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The Challenge of the Knowledge – Based Economy: The Polish Case

The Features and Requirements of the Knowledge – Based Economy

Contemporary knowledge and its influence on economics

Over the past two decades, average economic growth in the world (excluding cyclical effects) has increasingly resulted from factors other than just labor and capital. Even though the quality of these traditional factors has improved, the role of new, unexplained, factors has grown consistently. These unexplained factors, collectively defined as "multifactor productivity," are responsible for a particularly high and increasing share of economic growth in the United States and some other member countries of the *Organization for Economic Cooperation and Development* (OECD). According to Bassanini, Scarpetta and Visco, [2000, p. 25], "...something is changing in the productivity growth of a few OECD countries, and most prominently of the United States."

Innovation and knowledge are increasingly considered to be the main driving forces behind growth. They are seen as independent factors, and their role is not limited to supplementing traditional factors such as capital and labor.

The latest stage of growth has been referred to as a knowledge-based economy. It has been conditioned by dynamically developing markets, rapidly changing consumer preferences, globalization and international competition. Other key factors include the digitalization of key technologies and the diffusion of information and communication technologies (ICT). This last factor accelerates growth due to the following developments:

– high productivity growth in the ICT technology-producing sector,
– technical progress reflected by ICT equipment applied in other industries.

ICT also produces various network externalities and spillover effects, for example: cost squeezing due to real-time information systems, flexibility and economies of scale enabled by outsourcing, and enhanced distribution efficiency.

Extensive innovation relying on research, together with the changing competitive environment and the above mentioned opportunities offered by ICT, lead to new forms of doing business, namely [Coyle and Quah, 2002, p. 6]:

– networked organizational form (as opposed to hierarchical and bureaucratic),
– services-core structure (vs. manufacturing-core),

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– human and social capital as a source of value (vs. raw materials and physical capital),
– flexible organization of production (as opposed to mass production),
– innovation, quality, speed along the whole supply chain as a source of a competitive advantage (as opposed to reducing costs exclusively through economies of scale),
– alliance and collaboration, outsourcing as relations with other firms (go-it-alone previously),
– broad skills and adaptability (job-specific skills previously),
– lifelong learning (craft skill or degree, one-off requirement),
– collaborative workplace relations (adversarial before),
– employment marked by risk and opportunity (stable before).

These trends have been treated as an announcement of the New Economy in the postindustrial era of uninterrupted and inflation-free growth. Such an approach has been criticized, provoking a debate on the proportion of the old and new components of contemporary development. In particular, objections have been formulated against attempts to overestimate the latest technological advances, in comparison, for example, with the invention of the steam engine or the electrical revolution [Visco, 2000].

Undeniably, information and communication technologies interfere with research and development. According to [Foray, 2004, ch. 3, 4, 5], the actual complementarity between different research fields progresses when research output is distributed among different sites and disciplines. These features, together with the increased costs of research, imply the joint efforts of different centers that work together. Obviously, the existence of rapid and sophisticated codification and communication media enable exchanges crucial for this type of cooperation. Communication facilities also enable new sources of innovation, namely demand among users and problems implied by existing technologies.

Location patterns in a knowledge-based economy

Research and development structures nowadays are only partly dependent on ICT advances. [Sweeney, 2001, p. 12] points out that "the dominant global players are the big multinational corporations, beside whom politics appears like a spectator who wants to demonstrate his influence by wild gesticulations at the sportsground fence." Since the 1980s, multinationals have developed a number of research centers within the "Triad" of Western Europe, the United States and Japan. In the principal fields, usually two or three leading centers exist, competing with one another, and the multinationals tend to maintain their research units in different centers. To ensure additional flexibility, interfirm and interregional technological alliances are created.

As a matter of fact, a large part of the internationalized research of the biggest firms is carried out in the United States. This is especially true of large U.S. companies (90% of R&D activities at home), but also of the largest, relatively internationalized, European firms (22.4% of research abroad, mostly

in the United States). Within Europe, research is concentrated in Germany, France and the United Kingdom [Kuhlmann and Meyer-Krahmer, 2001].

This high concentration goes against the de-clustering hypothesis due to the decreasing costs of information transfer [Foray, 2004] and the apparent footloose-type of research activity. As this requires a highly qualified workforce, projects to establish research centers outside large urban areas in marvelous natural surroundings have been undertaken, but most of them have ended in failure. In fact, the process of innovation, from research to development to application, is a complex one and requires physical interactions. The most obvious interaction is that with universities, mainly because of the exchange of researchers. Some research fields are related to industries and thus tend toward places where they are concentrated (sometimes catalyzed by natural resources, more frequently by liberalization, foreign investment privileges, skilled labor, network externalities and economies of scale). With a growing number of research projects, the inspiration comes from demand and market-side factors, especially innovative customers. Examples include semiconductors, software production and clinical research [Quah, 2001].

All the stages of innovation appreciate a favorable socio-cultural and organizational environment. They require specialized suppliers and services capable of shaping the "research infrastructure" and, last but not least, the supply of venture capital. Obviously, all this would not be possible with a single research center; therefore a cumulative wave of individual decisions is necessary to create geographically concentrated clusters. Innovative firms within such a structure could also secure advantages due to their trust and cooperation, for example in the exchange of tacit knowledge, without losing their competitive drive.

All the above-mentioned factors imply a geographical concentration of research and innovation only slightly modified by ICT. The question is to what extent such a location pattern can be consciously modified. Interactive innovative systems embracing research activities and/or industrial innovators develop slowly and in a path-dependent manner under the existing state of research sector infrastructure, education and industry. They depend on the general culture of society, technology, entrepreneurship and the historical background [Kuhlmann and Meyer-Krahmer, 2001].

The problem is that the accessibility of information does not automatically ensure the absorption of innovation [Foray, 2004, ch. 5]. Between the potential and effective spillovers there is a range of absorptive capacities of the potential user. For this end, it may be necessary to bear the significant costs of an intelligent search and selection of information and of hiring specialists capable of evaluating and using this information. This is particularly true of SMEs, whose absorptive capacities are much smaller than those of multinationals. To an extent, absorptive capacities depend on the geographical proximity of knowledge producers and previous users, who may communicate the necessary tacit or procedural knowledge. This is why the territorial systems of production and innovation are especially important to the implementation of innovation. These structures, in turn, cannot be created by free market solutions alone.

Implementation is usually the weakest part of the innovation chain and needs public assistance [Sweeney, 2001]. This assistance should be "rather enabling without being imperative" [Krupp, 2001]. It is true that no autonomous agent can be forced to absorb innovation, but may be encouraged to do so.

The case is important because Europe is not a leading knowledge-producing region and probably will not be in the future. This is especially true of the new EU members. Their welfare will depend on their ability to absorb knowledge developed in other parts of the world [Kuhlmann and Meyer-Krahmer, 2001].

Policy making in a knowledge-based economy

Unavoidable interactions between the participants of the research, innovation and implementation chain, together with strong externalities, under the conditions of radical uncertainty, expose them to a high risk of lock-in [Elsner, 2001]. Communication between the parties in this field may be compromised by a fear of opportunism [Piore, 2001]. At least for these two reasons, the usual system of coordination based on price signals coming from the market is insufficient. The involvement of some intermediaries and in particular public agents is necessary to reduce uncertainty and enable stable inter-agent relations.

In general, the objective of innovation policy should be to "unlock" the learning and innovation process [Elsner, 2001] without replacing economic agents in their choices and operations.

As to the measures, they should cover:

– supply of infrastructures in the broad sense of the term (some types of research, technological parks, transfer of innovation, education, venture capital)
– creation of relevant institutions.

Undeniably, industrial policy aimed at innovation should ensure relevant institutions to enhance problem-solving, inter-agent coordination and communication.

One of the functions of innovation policy would be that of ensuring general conditions to enable flexible but at the same time secure networks conducive to undertaking uncertain common projects and collective learning. These conditions may embrace the control of the power of the members and avoidance of hub-and-spoke structures, ease of entry and exit, promotion of diversity of structures and agents, and admission of redundant and parallel processes [Elsner, 2001].

The innovation policy may deal with the promotion or direct organization of some types of research difficult to fulfill by the firms themselves as well as building facilities for newborn firms (technological parks) together with ensuring qualified intermediaries for inter-firm communication (for example promoting the transfer of innovation). Enhancement of the education of the local community and of entrepreneurship treated as an asset is, in a sense, infrastructure building. Another necessary asset is finance, so the promotion of venture capital and/or public participation in its structures is also a part of infrastructure building. The same applies to the promotion of communication media and the

verification of the contents of information. The shaping of fiscal rules and the creation of financial assets may also be classified as infrastructure building.

As in problem solving within the innovative process, there is a need for proper cooperation and reduction of opportunism, besides the obvious competitive behavior. A proper public innovation policy should ensure institutional and organizational instruments to promote cooperation and communication. The role of organizations ensuring technology transfer and inter-agent mediation (as well as a search for an adequate partner) – public, or even better, public-private – cannot be overestimated [Harding, 2001]. This mediating role can and should be attributed to technological parks – to not only enable start-ups but also promote learning, inter-firm communication and common problem solving.

The Triple Challenge Facing the Polish Economy

A specific feature of Central and Eastern European countries is that transition, coupled with liberalization and opening to the world, exposed them to the challenges of the New Economy after the demise of the old, non-performing systems and the destruction of previous industrial relations. Statistics reveal that research activities were reduced at the time. Transition meant getting rid of the burden of non-productive research, though it also limited the internal basis for the implementation of new technologies. The transition shock coincided with a massive entry of imported goods and international competition.

The transition to a market economy shaped conditions for the development of the New Economy. The first problem is that of the legacies of the past in the sphere of assets and of the impact of recession and restructuring during this period.

As to the structures inherited from the past, the problem of deficient productivity and the dominant ill-performing sectors of heavy industry and of the inadaptability of public firms is well known. More important, the burden of the past dominates the directions of public assistance, creating the following dilemma:

– On the one hand, technology, education services, R&D investment and infrastructure supporting innovation should be subsidized;
– On the other hand, social expenditures and support for declining enterprises cannot be suddenly discontinued.

Assets inherited from the previous system were mostly outdated, and the early transition period left many research units run down and spun off from industrial networks[1]. Moreover, it cannot be confirmed that the strategy of private economic agents was really oriented towards a knowledge-based economy, either in the case of foreign investors or (though for other reasons) in newly created native enterprises.

Another problem is ideological in nature. In the area of innovation, and especially its absorption, the conditions of success are not the same as those normally occurring in steady and predictable business activities. The endogenous activity of firms is decisive, but, as indicated in section 1, it necessitates some

[1] Strategic investors were required to keep labor, not research units.

assistance from intermediaries, in particular public agents. Due to high risk and specific cooperative requirements, the market mechanism and finances prove to be insufficient. This fact was difficult to accept by the early transition leaders who strove to create a "pure" market economy, without any function of state industrial policy [Kubielas, 2005].

The problem of new technologies is largely common to all EU countries, which poses yet another (third) challenge to Poland's emerging New Economy. Aware of the challenges of globalization, EU members adopted the Lisbon Strategy on March 23-24, 2000, defining the following measures:

- creation of an information society and the proliferation of information technologies in enterprises,
- policy of supporting R&D through programs at the community and national levels,
- supporting entrepreneurship policy (by easing administrative procedures, promoting venture capital and professional training for managers),
- economic reforms aimed at increasing the potential for growth and innovation (by enhancing the functioning of capital markets and liberalizing key sectors of the economy),
- macroeconomic policies aimed at stabilization, growth, employment and structural changes (including fiscal and budgetary policies promoting education, research and innovation),
- modernization of the European social model (to replace it with one based on investment in human capital, active social policies and fighting social exclusion),
- new priorities for national education policies to enable open and continuous education,
- new employment policies aimed at increasing employment, especially in service sectors,
- cooperation among member states to harmonize retirement systems in the face of the problem of aging.

All these measures add up to a long list of deficiencies common to the 15 "old" member states and Poland.

Even though the EU's efforts have undeniably resulted in some achievements [Rodrigues, 2003], official European Commission data show that R&D expenditure in the EU represents only 1.96% of the bloc's GDP, against 2.59% in the United States, 3.12% in Japan and 2.91% in South Korea. Similarly, the EU lags behind the United States in the transfer of research output to industrial innovation and competitiveness.

A 2003 report by the so-called Sapir Group [*An Agenda...*, 2003] goes further (or maybe deeper) than the Lisbon Strategy. Its authors, on the basis of data preceding the Strategy (up to 2000), conclude that the slower growth in most EU countries was due to the inadequacy of the postwar model of growth (especially with regard to the institutions and policies shaping this model) and its poor adaptation to contemporary requirements. This growth model, efficient for a long time, was based on investment coupled with imitation and

diffusion of technologies, along with standardization and large-scale production by giant firms, mostly thanks to the immigration of unqualified workers. This model exhausted its dynamism due to saturated demand and easy transfer to countries with lower labor costs.

The report underlined the importance of innovation for contemporary growth, which requires new organizational formulas, a lower level of vertical integration of firms, higher mobility and flexibility of labor markets, closer ties with financial markets, and stronger relations with higher education and research. The institutional environment should ensure the protection of property rights for innovative companies and an efficient system of education and research. Investment in research and innovation requires an efficient financial system (especially venture capital) and reasonable interest rates. The market for goods should ensure competitive pressure under low entry costs, and the labor market should guarantee easy hiring of skilled employees.

The revised Lisbon Strategy of 2005 focuses on creating growth and jobs through research and innovation efforts combined with various measures aimed at enabling the absorption of innovation by both industry and society (education, market opening and infrastructure for enterprises). These are embodied in recently adopted programs under the Financial Perspective 2007-2013: the 7th Framework Programme for Research and Development and the Competitiveness and Innovation Framework Programme, which focuses on enterprises.

Efforts by the more advanced EU countries to approach the New Economy stage may endanger similar attempts in the Polish economy. For example, there is competition for funds between research and structural policy. Another difficulty for Polish research units and businesses is that they must compete for European research funds with partners from more advanced countries. On the other hand, structural funds must be channeled to enhance human capital, institutions and infrastructure, which offers a chance to reduce support for obsolete industrial structures in favor of more promising projects undertaken by companies and local, regional and central administrations.

The Assessment of the Knowledge-Based Economy in Poland

Getting the measure of research, development and innovation

R&D expenditures are currently limited in Poland. According to OECD data [Main Science, 2005, Table 05], global expenditures on research and development (GERD) in 2003 accounted for only 0.56% of Poland's GDP, while in Germany and in Denmark the figure was 2.55%. France boasted 2.19%, Sweden had 4.27% (in 2001), and Finland reported 3.49%. This means that Poland lags far behind developed European countries in this area. Other new EU members in Eastern Europe are in a better position: R&D expenditures in the Czech Republic accounted for 1.26% of the GDP; Hungary had 0.95%, and Slovakia 0.58% [Main Science, 2005, p. 18]. According to data by Poland's Central Statistical Office [Nauka i Technika, 2005], in 1995-2004 the GDP

share of R&D expenditure in Poland decreased from 0.65% to 0.58%, though spending per capita more than doubled.

R&D in Poland is 61.7-percent financed from the state budget, while the share of businesses decreased to 22.6% in 2004 [Nauka i Technika, 2005, Table 14]. The role of public finances in R&D in Poland is much greater than in developed European economies. In Germany, the share of public finances amounted to 31.1% in 2003; in France the figure was 38.4% in 2002; the Netherlands showed 37.1% in 2002, and Sweden reported 21% in 2001. In the United States, the share is 31.2%. Other Eastern European countries had lower shares as well: 41.8% in the Czech Republic, 50.8% in Slovakia and 58.0% in Hungary [Main Science, 2005, Table 14].

Even though high R&D expenditure is not enough to ensure a high technological level of the economy, spending in Poland was insufficient for the existing network of research units, especially given the high and increasing depreciation of research equipment (77.9% in 2003) and the faulty structure of outlays in which day-to-day expenses are four times higher than investment.

In 2004, 39.5% of current outlays were earmarked for basic research, against 36.4% in 1995. Outlays on development fell to 35.2% and were comparable to those in 2000 in absolute terms [Nauka i Technika, 2005, graph 1.1]. The structure of R&D expenditures shows that industry displays little interest in doing research for its own purposes, though, on the other hand, this data may also illustrate the low efficiency of these projects because of insufficient government control over the quality of practical research results.

By contrast, expenditure on innovation[2] in the corporate sector was relatively high, at 2% of the GDP. It was dominated by outlays on machinery and equipment (59.8%), compared with just 7.5% for research and 2.8% for the purchase of new technology [Nauka i Technika, 2005, Table 2.4]. This seems to indicate that innovation in enterprises mainly covered "process enhancement" due to equipment wear and the need to bridge the technology gap separating Poland from developed economies [Baczko and Pieńkowska, 2005]. The scope of product innovation was much more modest. In 2004, sales of new and modernized goods constituted only 19.6% of overall industrial sales. The only exception were foreign-owned companies, which reported 36.3% [Nauka i Technika, 2005, Table 2.9]. The share of innovative firms in 2004 was 39.0%, compared with an EU average of about 53%. Interestingly, the public sector revealed a higher share of innovative firms (47.6%) than the private sector (37.8%) [Nauka i Technika, 2005, Table 2.1]. The smallest firms were the least interested in investing in innovation [Pieńkowska, 2005, pp. 193-194].

One of the causes behind the low efficiency of Polish R&D is a small number of patents submitted to the European Patent Office. In 2003, EU countries registered an average of 158.5 patents per 1 million residents, while in Poland the figure was only 2.7. While the number of patents registered by

[2] Defined as the introduction of new or considerably enhanced products or of new or considerably enhanced production processes from the point of view of the firm.

Polish research units at home is at a stable level, registration abroad is steadily increasing, which shows that Polish researchers are aware of the importance of protecting their property rights on foreign markets.

There is a striking asymmetry between the number of foreign licenses applied in Poland (337 in 2004) and Polish licenses sold abroad (nine in 2004). This shows that Poland has adopted a passive position of in the worldwide research system. The turnover of license-based goods has recently increased to account for 11.0% of total turnover, with 11.8% for export sales [Nauka i Technika, 2005, Table 2.11].

The progress in the application of telecommunications equipment by industrial enterprises is evident. In 2003, 96.2% of the enterprises had internet access, though they used the Web mostly to make purchases (26.3%) and less often to sell their goods to other enterprises (11.7%) and to consumers (5.2%). This shows that computers and telecommunications are still a poorly exploited asset.

As to the outcomes of the application of new technologies, it is interesting to review the structure of sales by technology level (OECD classification). The share of low-technology sectors is still the highest, at 38.6%, while medium-low technology sectors account for 31.3%, medium-high for 25.6% and high-technology for 4.5%. The shares for technologies at different levels are not the same in the public and private sectors. The private sector is the most (41.2%) dominated by low technologies, though in foreign-owned companies the proportion of medium-low technology is the highest (42.5%). The public sector reveals a higher technology level than the private sector: medium-low technology sectors account for 56.8% of overall sales [Nauka i Technika, 2005, Table 4.1].

The share of high-technology products in Poland's overall exports (2.7%) lags far behind the EU average (17.2%) [Baczko and Pieńkowska, 2005].

All this data shows that the level of technology and competitiveness of the Polish economy is not deteriorating, yet it is still much weaker than in other EU countries.

The role of FDI in technology spillover

In most countries, multinational corporations are the principal driver of globalization and of research and technological progress. But the intensive FDI inflows to Poland in the mid-1990s were mostly aimed at the internal market and the exploitation of labor resources with basic technologies.

The role of foreign investment as a principal channel of technology transfer (along with the transfer of resources for its application) has been considerably overestimated. While companies with foreign capital have won a considerable position in output (accounting for 38.1% of total sales in 2002), their participation in R&D finance constituted only 9.9% of the overall outlays of enterprises for this purpose. That same year the R&D expenditures of foreign affiliates constituted 78.5% of overall expenditures in Hungary, 43.4% in the Czech Republic and 22.6% in Slovakia [Main Science, 2005, Table 64]. This means that the research efforts of foreign direct investors in Poland were substantially below those in other Central and Eastern European countries.

Still, the internal structure of FDIs' R&D expenditures was advantageous: 32.1% of the outlays were dedicated to the aircraft sector, 15.8% were claimed by office machines, computers and electrical machinery; and 11.3% were concerned with pharmaceuticals. In these sectors, FDI outlays exceeded significantly those of Polish companies. Foreign investors visibly focused their research effort on advanced technologies. Even if some multinational companies (such as ABB, Delphi and Motorola) opened their research units in Poland, it was an exception rather than the rule [Stryjakiewicz, 2002]. This policy was due to the inadequate industrial competencies of the local research network and the insufficient skills of local research managers.

While research in Poland was visibly not the choice of multinationals, their efforts to intensity innovation were impressive. Outlays for this purpose by companies with foreign capital constituted 39.6% of overall innovation outlays in industrial enterprises. Outlays on (mainly imported) machinery and equipment dominated. Outlays on training programs were higher than in other companies, while spending on the purchase of new technologies remained limited [Witkowska, 2005]. The local branches of foreign companies developed their technologies, mainly by enhancing their production processes and applying information technologies; but developing these technologies in Poland was not their goal.

The spillover effect was limited as far as the intensity of relations with local producers was concerned, at least in the initial stage of implantation ("cathedrals in the desert"). Still, companies with foreign capital in Poland have changed their strategies over the past five years. Market saturation and recession have forced them to look for export markets. To meet competition abroad, they have improved their technologies and products.

New technology-oriented firms

The technological challenge for SMEs has increased since Poland joined the single European market and opened its economy to global competition. Undeniably, exporting companies cannot exclusively rely on cheap labor; nor can they afford to avoid innovation, at least with respect to their products. Even though, according to the statistical data as indicated previously, small and medium-sized enterprises in Poland are generally reluctant to innovate (they use relatively outdated technology and focus on exploiting their labor cost advantage), there exists a small but growing group of technology-based enterprises.

A study [Martin, 2004] shows that many small high-technology firms have emerged from universities and research centers. Most of them deal with information technologies as their core business. Undeniably, the high qualifications of Polish computer scientists and engineers, combined with moderate wages, play a significant role. Internationalized demand and advancement in communications promote access to global markets.

Other studies among small "success firms" [Sosnowska, 2005] prove that this success is often based on innovation. These companies, deprived of the possibility of pursuing their own research, apply generally known technologies and

solutions, but thanks to the skills and imagination of their staff, they are capable of meeting the individual needs of their customers. Small innovative firms in Poland show features typical of the New Economy: concern for meeting the needs of individual customers, attention to high product quality, telecommunications infrastructure, and the proper selection of employees and their creativity.

The principal barriers to the development of high-technology firms were also subject to scrutiny [Martin, 2004]. It has been confirmed that the main constraints were information and infrastructure shortcomings. In their case, these barriers were much more painful than for less technologically advanced firms, probably because for them information and contacts were more indispensable. Another barrier was a financial one, more painful than in the case of medium-technology firms. The market barrier (difficult access to the client, making it difficult to sell the product) was important as well. By contrast, internal barriers (posed by the production process and the labor force) were less important.

The activities of small technology-oriented firms show that the skills and creativity of individual employees are among the most precious assets of the Polish economy. This is confirmed by factors such as the heavy brain drain to the United States and Western Europe in the 1980s. The type of activity pursued by these firms – adoption of knowledge produced elsewhere and adjusted to individual conditions – is just the type of activity that a medium-sized European country can pursue. This explains why barriers to the development of small technology-oriented firms need to be removed as a priority.

Policies and Institutions Influencing the Condition and Prospects of the New Economy in Poland

The difficulties encountered in the development of the New Economy in Poland are not surprising because most of its determinants (as indicated previously) reveal stronger or weaker deficiencies.

In the area of infrastructure, small technology-oriented firms face an information barrier. Even though most companies in Poland have Internet access and are equipped with computers, some small businesses lag behind. Roughly 25% of Polish households had internet access in 2003. The main problem is the high cost of internet access and an underdeveloped network infrastructure in some regions, especially in rural areas. This is largely due to the continued market domination of Telekomunikacja Polska SA, previously the sole provider of telecommunications services in Poland. The company continues to use some of its old practices, even though it has been privatized with the participation of France Telecom. This means that in reality the previous state monopoly has been replaced by a private monopoly. The newly introduced regulatory framework aimed at liberalizing the telecommunication market has proved to be insufficient to fully admit new competitors [Goldberg, 2004, ch. 7].

SMEs, including those oriented toward technology, also complain about difficult access to outside financing. Expenditures on innovation in industrial

enterprises are 78.9% financed from internal sources (profit and depreciation) and only 15.6% financed with loans [Nauka i Technika, 2005, Table 2.7].

Under a program designed to simplify the national tax system [Kubielas, 2005], the Polish government has removed most of the previously available tax breaks. This may explain why some FDIs, especially those sensitive to fiscal incentives, have been hesitant to open research centers in Poland. Another problem is that the Polish tax system remains complicated, while tax breaks helped enterprises make their investment decisions.

Investment by venture capital funds represented about 0.1% of Poland's GDP in 2001 (the same level as in Austria and Greece, and a little less than in Switzerland). One of the funds, Enterprise Investors, is considered to be one of the best in Eastern Europe [Goldberg, 2004, pp. 46-47]. Venture capital funds invest mostly in existing companies. One reason why they avoid smaller firms is high monitoring costs in the case of dispersed projects. Another problem is that most funds do not wish to expose their owners to excessive risk and their staff lacks the necessary technical skills to assess new technologies. Other reasons why venture capital funds in Poland "fear" small technology-oriented firms include financial market regulations that discourage smaller firms from floating their shares and bonds on the stock exchange. This deprives them of cheaper funds and makes it difficult for venture capital funds to sell the shares of the companies at any time. As a result, venture capital funds in Poland are unable to invest all their resources [Goldberg, 2004, p. 49].

SMEs, with their reputation as high-risk clients, have difficult access to bank loans. Polish banks generally prefer bigger and more reliable borrowers. To an extent, SMEs are helped by loans and guarantees provided by institutions such as the Polish-American Enterprise Fund (PAEF), endowed by the United States Agency for International Development (USAID), and loans from the European Bank for Reconstruction and Development, administered by Polish banks.

The most popular source of external finance for SME innovation are state subsidies (for consultancy and training for new technologies – administered by the Polish Agency for the Development of Entrepreneurship, for the purchase of technologies and equipment from the PHARE fund) and grants from EU structural funds and from the 6th EU Programme of Research and Technology Development [Systemy, 2003, ch. 6 and 7]. In 2003, all these external non-credit sources accounted for 17.6% of innovation finance in enterprises, a level that is considered insufficient.

Poland's European Union accession has led to a considerable amount of EU structural funds, PLN 34.5 billion in 2004-2006 (with the country's 2003 GDP at PLN 816 billion). However, these funds are distributed with a considerable delay, which is largely due to complex EU administrative procedures. Another barrier is the need to co-finance EU projects from the national budget and to pre-finance them (which means the need to cover the expenses involved before actually being refunded by the EU).

Research networks are an important component of the innovation infrastructure. Their capabilities and propensity to cooperate are especially

important to smaller businesses that are either unable or unwilling to maintain their own research units. For this reason, the economy would particularly benefit from research facilities that are capable of adapting foreign technologies to local conditions and of developing them in Poland. Despite this, some of Poland's research units have been abandoned by privatized enterprises since the beginning of transition, and they are now mostly financed from public sources and evaluated according to academic criteria (publications) that are incompatible with industrial requirements. Only a small percentage of the research centers are capable of working out technological innovation and supporting themselves from cooperation with industry.

The public support system and its assessment criteria negatively affect the activities of research units and discourage them from establishing cooperation with enterprises [Goldberg, 2004, ch. 4]. Another problem is a deficient technology transfer system: even if an innovation is developed, hardly anyone learns about that, and it is difficult to organize an implementation process that involves many different entities.

Some of the infrastructure available in Poland has been created over the past 10 years to support entrepreneurship under the auspices of two central bodies: the Polish Agency for Enterprise Development (PARP) and the Industrial Development Agency (ARP). This duality impedes efficiency and cohesion. There are also regional organizations that support newly born enterprises and technology transfer.

In 2004, a total of 53 business incubators and technology centers existed nationwide, hosting 1,018 firms and 11 technological parks [Ośrodki, 2004]. There are also 39 technology transfer centers [Wojnicka, 2005, pp. 84-85]. This number is limited compared with the number of SMEs (about 60,000 businesses with more than nine employees). Moreover, 70% of them were established in regions with declining industry and heavy unemployment, and they were aimed at employment rather than technology objectives. They operated on a short-term basis as real estate facilities renting their space to unemployed individuals who were granted funds to start small businesses. The principal causes for the deficient functioning of these intermediary organizations are their unclear objectives, unstable financing and institutional confusion.

The protection of intellectual property rights was finally regulated in the Industrial Property Act passed in 2000 and amended in 2002 and 2004. However, the definition of intellectual property rights remains unclear. The problem of ownership and financial rights involving innovation is particularly acute in universities and research centers. This especially applies to incomes derived by researchers and their employers. This problem must be resolved as soon as possible to facilitate the transfer of innovation to industry.

A related problem is the enforcement of property rights. In general, Poland is notorious for its sluggish enforcement procedures. According to the World Bank, the time needed to enforce business contracts in Poland is 1,000 days, against 270 in the Czech Republic, 365 in Hungary and 420 in Slovakia. The OECD average is 233 days [Goldberg, 2004, p. 40]. Patent information is

difficult to obtain and courts specialized in patent issues are unavailable for the time being.

Conclusions – Obstacles and Opportunities for the Development of the Knowledge-Based Economy in Poland

In its current state, the Polish economy can only to a limited extent be classified as a knowledge-based economy. The problem is why this is the case and how to remove the principal obstacles to improving the situation. As to the harmfulness of the legacies of the past, the traditional industrial structure is not an insurmountable barrier because of the availability of imported equipment. Still, the insufficient local supply of modern, ICT-intensive equipment is important, first, because it deprives the national economy of rapid technological advancement in this field of production, and, second, because it may imply difficulties in assimilation due to the distant location of the producers and the impossibility of acquiring tacit knowledge.

Another burden posed by the traditional industrial structure of the past is that it limits public aid to developing enterprises in favor of declining industries. This is not an automatic outcome, but one that results from political decisions. The poor condition of tangible infrastructure (especially telecommunications and transport) is also rooted in pre-transition neglect. This permanent shortage, despite 15 years of opportunity, is an outcome of misguided policies. Another inherited feature is the lack of experience in industrial and rewarding research, compounded by inconsiderate choices in financing research units under transition.

Last but not least, the long period of central planning, when any initiative was perceived as quasi-illegal, distorted social attitudes to ownership and individual success, and led to deficient managerial capabilities and a lack of responsibility, trust and fair cooperation in professional relations.

Under the impact of the global environment, including Poland's EU partners, the easy entry of imported goods and the need to compete on larger markets is a threat, but it is also the essence of the knowledge-based economy challenge. At the same time, the EU is a potential source of considerable financial support, but another challenge is the need to make full and rational use of it. On the other hand, EU regulations limit public aid. Its impact may be either positive (subsidies for declining industries) or negative (support for promising regions and advanced industries). Finally, in many institutional matters, EU legal requirements stimulate and have a disciplining effect on Polish legislative initiatives, many of which are incoherent and short-sighted.

The principal challenge to Poland's future position in the New Economy and international competitiveness is the quality of internal policies and institutions. In turn, the principal asset is the flexibility of young entrepreneurs, who can easily adjust to obstacles, and the technical skills of many highly-qualified employees. The problem is how to stop these people from leaving the country, while giving a boost to small technology-oriented firms and encouraging

multinational companies to open research and innovation centers in Poland – instead of passively watching them establish such facilities abroad.

While Poland is unlikely to become a significant producer of new technologies in the future, it can reasonably adapt and implement many of the technologies developed abroad, as demonstrated by the experiences of small high-technology firms.

Currently, many opportunities are being wasted due to inadequate decision-making on public undertakings and institutions. This distorts the conditions and criteria for the operation of the research sector and leaves many problems unresolved, such as those involving the protection of property rights. Another problem is the reluctance of the government to really demonopolize the telecommunications sector and promote less profitable parts of the network (for example those in rural and sparsely populated areas). Coherent policies, proper organization and an institutional environment supporting innovation transfer, adaptation and implementation are still unavailable. Policymakers seem to be distant from being aware of the real problems of companies as the final agents who determine the propensity to innovate.

The crucial problem is inadequate demand for innovation, on the one hand, and the supply of financial resources, on the other. The sense of entrepreneurship among Polish managers is harmed by the lack of education and information and by the strong pressure of uncertainty, which discourages innovation, cooperation and fairness. The high risk of opportunism adds to this uncertainty and impedes the absorption of innovation. Potential financial resources are underutilized due to risk aversion and distrust in the quality and fairness of projects undertaken by companies. The institutional and organizational environment, which insufficiently punishes opportunism and fails to promote cooperation, network effects and managerial skills, together with inadequate education efforts, are partly responsible for this lock-in.

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THE CHALLENGE OF THE KNOWLEDGE-BASED ECONOMY: THE POLISH CASE

Summary

The paper focuses on barriers to the development of a knowledge-based economy in Poland.

The author analyzes views about the knowledge-based economy presented in professional literature. She examines the conditions for the development of the economy, considering changes in geographic factors and economic policy. Her analysis of the knowledge-based economy is based on a presentation of statistical data and reports. Lissowska also considers information on the European Union's plans to enhance research and innovation across Europe.

The analysis shows that the knowledge-based economy is insufficiently developed and differs unfavorably from the state prior to transition and from the average state displayed by other EU countries with a similar level of development. Industrial enterprises display insufficient initiative, with little involvement among foreign-owned companies to create innovation in their research centers in Poland. Small technology-oriented firms have made little effort despite their intellectual potential and possibilities.

The main barriers to the development of the knowledge-based economy include the unfavorable legacy of the period prior to transition and imperfect industrial and innovation policies, along with an inadequate institutional and organizational environment. These imperfections may aggravate the vicious circle of uncertainty by adding to risk avoidance among suppliers of capital and an insufficient absorption of innovation, the author concludes.

To tap the existing intellectual potential and make good use of the growing amount of funds (including EU structural funds and money for research and competitiveness promotion), it is necessary to focus on institutional and organizational tools likely to encourage potential investors and enable them to pursue knowledge-based projects.