, L. (eds) Technical change and economic theory. Pinter, London, pp 349–369

[27] Porter M. E. [1990]: The Competitive Advantage of Nations. The Free Press, New York

[28] Bresnahan, T. – Greenstein, S. [2001]: The economic contribution of information technology: towards comparative and user studies. Journal of Evolutionary Economics, vol. 11, No. 1

[29] Arora, A. – Fosfuri, A. – Gambardella, A. [2004]: Markets for Technology: The Economics of Innovation and Corporate Strategy. MIT Press

companies, as it happened in the case of the Italian Fiat Ferroviaria, the developer of the Italian high-speed train or in the case of the Swedish Asea in the same industry. The former was bought by the French Alstom, the latter by the German AdTranz. National competitiveness increases as a result of public technology procurement actions only in case national champions' new products acquire export markets as well not only the domestic one. If this is not the case, developmental public procurement contributes only to the domestic diffusion of the newly developed technology. However, the costs of this exercise will be far higher and the process far slower than in the case of purchasing an existing technology at world markets.

Korea chose a hybrid solution when it bought the technology of the French TGV but made it develop further by Korean engineers. In 2004 there were 46 rapid trains in Korea, twelve of which built by the French Alstom and the others were developed by a Korean company. China also chose a similar solution, importing a turnkey project from Siemens and for another track from the Japanese Kawasaki Heavy Industries. Chinese engineers modified and further developed both versions and now a high speed train manufacturing company in Qing-Tao operates at full capacity to serve the future rail tracks that are presently in construction.[30]

We can draw the conclusion that in the case of large turnkey projects like the one of high speed rail construction, the optimal public procurement policy for follower countries is the purchase of existing technology and the promotion of its adaptive development through incremental innovations by local engineers and local firms. This may more effectively contribute to learning and to national competitiveness increase than the financing of the development of the national solution.

Of course, the choice of an optimal public procurement policy is technology-specific. The promotion of national champions through public technology procurement is far more promising in the case of software development or other activities necessitating high intangible and relatively little tangible capital.

Summary

„When geographical shifts occur in world industrial strengths" and new countries take the top positions in the rank of industrial leaders, the explanation of this process is usually the creation of new institutions (institutional innovations) by the newcomers – writes Kodama (op. cit. p. 2). Analyzing the factors behind Japanese success Kodama formulates an interesting research question. His question is whether shifts in individual countries' competitive position is caused by institutional innovations or by the fact that the specific new technological paradigms that emerged as a result of technological breakthroughs fit some socio-economic systems, while other technological paradigms favor other socio-economic systems? The answer is of course both.

Technological opportunities change over time. Some countries' technological specialization may happily coincide with the highest actual opportunities and their institutional structure with the requirements of the actual technological paradigm. In this case their technological and economic performance improves rapidly. Nevertheless, as Vertova found as a result of her historical investigation of advanced economies' technological specialization, there is no single country even

[30] Source: Wikipedia High speed rail (http://en.wikipedia.org/wiki/High-speed_rail)

among the advanced ones either, the technological specialization of which would always coincide with the actual paradigms.[31] In case there is a mismatch between the institutional setup and the requirements of the actual technological paradigm state intervention and the adjustment of the institutional setup becomes indispensable. The more efficient this intervention is and the more flexibly institutions react, the more probable is that the technological performance and the innovation potential of the country improves, so that it can maintain or even strengthen its world economic position.

[31] Vertova, G. [2001]: National technological specialisation and the highest technological opportunities historically. Technovation, vol. 21, No.9