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Poland and the Knowledge Economy

Enhancing Poland's Competitiveness in the European Union

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Itzhak Goldberg

**THE WORLD BANK
EUROPE AND CENTRAL ASIA REGION
PRIVATE AND FINANCIAL SECTOR DEVELOPMENT**

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ACRONYMS AND ABBREVIATIONS

CASE	Center for Social and Economic Research
CBOS	<i>Centrum Badań Opinii Społecznej</i> , Public Opinion Research Center
CEEC	Central and Eastern Europe Countries
CEO	Chief Executive Officer
CMEA	Council for Mutual Economic Assistance
EBRD	European Bank for Reconstruction and Development
ECTS	European Credit Transfer System
EIF	European Investment Fund
EPO	European Patent Office
EU	European Union
EUA	European University Association
FDI	Foreign Direct Investment
FIAS	Foreign Investment Advisory Service, World Bank
FTE	Full-Time Equivalents
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditures on R&D
GICT	Global Information and Communication Technologies Department, World Bank
GNI	Gross National Income
GRI	Government Research Institute, See (<i>JBRs</i>) <i>Jednostki Badawczo-Rozwojowe</i>
GSM	Global System for Mobile Communications
GUS	<i>Główny Urząd Statystyczny</i> , Central Statistical Office of Poland
HEI	Higher Education Institution
IALS	International Adult Literacy Survey, OECD
ICA	Investment Climate Assessment, World Bank
ICT	Information and Communication Technologies
IDC	International Data Corporation
IFI	International Financial Institutions
IPO	Initial Public Offering
IPRs	Intellectual Property Rights
ISP	Internet Service Provider
IT	Information Technology
JBR	<i>Jednostki Badawczo-Rozwojowe</i> . [Government research institutes / units]
KAUT	<i>Komisja Akredytacyjna Uczelni Wyższych</i> , Accreditation Commission for Technical Universities
KBN	<i>Komitet Badań Naukowych</i> , State Committee for Scientific Research. See MNiI
KEA	Knowledge Economy Assessment, World Bank
KRASP	<i>Komisja Akredytacyjna Konferencji Rektorów Akademickich Szkół Polskich</i> Accreditation Committee of the Conference of Rectors of Polish Academic Schools
LAC	Latin America and the Caribbean Region, World Bank
LGS	Loan Guarantee Scheme, United Kingdom
MA	Master of Arts
MAP	Multi-Annual Programme, European Commission
MBA	Master of Business Administration
MCI	[A Polish venture capital fund]
MENiS	<i>Ministerstwo Edukacji Narodowej i Sportu</i> , Ministry of National Education and Sports
MNiI	<i>Ministerstwo Nauki i Informatyzacji</i> Ministry of Scientific Research and Information Technology. Formerly KBN.
NIS	National Innovation System
NRA	National Regulatory Authority
NRI	Networked Readiness Index
OCS	Office of the Chief Scientist, Israel
OECD	Organisation for Economic Co-operation and Development
OPIC	Overseas Private Investment Corporation
OSI	Open Society Institute
OTC	Over the Counter [stock market]
PAN	<i>Polska Akademia Nauk</i> , Polish Academy of Sciences
PARP	<i>Polska Agencja Rozwoju Przedsiębiorczości</i> , Polish Agency for Entrepreneurship Development
PC	Personal Computer
Phare	Poland and Hungary: Aid for the Restructuring of the Economy. [An EU Programme.]
PISA	Program for International Student Assessment

Acronyms and Abbreviations

PKA	<i>Polska Komisja Akredytacyjna</i> , State Accreditation Commission
PLOTEUS	European Internet Portal on Learning Opportunities
PMR	Polish Market Research [A research and consulting company.]
PTC	<i>Polska Telefonia Cyfrowa</i> . [Poland's leading mobile telephone operator]
R&D	Research and Development
RIS	Regional Innovation Strategy
RPIC	Regional Patent Information Center
S&T	Science and Technology
SBA	Small Business Administration
SBIC	Small Business Investment Company, U.S.A.
SBIR	Small Business Innovation Research, U.S.A.
SBLA	Small Business Loan Act, Canada
SEBRAE	[A regionally based Brazilian program aimed at providing advice and assistance to SMEs]
SITC	Standard Industrial Trade Classification
SME	Small and Medium Enterprise
SMP	Significant Market Power
SOFARIS	<i>Société Française de Garantie des Financements des Petites et Moyennes Entreprises</i> [A public-private partnership between the French government and the banks]
SQA	Scottish Qualifications Authority
STI	Science and Technology Index, OECD
STPC	Science and Technology Policy Council, Finland
SWOT	Strengths Weaknesses Opportunities and Threats [Poland's patent system]
TFP	Total Factor Productivity
TIGER	Transformation, Integration, Globalization, Economic Research [A Polish think-tank]
TNO	[The Dutch national technology organization]
TPSA	<i>Telekomunikacja Polska S.A.</i> [Leading telecommunications company in Poland]
TRIPS	Agreement on Trade-Related Aspects of IPRs
TTA	Technology Transfer Accelerator
UKA	<i>Uniwersytecka Komisja Akredytacyjna</i> , University Accreditation Committee
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UPRP	<i>Urząd Patentowy Rzeczypospolitej Polskiej</i> , Polish Patent Office
URTiP	<i>Urząd Regulacji Telekomunikacji i Poczty</i> , Office of Telecommunications and Post Regulation
USO	Universal Service Obligation
VC	Venture Capital/Venture Capital institution
VET	Vocational Education Training
WBI	World Bank Institute
WITSA	World Technology and Services Alliance
WSE	Warsaw Stock Exchange
ZUS	<i>Zakład Ubezpieczeń Społecznych</i> [Poland's social security administration]

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EXECUTIVE SUMMARY

The Poland Knowledge Economy Assessment (KEA) aims to provide Polish policymakers with policy options for securing sustainable growth and improving its competitiveness by creating an environment conducive to business development and investment in general and to knowledge generation and absorption via innovation and learning, in particular, as well as by stimulating investment in innovation and in learning systems. The Minister of Scientific Research and Information Technology requested the World Bank to conduct the assessment, in cooperation with a Steering Committee appointed by the Minister. The World Bank team hosted a public consultation process, through which the Assessment's major findings and identified priorities were disseminated.

Productivity, R&D, and Growth (Chapters 1 and 2)

Since the early 1990s, Poland has weathered tremendous political, economic, and social upheavals posed by the transition and pre-accession processes. Although the country has enjoyed seven years of uninterrupted growth at an annual rate averaging over 5 percent, the living standards still remain below those in Hungary and the Czech Republic. When Poland is compared to middle- and high-income countries in the European Union (EU), the gap is substantial. Polish productivity is on average 34 percent that of the EU.

In its 2000 Lisbon Strategy, the European Council has set out a 10-year strategy “to make the EU the world’s most dynamic and competitive knowledge-based economy by 2010.”¹ According to this strategy, research and development (R&D) is one of the main sources of innovation and innovation is one of the key drivers of productivity, which in turn drives cross-country differences in per capita income and growth. To this end, EU member states are urged to increase R&D up to 3 percent of their gross domestic product (GDP). In view of the linkages between knowledge, productivity and growth and in line with this EU goal, this report proposes that increasing Polish R&D from its current level of 0.7 percent of GDP while simultaneously reallocating current budgetary resources more competitively, be a major government policy objective.

This KEA argues that efficient and relevant Lifelong learning systems, Information and Communication Technologies (ICT), institutions and funding mechanisms to support innovative R&D are all essential components of the National Innovation System (NIS). The foremost theme of this report is securing sustainable growth and competitiveness in Poland by stimulating investment in R&D and in appropriate learning systems, which have a key role in developing a country’s *absorptive capacity*—the ability to identify, assimilate, and exploit knowledge from both domestic and external sources. Therefore, policies that support the development of inter-firm linkages, and the capacity to absorb new knowledge that can be gained through such linkages, are crucial elements.

Business Environment For Innovation (Chapter 3)

The impact of these components on productivity and growth, however, depends critically on the business environment in which innovative technology-oriented firms must operate. As shown by the World Bank’s 2004 Investment Climate Assessment, there was a visible deterioration in business activity and the investment climate in Poland by the end of the 1990s. Indicators of regulatory quality showed that Poland lags behind neighboring Accession

¹ European Commission, 2003, Raising EU R&D Intensity

countries and showed no improvement between 1998 and 2002. As small and medium enterprises (SMEs) are an important part of Poland's economy and knowledge economy development, the decrease in 2000 in the number of active SMEs, observed for the first time since 1994, is worrisome. Poland's business environment contains barriers, which affect all businesses but particularly technology-oriented SMEs, such as numerous procedures and relatively high costs associated with business incorporation, unfavorable tax and labor regulations, high level of social contributions, low efficiency of the bureaucracy and of the judicial infrastructure. Specifically, intellectual property rights (IPR) protection and the effectiveness of the Polish Patent Office need to be improved and a national campaign in the SME sector promoting IPRs should be undertaken. IPR ownership issues between researchers and their employers, universities, or institutes need to be resolved to establish incentives for innovation. The business registration process should be simplified to allow for the completion of all necessary registration-related activity within one visit, enabling companies to begin operating effectively immediately. Additionally, the implementation of e-registration, in particular, and e-government services for business and citizens, in general, could greatly enhance the business environment for technology-based SMEs. The high level of non-wage labor costs, in particular the lump-sum contribution on persons starting self-employment, represents a barrier to the establishment of technology-based SMEs and by extension to innovation. However, in view of the dire budgetary situation and the growing costs of social protection for the aging population, it seems unrealistic to recommend reductions of non-wage labor costs in the short-run, although they should gradually decline in the medium term.

Encouraging Private Funding of R&D (Chapter 4)

The instruments described in this chapter, are based on the 2003 EU report, *Raising EU R&D Intensity*, with the view that the proposed instruments qualify as EU schemes. The continuum of indirect and direct measures that a government can implement to influence private R&D investment is presented in the KEA. Our basic proposal to the Polish government is that it should consider a mix of funding measures. The KEA reviews various instruments such as tax benefits, loans, guarantees, government procurement and venture capital (VC) funds and identifies those instruments that are most appropriate for the specific conditions in Poland.

Matching grants for R&D projects by firms—small and/or large firms and by consortia of academics and firms—are proposed because they have proven beneficial in certain countries (e.g., Finland, Israel and even Macedonia). Matching grants would probably be the most advantageous way for Poland to provide incentives for the development of new networks and collaborative linkages between firms and research institutions. The administration of matching grants requires an independent selection process, which runs the risk of undue pressures. To mitigate this risk, many countries devise peer review mechanisms that look to external evaluation of their clusters and programs. There are many international specialists that could be involved in the evaluation of such projects in Poland.

Another preferred role for the government is to seed the VC industry by investing in privately managed funds. In these public-private partnerships, governments mitigate some of the risk inherent in technology-oriented start-ups while the venture capitalist provides commercial and managerial expertise. It should be stressed that VC is not a substitute for grants. The proposed system has grants and VC interwoven: these two are complementary because the grants are needed to fund R&D, which will hopefully yield the ideas (deals) for venture capitalists.

This approach is exemplified in the proposed Pilot Trust Fund, as described in Box 4.2 in Chapter 4. It is essential that, if this option were chosen, the Trust be linked to funding for technical assistance to train the VC industry in technology investments so that it can devote sufficient energy and expertise to this pilot. Moreover, while considering this proposal, an assessment of the potential “pipeline” or “deal flow” would need to be conducted.

We consider the obstacles in the local capital markets, which do not allow investors to exit by selling their stake in early-stage companies. In developed economies, a well-functioning stock exchange, which can provide an exit route for early investors as well as new capital for burgeoning businesses, is essential for the health of the VC market. To make the Polish capital markets more accessible to smaller companies, we propose simplifying the listing procedure for smaller companies on the Warsaw Stock Exchange (WSE) so that it is not as costly and time-consuming. We also propose that pension funds and insurance companies be allowed to invest a small proportion of their funds, say 2 percent, in the pre-initial public offering (IPO) stage alongside VC money and in smaller-cap companies once they are on the capital market.

Building Institutions for R&D and Innovation. (Chapter 5)

Around 200 government research units or *jednostki badawczo-rozwojowe*, (JBRs), still constitute a government-run enclave in the economy. In 2002, the annual budgetary expenditure on JBRs was circa 1511 million zł divided by average ex rate in 2002. In autumn 2003, an inter-ministerial team for ownership transformation developed a structural transformation program for all JBRs. We propose that the Government effect urgent changes along the lines described in this and other reports—consolidation, privatization or closure—as the better institutions among these have the potential to play a valuable role in the regeneration of industrially focused research and the fostering of networks. The other JBRs, which cannot play such a role should be restructured or privatized and, in certain cases, JBRs that cannot be restructured and represent a significant drain on the budget, should be closed down. The KEA presents examples of successful restructuring of JBRs in Hungary and Estonia. The savings from restructuring certain JBRs should be used to elicit private funding for R&D via the measures proposed above: matching grants and public co-funding of the Pilot Trust Fund. Action is also needed to develop skills and infrastructure to facilitate linkages and commercialization. This is entirely in line with the strategies followed by the other members of the EU; the equivalent institutions across Europe have been encouraged to become relevant to the business sector to the point their main funding comes from business—through joint projects, service provision, or core membership fees.

The fiscal cost of the proposals made above, matching grants and the proposed Pilot Trust Fund, is an important consideration in the government's decision whether or not to accept all or some of these proposals. However, one needs to look at the budgetary cost of the entire NIS, as restructuring, merging, and closure of some of the JBRs will save an amount that would presumably (depending on the scope of the program to be undertaken) cover a significant part the cost of a grants program or seeding of the VC industry.

Learning Systems for a Knowledge Society (Chapter 6)

The discussion of learning systems in the KEA shows that Poland needs improved education and training policies to develop the absorptive capacity and human capital necessary for a competitive knowledge society. In the short run, we suggest that a concrete action plan to implement a lifelong learning system be developed with the full cooperation of the various concerned Ministries. In order to broaden the governance structures of the higher education institutions (HEIs) and to involve external stakeholders, we suggest that the draft Law on Higher Education be revisited with a view to requiring HEIs to appoint business representatives on university boards and academic committees. Finally, we propose that incentives to hire, retain and promote qualified staff in HEIs be developed and that the draft Law on Higher Education be revised to consider allowing the employment of academic staff in business or working on R&D projects with business partners.

In the longer term, we propose that, using the analysis of the OECD PISA survey as a guide, further reform of the formal education system should focus on the development and evaluation

of appropriate student outcomes based on the skills and competencies essential for a knowledge society. We encourage HEIs to continue to develop systems for internal quality management with external assessments by the State Accreditation Committee, as and when, necessary. We also propose a number of policy options to improve the financing of tertiary education, including the development of multi-annual strategic and investment plans and the creation of incentives to achieve efficiencies and economies of scale. The development of a funding formula together with a mechanism to improve quality, promote innovation in the educational process and to enhance linkages between the scientific/research community and the business world are also suggested. We propose as well that improved targeted scholarships and student loans be created to address the needs of disadvantaged students and that new strategies be introduced to leverage additional private funding through tuition, private endowments and donations from the business community.

Building The ICT Infrastructure (Chapter 7)

The Polish electronic communications market has been progressively liberalized since 1992. Significantly, despite this process, *Telekomunikacja Polska* (TPSA) still retains over 90 percent of fixed line customers. A recent EU report on telecommunications in Accession countries noted that international long-distance calls in Poland were three times as expensive as in member states, and eight times as expensive when making a call to the United States. There is some uncertainty regarding the functioning of the interconnection framework, without which the linkage of communications networks—that is, the core characteristic and requirement of the ICT environment—cannot flourish. As of 2003, Poland does not seem to have an adequate regulatory and business environment in place to support the diffusion of ICT and this represents a significant obstacle to overall competitiveness and development of a knowledge economy. ICT is the toolkit of the knowledge economy and electronic communications are the engine of the toolkit. Effective competition drives down prices, increases choices and brings forth new services. However, competition can only be sustained by an appropriate regulatory environment. Best international practice regarding the regulatory environment (and a requirement of Poland's EU membership) is the EU *acquis communautaire* for electronic communications. The current regulatory and legal framework does not appear to conform to the 1998 *acquis* and will now have to be updated to take account of the new EU regulatory package of 2002.

A more competitive market will ensure that ICT hardware and software is available in Poland at the best prices by removing any barriers (technical or physical) to trade in these products. Lower prices will allow more cost effective linkages between businesses and greater diffusion of ICT in the business sector in order to enhance productivity and microeconomic competitiveness. The diffusion of ICT will help to build confidence of businesses, households, and civil society in ICT and its usage. Universal access is an interim goal for sector policy. "Smart Subsidies"—at least at their pilot stage—could be used to promote universal access and provision for this approach should be made in any law on electronic communications, following the Guidelines of the European Commission, if Structural Funds are to be used.

The key proposals of this knowledge-economy assessment are regarding R&D, the business environment, learning and ICT:

- As regards R&D and innovation, efforts need to be made to build institutions and provide financial incentives aiming to increase Polish R&D from its current level of 0.7 percent of GDP. Following the experience of other countries and the literature reviewed in the KEA, which suggests that increased R&D and innovation is associated with faster growth, a system of grants and a pilot seed capital fund is proposed. These two are complementary because the grants are needed to fund R&D, which will hopefully yield the ideas (deals) for the seed capital fund. Although several other measures are being used in OECD countries, we consider these

two to be most appropriate given Poland's fiscal situation and the problems of bureaucracy and corruption discussed below.

- As regards the business environment, it should be stressed that an improvement in the business environment in Poland is a necessary condition for raising the R&D in firms. Grants and VC alone cannot succeed in raising private R&D, if entrepreneurs are forced to operate in the current business environment. Therefore, measures addressing entry, social costs and IPR ownership, should be implemented as soon as possible.
- As regards learning systems, efforts need to be made to increase the quality and relevance of the formal education system, ensure the provision of life long learning systems to the entire population and improve the linkages between academia and the scientific and business communities that assist the transfer of technology in other countries.
- As regards ICT, since the telecom liberalization process to date is incomplete, efforts should be made to significantly increase competition in communications and reduce the cost of long distance calls as well as internet access. It is proposed that the regulatory framework be updated to the EU 2002 level and that the capacity and market credibility of URTiP, the regulatory authority, be strengthened in order to sustain competition. The implementation of e-government services for businesses as well as citizens is key in improving the efficiency and competitiveness of Polish business.

1. INTRODUCTION

The Poland Knowledge Economy Assessment aims to provide Polish policymakers with policy options to increase and maintain productivity and growth by creating an environment conducive to knowledge generation and absorption via innovation and learning. The Minister of Scientific Research and Information Technology, Michał Kleiber, requested the World Bank to conduct this Assessment, in cooperation with local stakeholders. The World Bank team working on this report has devised key policy options that the Government of Poland could implement to better position itself for the competitive challenges and opportunities it will face as a new member of the European Union. With assistance from the Poland Knowledge Economy Assessment Steering Committee, appointed by the Minister, and numerous other stakeholders involved in the drafting of this report, the World Bank team hosted a public consultation process to discuss the report's major findings and established priorities.

Poland has weathered tremendous political, economic, and social upheavals posed by the transition and Accession processes. Although the country enjoyed seven years of uninterrupted growth at an annual rate averaging over 5 percent, the living standards remain below those in Hungary and the Czech Republic. When Poland is compared to middle- and high-income EU countries, the gap is substantial. Polish productivity in 2002 amounted to on average 34 percent of EU productivity (Figure 1.1)



In its 2000 Lisbon Strategy, the European Council set out a 10-year program “to make the EU the world’s most dynamic and competitive knowledge-based economy by 2010.”¹ According to this Strategy, research and development (R&D) is one of the main sources of innovation and innovation is one of the key drivers of productivity, which in turn drives cross-country differences in income per capita and growth. To this end, EU member states are urged to increase R&D up to 3 percent of their gross domestic product (GDP). In view of the linkages between knowledge, productivity and growth² and in line with this EU goal, this report proposes that increasing Polish R&D from its current level of 0.7 percent of GDP while simultaneously reallocating current budgetary resources more competitively, be a major government policy objective.

The Assessment argues that learning systems, discussed in Chapter 6 below, and Information and Communication Technologies (ICT), and institutions and funding mechanisms to support R&D are all essential components of the National Innovation System (NIS). Moreover, the impact of these components on productivity and growth depends critically on the business environment in which innovative firms must operate. The report explores this interaction within a holistic NIS framework. However, the foremost theme of this report is securing sustainable

¹ European Commission, 2003, Raising EU R&D Intensity

² A recent World Bank study by Lederman and Maloney (2003) shows that R&D effort measured as a share of GDP rises with development at an increasing rate. Their study shows that few countries that displayed impressive R&D take-offs—Finland, Israel, the Republic of Korea, and Taiwan (China)—exhibited high estimated social rates of return, which probably justify their high R&D. Attempting to explain why rich countries invest more in R&D, the authors conclude that financial depth, protection of intellectual property rights, government capacity to mobilize resources, and the quality of research institutions are the main reasons why R&D effort rises with the level of development.

growth in Poland and improving its competitiveness by stimulating investment in R&D and in learning systems, which have a key role in developing a country's *absorptive capacity*—the ability to identify, assimilate, and exploit knowledge from both domestic and external sources. Significant improvement in learning systems (see Chapter 6) and indigenous investment in R&D (Chapters 4 and 5) are required, before a country can benefit from technology transfers.³ We will show below that merely attracting investment in these industries is not enough. Policies that support the development of inter-firm linkages, and the capacity to absorb the new knowledge that can be gained through such linkages, are crucial elements.

One initial clarification is in order: this report will argue and show that a knowledge-based economy is not necessarily an economy based primarily on the production of high technology or ICT products. A number of developed economies are intensive users of new technology or ICT but do not have a production base. As will be stressed in Chapter 7, it is the optimal use of ICT, rather than its production, that is crucial for immediate increases in efficiency and developing new markets. For example, Australia has little in the way of ICT production but significant ICT investment generated productivity gains and growth. By contrast, some of Australia's East Asian neighbors have large ICT production capabilities but as ICT goods and services are not widely diffused in their economies, these countries do not reap productivity gains from ICT.

The KEA proposals regarding matching grants and the proposed Pilot Trust Fund could be considered for potential support under the relevant EU schemes for Poland. The EU's support for R&D, through its Structural Funds for developing areas in lower income countries that entered the EC 10 to 20 years ago (Ireland, Greece, Spain, Portugal) has been very important for the development of a number of regions in those countries.

³ See Kinoshita (2000) studied absorptive capacity in a sample of Czech firms.

2. PRODUCTIVITY, R&D, AND GROWTH IN POLAND

Structural Changes in the Economy

After record achievements made during the remarkable economic transformation process, and now as an EU member, Poland is now facing a number of serious economic problems. Following a decade of economic growth of approximately 5 percent per year, the recent years have been characterized by an economic slowdown. Polish GDP growth, which averaged 6.3 percent between 1994–97, slowed down in 1998, and hovered at an average of 4.3 percent during 1998–2000, fell as low as 1 percent in 2001, and slowly came back up to 1.4 percent in 2002. In 2003 recovery has been under way and annual growth is expected to be about 3.5 percent. Inflation has been brought under control, though real interest rates remain relatively high (around 3.65 percent as compared to less than 1 percent in the Euro area). However, the current increase in the growth rate is too low to reduce the per capita income gap between Poland and the EU average. If Poland were to grow at an annual rate of 5.7 percent (the 1994–99 average), assuming that the EU only grows 2 percent annually, it will take Poland 34 years to catch up with the EU average. Convergence with Greece, the poorest country in the EU, will take 22 years, if Poland grows at 5 percent and Greece at 2 percent per annum¹. Over the last 10 years, economic growth in Poland has been driven by a combination of foreign direct investment (FDI) and the emergence of new, indigenous firms. Polish start-ups have tended to concentrate on sectors left completely underdeveloped by the centrally-planned system (such as services), or on the production of relatively simple goods for which there was an immediate and palpable demand. At the same time, the multinational corporations tended to concentrate on developing production and distribution networks in specific sectors.

The World Bank Investment Climate Assessment for Poland (ICA, 2004) notes that the “macroeconomic slowdown was immediately echoed in the corporate sector. For example, the number of newly-registered business firms declined from 219,000 in 1999 to 164,000 in 2000; making 2000 the first year to see a decrease in the number of active SMEs since 1994. The most rapid development of the SME sector was observed between 1996–97, when the number of active SMEs increased at a rate of about 18 percent per year. In 1998, this rate dropped by half to 9 percent, to reach a relatively low level of 2 percent in 1999. Gross sales profitability of private firms decreased in 2000 to 1.7 percent, compared with an annual growth of 4 percent in 1995” (PARP 2002). As we argue in Chapters 3 and 4, SMEs are an important channel for the development of the knowledge economy, and therefore the abovementioned recent decline is worrisome. In the next chapter we will explore how improvements in the business environment could encourage the development of SMEs and in Chapter 4 we will discuss funding channels for technology-oriented SMEs.

TOTAL FACTOR PRODUCTIVITY

Total Factor Productivity (TFP) growth in Poland averaged somewhat less than 4 percent annually between 1992 and 1998.² Only two industrial countries, Finland and Ireland, registered a growth rate of TFP exceeding 3 percent in the 1990s. High TFP in Poland between 1992–98 was primarily due to the reallocation of inputs from inefficient to efficient sectors as part of the transition: large

¹ World Bank, 2000, p. 42 and authors’ calculations.

² Poland Investment Climate Assessment 2003, World Bank, p. 10.

state-owned enterprises, reacting to market pressures cut costs and shed labor that mostly moved to services.

TFP for the group of industries with high R&D spending³ was growing faster than TFP for all manufacturing sectors during this period⁴. This result suggests that the accumulation of “technology stocks”—calculated from flows of business R&D expenditures—as explained in the endnote⁵—has probably contributed to TFP growth because sectors that spend more on creating new technologies have been on an average more productive between 1994–2000. In contrast, building of local technology stocks by foreign firms seems to be much less connected with higher-than-average productivity growth. Only the three industries, which have the highest holdings of foreign technology stock—motor vehicles, pharmaceuticals, and electrical machinery—are on average more productive.

ABSORPTIVE CAPACITY: A PREREQUISITE FOR THE ASSIMILATION OF KNOWLEDGE

Countries can reap economic benefits through both indigenous technological innovation and diffusion via imports, FDI, and purchase of know-how through licensing. However, indigenous effort is required before a country can benefit from technology transfers through either FDI or imports. As recent work in innovation stresses the adoption of existing technology is not guaranteed or cost-free. Firms and countries need to invest in developing “absorptive” or “national learning” capacity, which in turn is hypothesized to be a function of spending on R&D. Therefore, domestic R&D has a role in developing a “firm’s ability to identify, assimilate, and exploit knowledge from the environment, i.e., enhancing the *absorptive capacity* of the economy.”⁶ The impact of FDI is indirect via “spillover effects”⁷ due to the presence of multinationals—first, because they create linkages with domestic firms, and second, because their presence spurs domestic producers to invest in new technology in order to compete with the foreign-owned firms. For example, in the Czech manufacturing sector during 1995–98, the indirect effect of R&D via the development of the absorptive capacity was found to be far more important than the direct effect of innovative R&D in increasing productivity growth of the firm; it was also found that R&D and intra-industry spillovers from FDI go hand in hand. (Kinoshita 2000). In Poland, so far, spillover effects leading to technology improvements in firms are observed only in a few industries, such as the auto industry, where foreign R&D is high.⁸

The literature suggests⁹ that technology-embedded imports indirectly provide the host country with access to R&D investments. The importing country benefits by employing these intermediate goods in production, because while it does not bear the R&D cost of inventing

³ These were machinery, chemicals (including pharmaceuticals), electrical machinery, motor vehicles, television, radio, and telecommunications equipment, other transport equipment, and rubber and plastic products.

⁴ Calculations by Malgorzata Jakubiak of CASE for the KEA.

⁵ Technology stocks were calculated from flows of R&D business expenditures obtained from the Polish Central Statistical Office (GUS) and were used to calculate stocks using the perpetual inventory method.

⁶ Cohen and Levinthal (1989); Kinoshita (2000).

⁷ Spillover effects (from neighboring countries or industries) arise when production affects the economic activity of other local firms or their employees. Positive spillover effects occur through the supply of new information, new technologies, managerial practices, and so on. Thus the “social” gain is larger than the profit or productivity gain made by the “source” company.

⁸ This is consistent with Kinoshita’s (2000) finding, concerning Czech enterprises’ data, that in oligopolistic sectors such as electrical machinery and radio and television, there exists a significant rate of spillovers from having a large foreign presence. Also, R&D investment has a higher rate of return in these sectors. On the other hand, less oligopolistic sectors such as food and non-metallic minerals show no evidence of spillovers despite the large presence of foreign investors in these sectors.

⁹ Keller (1997), based on Romer (1990) and Ethier (1982).

new designs, it captures the foreign R&D or technology content of a good. According to this reasoning, productivity increases as more types of high-tech intermediates are employed in production. However, as the empirical findings cited above imply, in order to take advantage of such processes, there must be absorptive capacity within Polish manufacturing industries. The recent decrease in business R&D expenditures in 2001 was greater than the general slowdown in economic activity. If this signals a trend in R&D slowdown, it may reduce the absorptive capacity of the Polish economy to benefit from R&D embedded in imports¹⁰.

R&D Trends in Poland and Other Countries

According to the EU report, *Raising EU R&D Intensity*, “R&D is the main source of innovation in modern economies, and innovation is one of the main drivers of economic growth, productivity gains, economic adjustment and job creation.”¹¹ It should be stressed that R&D in its widest sense includes improvements in existing processes or products as well as the imitation and adoption of knowledge and is not restricted to original innovation. Following the literature, R&D should be understood as “the process by which firms master and implement the design and production of goods and services that are new to them, irrespective of whether or not they are new to their competitors—domestic or foreign.” In other words, R&D is a “continuous improvement in product design and quality, changes in organization and management routines, creativity in marketing and modifications to production processes that bring costs down, increase efficiency and ensure environmental sustainability.”¹²

Receptive to the implications of the R&D spending deficit in Europe—1.9 percent compared with 2.7 percent in the United States and 3 percent in Japan—in 2002 the Barcelona Council for the Lisbon Strategy set an EU target of 3 percent to be achieved by 2010. Two-thirds of this spending is to come from the private sector.¹³

In Poland, low spending on R&D constitutes one of the most serious obstacles to the development of a knowledge-based economy.¹⁴ By 2001 R&D intensity dropped to a low 0.7 percent, placing the country not only at the tail end of Organisation for Economic Co-operation and Development (OECD) countries but also behind neighboring Accession countries. In comparison, the Czech Republic and Hungary devoted 1.26 and 0.8 percent of their GDP, respectively, to R&D. Figure 2.1 presents the progressive decline in Gross Domestic Expenditures on R&D (GERD) relative to GDP in Poland, by source of financing.

While a trend in decreasing GERD/GDP is observed across Central and Eastern Europe, the most recent decline in Poland (1999–2001) is fairly worrisome. As we will see below, this affects the country’s *absorptive capacity*, which is its ability to identify, assimilate, and exploit knowledge from both domestic and external sources.

The decrease in R&D spending in 2001 was most pronounced in Poland’s enterprise sector.¹⁵ Indeed, one of the main reasons why R&D spending is so low lies in the way it is financed.

¹⁰ See Annex 3 for an analysis by CASE of export-led growth: the analysis suggests that Poland could take advantage of its relatively low cost of labor (within Europe) to increase medium-tech exports based on the technology embedded in high-tech imports, which could be imitated and applied to med-tech products, if the required absorptive capacity were in place.

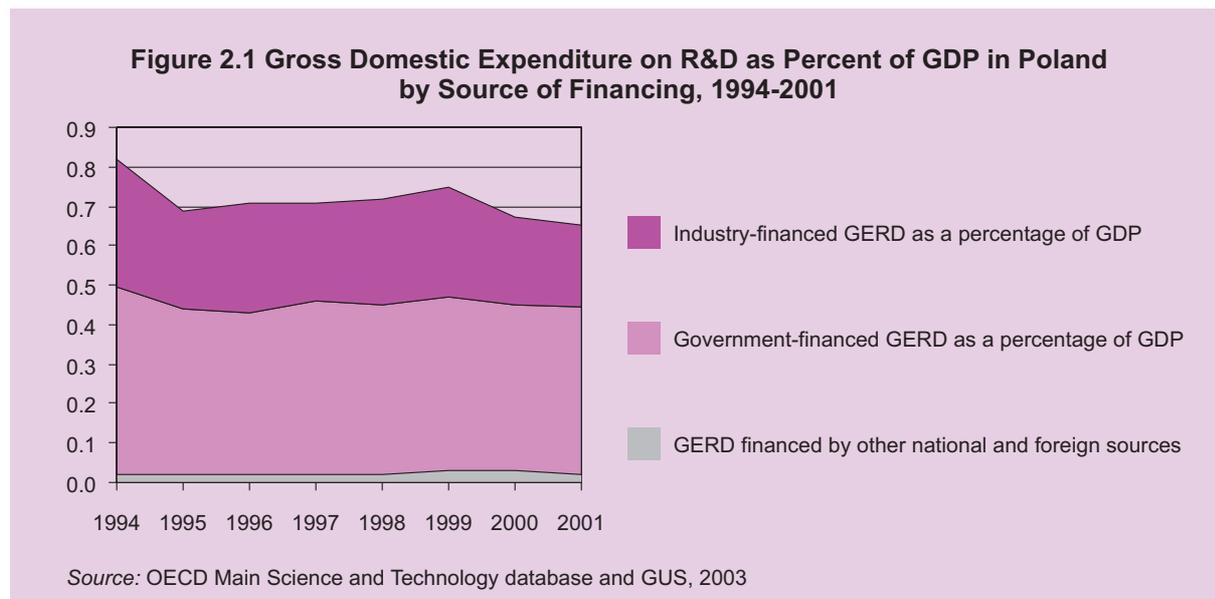
¹¹ *Raising EU R&D Intensity*, p. 13.

¹² Mytelka and Farinelli (2000); Ernst et al. (1998, pp. 12–13).

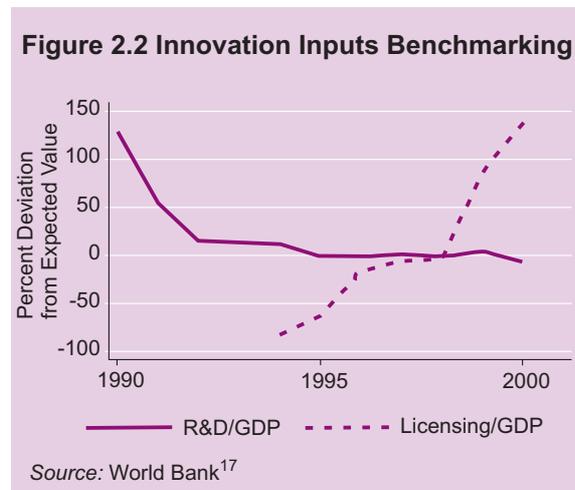
¹³ OECD (2002), *Main Science and Technology Indicators*, volume 2002/1, Paris.

¹⁴ Gorzyński and Woodward (2003). Polish Central Statistics Office (GUS) (2001, pp. 29, 83), based on OECD (2000).

¹⁵ This sector consists of private enterprises (around 32 percent of the sector’s total R&D spending in 2001), public enterprises (14 percent), and the state-owned R&D institutes—the so-called public research and development units—(54 percent). The other two sectors of the economy are higher education and the government sector. Polish Central Statistics Office (GUS) (2003).



The bulk of R&D spending, as much as 63.4 percent is financed by the government, whereas only 32.6 percent is financed by industry. By contrast, in countries with high rates of R&D expenditure such as Japan, the United States, Sweden, Finland, Ireland, and Germany, the share of industry-related R&D spending ranges from 65 to 70 percent, while government spending amounts to only 20–30 percent (OECD 2002). Among the transition countries; in Hungary the share of industry-financed GERD is similar to Poland’s, while the Czech and Slovak Republics achieve rates close to the EU average of over 50 percent.¹⁶



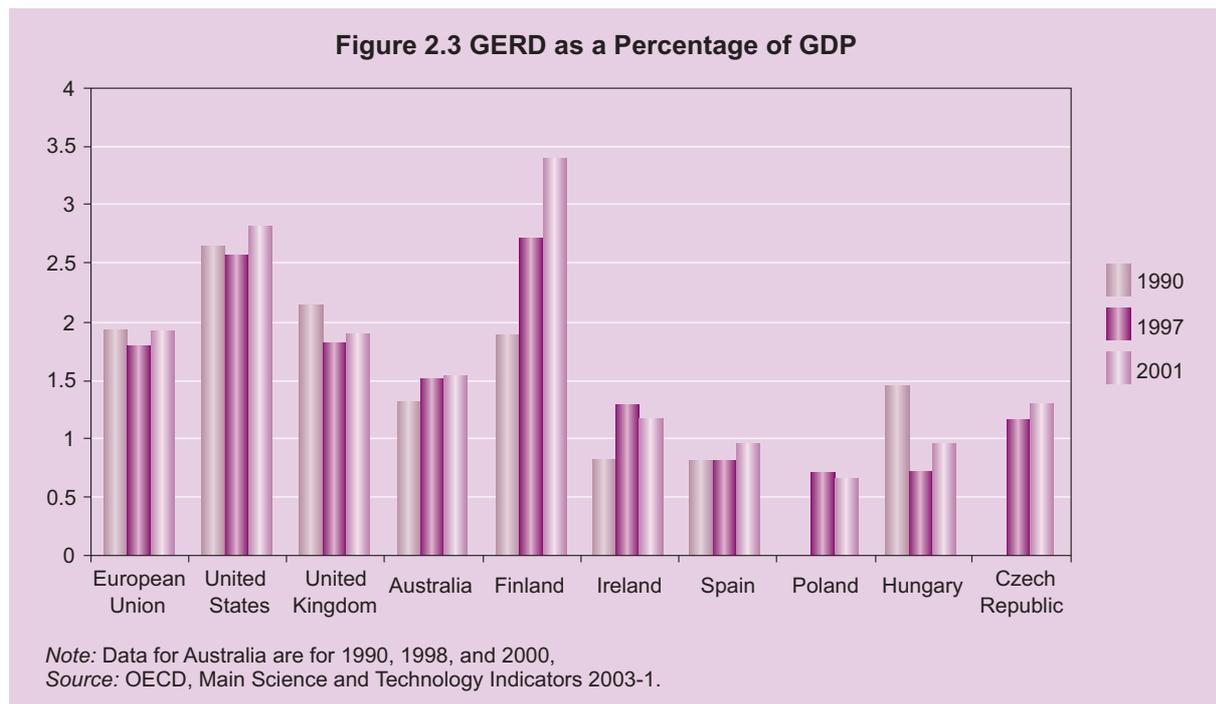
In Figure 2.2 below, we look at a World Bank database that tracks innovation inputs over time by following two indicators: R&D and licensing. Figure 2.2 benchmarks research inputs in comparison with the average inputs in countries with the same levels of GDP, the same size labor force and the same value of exports to the United States since the 1960s¹⁸. The graph shows how far Poland is from the average of similar economies (the zero line). A negative number on the vertical axis is evidence of underperformance. Figure 2.2 illustrates that Polish R&D/GDP is declining over time relative to the predicted values, reaching the trajectory 2–3 years ago and has stayed recently under the trajectory.

¹⁶ Gorzyński and Woodward (op. cit.).

¹⁷ Calculations based on methodology in Lederman and Maloney (2003).

¹⁸ The data on patents granted by the U.S. Patent Office to innovators residing around the globe and the number of scientific publications provided by the U.S. National Research Foundation were collected by Lederman and Saenz (2003). The series plotted are the residuals from a regression on GDP and Population and their squares. See Bosch et al. (2003) for technical details about the methodologies and data.

Figure 2.3 shows GERD as a percentage of GDP in selected OECD countries in comparison with Poland.



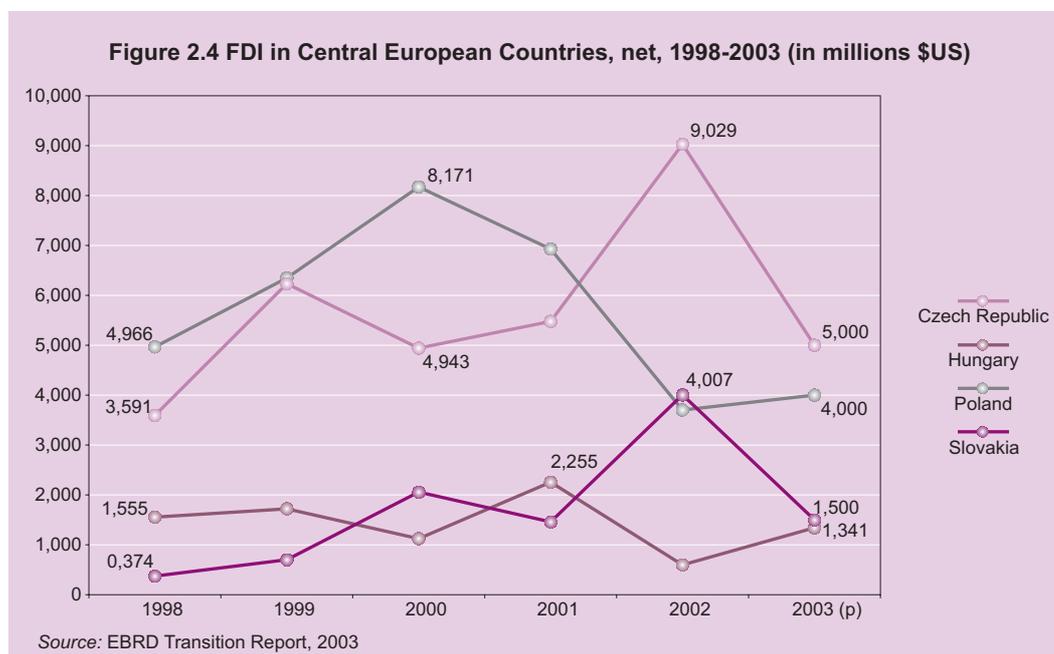
BASIC RESEARCH

In addition to low R&D expenditures, particularly by the private sector, another characteristic feature of Polish research funding is that it is mostly spent on funding of basic research. Basic research consumed 38.5 percent of total Polish R&D spending in 2000, which is the highest among OECD countries. In contrast, the Netherlands, ranking last among OECD countries, dedicated slightly less than 10 percent of its R&D budget to basic research. Spending on applied research, that has commercial potential, is very low in Poland when compared with the world's most developed countries (GUS 2001). The current allocation of research funding, which is skewed away from applied research activities, contributes to the apparent lack of collaboration between the science and business sectors. Interaction between industry and potential sources of innovative technologies such as universities, polytechnic institutes, industrial R&D institutes, and the Polish Academy of Sciences (PAN),¹⁹ is viewed as ineffective by both sides. In particular, the weak cooperation between state-owned R&D institutes (also called research and development units or government research units [JBRs]) and the private sector is identified as an obstacle to building a knowledge-based economy and imposes a significant fiscal drain; this issue will be discussed in Chapter 5. Although we review the data above, the KEA does not present a view on the optimal allocation of resources between basic and applied research. Such a distinction may not be meaningful as what is called basic research can unexpectedly bring very practical results. Of course, by definition, an increase in the absolute spending on R&D, without a parallel increase in spending on basic research, would change the abovementioned proportions but it is beyond the scope of this report to recommend shifting resources away from basic to applied research or to propose an optimal ratio between spending on the two.

¹⁹ Radosevic, S. (1999); Gorzelak, G., B. Jałowiecki, A. Kukliński, L. Zienkowski (1995); Kraslawski and Gajewski (2000).

FOREIGN DIRECT INVESTMENT (FDI)

FDI inflows to Poland slowed in 1999—though there was a slight rebound in 2000 with the \$2.5 billion privatization deal of the telecom industry—partly because of a marked decline in the pace of privatization (Figure 2.4, reproduced from ICA, 2003). Foreign firms accumulated only one-fifth of the total technology stock in manufacturing through 2000. Poland has one of the lowest shares of foreign engagement in R&D activity among OECD countries (GUS 2001, p. 50). Thus, Poland stands in stark contrast with other European countries such as Ireland and Spain, whose dynamic growth in the 1990s was to a large extent owed to R&D-intensive activities carried out by multinational investors. Although the share of foreign technology stock in Poland increased from 6 percent of all accumulated R&D in 1997, to 20 percent in 2000, it stayed roughly at the same level in 2002. This was due to the fact that foreign enterprises were reducing their expenditures for research between 2001–2002, and hence the accumulation of foreign R&D stock slowed down.



Foreign investors concentrated their R&D activities in few sectors: auto manufacturing and the production of television, radio, and telecommunications equipment.²⁰ In other sectors however, the significance of FDI-related R&D was minor. Two reasons why foreign firms rarely move their R&D to Poland are the difficulties involved in finding and establishing partnerships with local research institutes that are willing to cooperate as well as the lack of adequate managerial skills among Polish researchers and scientists. Additionally, VC managers claim that the majority of Polish projects pursuing external funding are at too early a stage of development and seek investment levels that are too low to be of interest to VC investors. As will be discussed in Chapter 5, there is a serious lack of seed capital in Poland, which is needed to finance innovation from the invention stage through to the project phase when it is ready to be financed by VC funds.²¹

²⁰ In the case of auto manufacturing, it is surprising that there is any domestic R&D at all, since there are no domestic producers in Poland. In fact, in both cases, this is not an indication that foreign companies are spending a lot on R&D; it simply reflects the foreign domination of those industries.

²¹ The opinions of multinational corporations' managers on this issue were gathered during the roundtables for investors, policymakers, and scientists, organized by CASE and the daily *Rzeczpospolita* in 2002. See Gorzyński and Woodward (op. cit.).

3. A BUSINESS ENVIRONMENT FOR INNOVATION

The development of a knowledge-based economy requires the human capital, ICT, and innovation systems to be interlinked. Cohesive progress in these sectors—impacts productivity and growth, which also depends critically on the business environment in which innovative firms must operate. The business environment in Poland has been evaluated in various studies including the World Bank ICA presented recently to the Government. We stress that some of the deficiencies of this environment are particularly burdensome for innovative entrepreneurs and SMEs (for example, with respect to the protection of IPRs). Therefore, we examine them closely in this chapter by taking a holistic approach towards the macroeconomic conditions, capital markets, the tax system, and public procurement.

As stated in the recent *Raising EU R&D Intensity* report, “In most Accession countries, the challenge is to find technology-based firms with sufficient resources and vision to look beyond the day-to-day struggle for survival and the courage to begin the virtuous cycle of investment in innovative activities. Building links with existing research institutions may also be complicated because traditional competence in this sector may not be aligned with the needs of firms involved in rapidly-changing technology sectors.”¹

THE NATIONAL INNOVATION SYSTEM (NIS)

The realization that individual measures to support R&D are ineffective when poorly coordinated, has led to extensive literature on the concept of a holistic national innovation system.² The NIS is a system in which those who generate new knowledge are efficiently connected to those who can benefit from its use. This connection is established through a set of instruments and infrastructure that accelerates knowledge flows and enable innovation. For the system to work efficiently the “links” form effective networks that help overcome market failures caused by coordination and information problems (see below on the economic rationale for public support of R&D). Specifically, the NIS needs to have institutions, instruments, and incentives and the proper linkages among them.

A proper intellectual property rights regime is an example of an incentive. Another example of incentives is competition in product and input markets. It has been found that the level of training in firms depends more on the competitive pressures they face, and their incentives to adopt, adapt, and create new technologies, as well as on the quality of education of the labor force they can hire, rather than on subsidies for training. Institutions and linkages can exist in the form of university-university, university—private sector, public-private sector, and other domestic and foreign linkages; centers of technological innovation, cluster development, networks, incubators, etc. These are discussed in Chapters 6 (on education) and 5 (on institutions). As for instruments, there needs to be a public-financing process to elicit the largest possible private sector R&D investment response, such as fiscal and financial incentives to private sector R&D. These instruments can be direct (grants and loans, discussed in Chapter 4); indirect (fiscal) measures of public support for private R&D training; VC (Chapter 4); and ICT (Chapter 7). The latter is important, for example, in facilitating innovation and helping secure all of its associate benefits

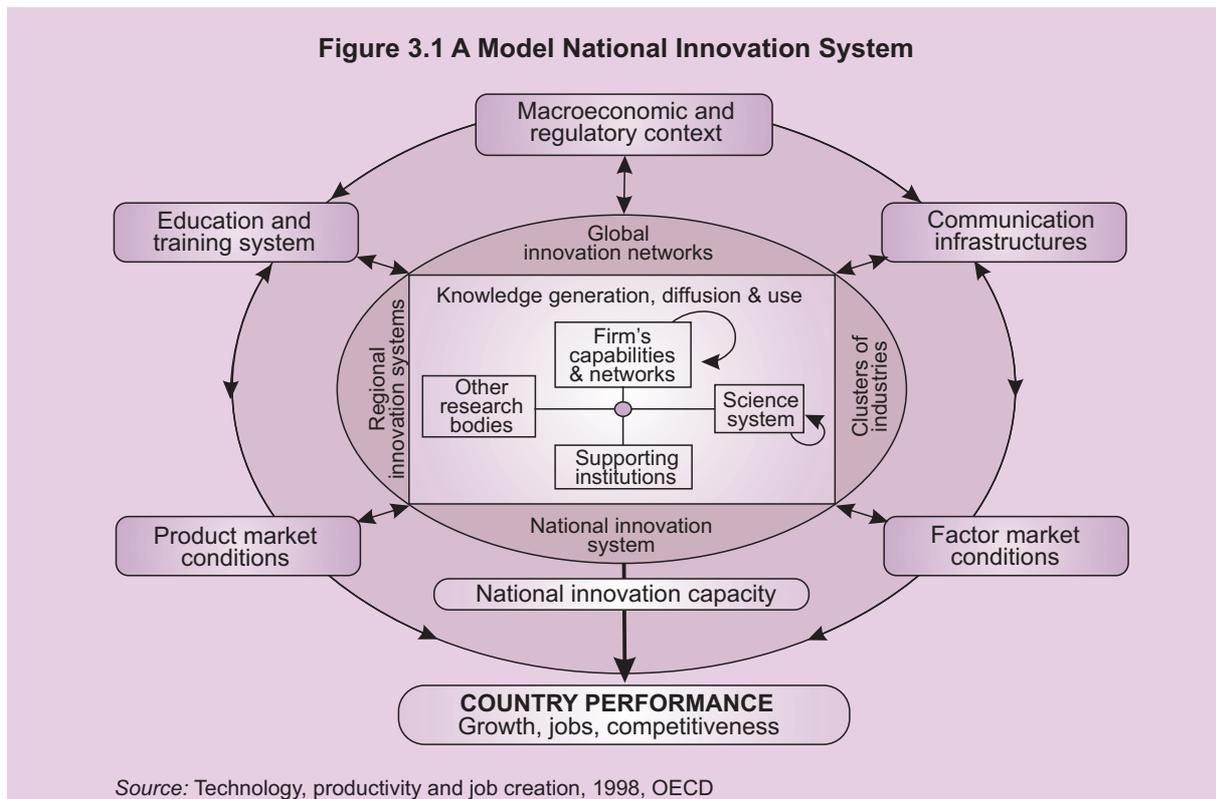
¹ *Raising EU R&D Intensity*. Report to the European Commission by an Independent Expert Group 2003.

² The concept is elaborated upon in Nelson (1993); OECD (1998, 2001); Lundvall and others (2002).

3. A Business Environment for Innovation

and spillovers. However, ICT is an instrument mostly of diffusion and speed rather than a final objective. As such, it is more like a highway, while innovation is more like the vehicle.³

Notwithstanding the national scope of the innovation system, a critical element of its success is the ability to take advantage of the stock of knowledge abroad and apply it. This implies that national learning capacity is about both new innovation generated locally as well as how plugged-in the national innovation system is to innovations generated in leading global centers. The capacity to access and absorb global innovation improves the flow of innovative ideas from the outside and, importantly, these include ideas from the economic domain (relating to market changes, competitor behaviors, supply chain linkages, standards and quality assurance approaches, etc.) as well as from the technological and R&D sources. Linkages between national and leading global R&D capabilities, while not sufficient alone, are important—and the EU Accession process has already moved Poland along in that direction. Local capacity must be better linked to local production: we observed a worrisome disconnect between academia and industry, where businesspeople perceived academics as theoreticians and did not expect any involvement on their behalf in R&D projects. In Okoń-Horodyńska and Jasiński (2002, p. 104) one finds a reverberation of this pessimistic assessment: “Especially alarming are the passive attitudes of industrial companies towards R&D and innovation together with limited interest in technology transfers.” On the other hand, we met entrepreneurs who were keen to cooperate with individual researchers, especially those who studied abroad and spent time in foreign enterprises—or those who, in addition to their basic degrees in engineering or science, have finance, marketing, and/or management skills. A combination of engineering and science with business education has been a common view as a successful factor in the United States and is now sought after in Europe as well.



A second caveat is that the innovation system depends heavily on factors that may or may not be strictly innovation-related. Figure 3.1 above offers a schematic presentation of a National

³ Based on peer review by Jose L. Guasch, LAC, dated 04/07/2003.

Innovation System. Since the center of the process must necessarily be the firm, all factors that impinge on its perception of gains from R&D and the barriers to innovating must be considered part of the NIS. Such factors are examined below in this chapter as components of the business environment. First, we will discuss how Poland's NIS is a product of and is linked to its regional innovation system.

REGIONAL INNOVATION SYSTEMS (RIS)

Poland's regions have historically experienced an unequal distribution of knowledge endowments. A recent Polish study finds a significant relationship between the knowledge base of a region and its economic performance. (Table 3.1)⁴ Greater integration of existing regional knowledge endowments into the national innovation system, thereby, is a natural goal for Poland and is supported as a means of promoting long-term socio-economic prosperity by the European Union Structural Funds. The ongoing formulation and implementation of some 16 Regional Innovation Strategies across the *voivodships* is an important step in this direction.

Class	MV ₁	MV ₂	MV ₃	Interpretation	Regions
I	+	+	+	well-developed knowledge base, demographic youth, great information and technological progress in industry	Lower Silesia, Silesia
II	+	+	-	well-developed knowledge base, demographic youth, poor information and technological progress in industry	Pomerania, Wielkopolska
III	+	-	-	well-developed knowledge base, demographic ageing, poor information and technological progress in industry	Łódź, Małopolska, Mazovia
IV	-	+	+	poorty-developed knowledge base, demographic youth, great information and technological progress in industry	Kujawy-Pomerania, Lubuska Land, Opole
V	-	-	+	poorty-developed knowledge base, demographic ageing, great information and technological progress in industry	Podkarpacie, Świętokrzyska Land
VI	-	+	-	poorty-developed knowledge base, demographic youth, poor information and technological progress in industry	Warmia-Mazuria, West Pomerania
VII	-	-	-	poorty-developed knowledge base, demographic ageing, poor information and technological progress in industry	Lublin, Podlasie

Source: Chojnicki, Czyż 2003

Leading thinkers on knowledge economy in Poland, emphasize *mezzo*, in addition to micro and macro, level policies to promote the regional trajectory. Key actors to be included in a strategic alliance for regional growth would be the firms, regional research institutes and the regional authorities.⁵ Industrial policies that support the development of strategic industry “clusters” and or knowledge transfer from large or foreign firms are a key instrument of governments to foster innovative companies (Sunderland 2003). However, clusters tend to develop through the

⁴ Zbyszko Chojnicki, Teresa Czyż, Poland On the Road to a Knowledge-Based Economy: A Regional Approach. In Recent Advances in Urban and Regional Studies, Polish Academy of Sciences, Committee for Space Economy and Regional Planning. Pp. 208–209.

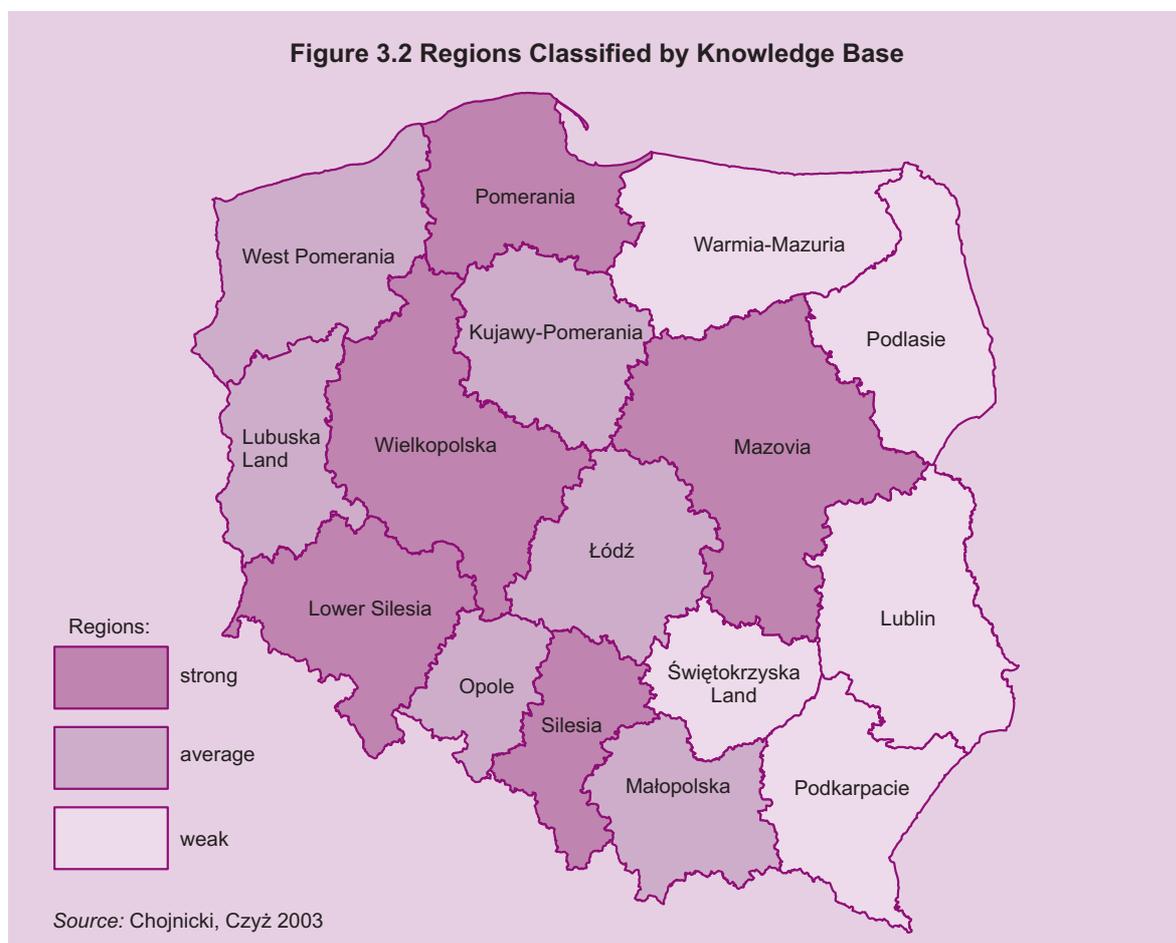
⁵ Antoni Kukliński, Rozwoj gospodarki opartej na wiedzy: Trajektoria regionalna. In Gospodarka Oparta Na Wiedzy—Perspektywy Banku Swiatowego. Warszawa 2003. pp. 196

confluence of many circumstances, which are difficult to prescribe. Therefore, government's role is perhaps best described as a catalyst.

Lagging Regions

The policy challenge is to overcome a poor legacy that is likely to hold back a less developed region from fully participating in the knowledge economy. Figure 3.2 illustrates the weak and less developed regions in Poland. Areas of policy intervention that have been successful are:

- Infrastructure—(i) bringing ICT infrastructure; (ii) building a set of initiatives that implement development-oriented institutes geared to innovation in the sectors in which the region's economy is based; (iii) building modern transport linkages and upgrading factories and workshops for new, larger inward investment and SMEs.
- Education—improving access to advanced training in vocational and academic fields to upgrade the human resources of the region plus building outreach and virtual training centers that enable cost-effective student participation in training within the region itself.
- New business development—two thrusts, first, into creating a culture and skill base in entrepreneurship and innovation and, second, putting in place an infrastructure of business services that encourages new business growth.
- Promotion—of the region externally both as a place to visit (in terms of its environment, history, quality of life, leisure, etc.) and as a location in which to do business.
- Linkages—building linkages with national centers of excellence and improving the information flow of innovation into the region.



The aim, usually, is to stop the exodus of talented locals, by giving them the opportunity to stay and succeed locally, to attract new activity into the region and to change its image to being a vibrant location with a high quality of life.

Advanced Regions

The policy objective is usually to work with the image of a vibrant region, such as the leading region Mazowsze, raise its perspectives to ensure that it strives to be competitive globally rather than being satisfied with its domestic leadership, and to fill gaps that are identified as constraining development.⁶ Figure 3.2 illustrates the country's stronger regions, which are mostly situated around large metropolitan areas. The usual policy strands are:

- Promoting the business environment to change perceptions and build a well articulated cooperative culture that maximizes the potential synergies. This also provides encouragement for the private sector to invest by indicating likely future trends and development directions.
- Improving specialized infrastructure by placing new or upgrading existing national centers of specialists in R&D to ensure that they stay at the leading edge and enable new knowledge to be brought to and developed for the benefit of the regions and the country.
- Coping with growth—anticipating needs for social and economic infrastructure that come with a vibrant region, therefore enabling the growth to maintain its fast pace without a loss in quality of life.

Innovation Specifics

- An emphasis must be placed on education at both the advanced academic and technical levels to provide a skill base for the new knowledge economy.
- Concentration of specialist infrastructure and tools must be facilitated in regions where there is a potential industrial client base, the skills and labor markets to staff the institutes, absorb the new ideas and where a vibrant business base can provide the specialist services (legal, financial, marketing, etc.) needed to make maximum use of innovation.

In general, schemes supporting small firms need to be as close as possible to potential clients and thus regionalized with local offices. In Poland, it certainly matters where such support schemes would be based, particularly, in view of the size of the country.

Before moving on to a detailed analysis of the business environment, the reader might find it useful to from the experiences of Israel and Finland that have invested heavily in R&D and had dramatic take-offs in the 1990s⁷. Their experience presents Poland with models that can be used in designing its own NIS, in particular public measures to support private R&D in the context of a national innovation system (see Box 3.1).

⁶ Stanislaw Furman, Warszawa wobec wyzwan gospodarki opartej na wiedzy, Gospodarka Oparta Na Wiedzy—Perspektywy Banku Swiatowego, Warszawa 2003.

⁷ The R&D/GDP of these countries exceeded a R&D/GDP benchmark calculated by a WB team for each country as a function of the country. (Lederman and Maloney, 2003)

Box 3.1 Case Study: Israel and Finland

The governments of Israel and Finland realized, after targeting a certain level of R&D, that the entire NIS had to be examined to achieve their goal. In response, Israel established the Office of the Chief Scientist (OCS) in 1968 with the mandate to subsidize commercial R&D projects. Previously government support had been restricted to national R&D labs, especially those dedicated to defense and agricultural sectors. Industrial R&D expenditure grew 14 percent a year for the next 20 years. The next key innovation was the Law for the Encouragement of Industrial R&D in 1985. Its goal was to develop science-based, export-oriented industries. The centerpiece of the program was a system of financial incentives—matching funds of up to 50 percent of R&D expenses in established companies and 66 percent for start-ups. These subsidies are thought to have “crowded in” an additional 41 cents of R&D spending for every dollar. Successful firms are required to repay royalties of 3 percent of annual sales up to the dollar-indexed amount of the grant. Paybacks now account for 32 percent of the OCS budget. R&D must be executed by the applicant firm itself, products developed must be manufactured in Israel, and the know-how acquired may not be transferred to third parties. (See Chapter 4 and Annex 4 for details.)

Israel’s “magnate” program sought to integrate the fragmented industrial landscape and encourage cooperation among firms and between firms and the country’s world-class universities. The “incubator” program sought to provide support for fledgling entrepreneurs and provide a variety of services not available through the market—start-up capital, managerial skills, etc. The government also signed a variety of bilateral agreements with foreign governments designed to encourage cooperation with foreign firms and co-finance R&D projects with foreign governments to foment research in both countries. Both the R&D subsidies and the Yozma VC start-up funds were designed to remedy failures in the capital markets.

Finland targeted a rise in R&D spending from 1.5 percent of GDP in 1983 to 2.7 by 2000. From the beginning, the government adopted a “systems” approach, viewing all elements of the NIS as essential to the R&D goal. A National Technology Agency, Tekes, was established in 1983 to finance applied and industrial R&D, especially through clusters. In 1987 Finland’s Science and Technology Policy Council (STPC) was expanded to include representatives from industry and the research community, its status was raised within the government, and its mandate set to include ensuring collaboration across ministries. STPC reviews science and technology policy every three years, identifies main policy challenges facing the country, and makes proposals for all actors. The deficient venture capital market was addressed partly by financial liberalization, and partly by Tekes policy of financing 30–40 percent of total R&D costs in product development projects it runs. These programs require cooperation and networking between business enterprises and research institutes and promote technology transfer and internationalization. In this case, Finland’s universities were allowed to collaborate with industry in a reversal of previous policy.

Source: Closing the Gap in Education and Technology. World Bank (2003).

ECONOMIC RATIONALE FOR PUBLIC SUPPORT OF INNOVATION AND R&D⁸

Knowledge is distinguished by a number of market and coordination failures that inhibit the optimal level of private effort and investment and argues for government intervention to address those failures:

- *Knowledge is not appropriable.* Since firms making investment in knowledge do not always get to keep the resulting profits to themselves or receive compensation for the effect of their actions, they do not invest optimal amounts—because once diffused, knowledge can be accessed by anyone.

⁸ Based on *Closing the Gap in Education and Technology*. World Bank (2003, pp. 134–35).

- *Knowledge and innovation generate significant positive externalities and spillovers.* The social rate of return on R&D expenditures is often three times as large as the private rate of return.⁹
- *Investments in R&D are long term and risky.* Less-developed financial markets seldom provide the right instruments and term structure for financing R&D expenditures.
- *There are indivisibilities in innovation expenditure.* Innovation is lumpy, requires critical mass of investments, and in a broader sense is subject to economies of scale.
- The process of innovation involves bringing diverse stakeholders together and that process is costly—because it is subject to *coordination failures and free-riding behavior*.
- Recognition that the process of knowledge acquisition and diffusion is plagued by market and coordination failures has led to an emphasis on the public interventions necessary to ensure the socially-optimal level of innovation. Countries that have successfully managed to advance on innovation have addressed those market failures through the following government actions:
 - Taking on the role as overall coordinator of science and technology activities (setting up public or private institutions and implementing and coordinating programs to maximize net social returns).
 - Intervening to correct market failures by supplying funds, directly and indirectly, to public and private agents alike; providing intellectual property rights protection to innovation; and facilitating access to foreign technology.
 - Correcting, particularly in recent years, so-called systemic failures (economies of scale, public goods, externalities, and coordination issues) by setting up training programs and specialized research centers (cooperation schemes designed to promote joint public-private R&D efforts and improve the dissemination of information in society), and facilitating the development of networks for effective and fast diffusion of knowledge.

POSITIONING THE FIRM AT THE CENTER OF R&D-BOOSTING EFFORTS

Commercialization of scientific and technological progress, which is generally accepted as a major driver of economic development, is frequently undertaken by new rather than existing firms. In most cases, an idea originates in a new company, ownership is distributed to associated parties in the form of shares, and new funds are raised from existing shareholders and outsiders on the basis of the concept's development prospects. The SME sector—and particularly the segment whose primary activity is the exploitation of an invention or technological innovation with significant risk (these enterprises are referred to as “technology-oriented SMEs”)—is a critical component of the knowledge economy as it provides one of the main links between R&D based in state-owned universities and research institutes, and business-sector R&D.

However, although commercialization done by new firms is important, large-firm supply chains (including U.S. government procurement through Small Business Innovation Research—SBIR) have been a major driver for innovation as have large firms in the chemicals and pharmaceutical sector because of their scale of investment. In ICT and software, as well as in technical services and design, small firms have gained prominence. Additionally, the licensing route to commercialization might be more suited to advanced science and technology commercialization from universities and R&D institutes than new firm formation.

Should firm-size matter for government support?

⁹ Griliches (1995)

Before elaborating on measures to support private R&D, it is useful to briefly address the question whether these measures should apply to all firms regardless of size or should the Polish Government target only SMEs? There is an ongoing debate on whether governments should be targeting support for R&D in small and large firms or whether the subsidies should be targeted primarily to SMEs. With regard to this debate, we discussed in Chapters 2 and 3, the following five rationales for government subsidies: (1) Knowledge is not appropriable, (2) Knowledge and innovation generate significant positive externalities and spillovers, (3) Investments in R&D are long term and risky, (4) There are indivisibilities in innovation expenditure, and (5) R&D is subject to coordination failures and free-riding behavior. Some of these rationales call for subsidization of all firms, either small or large. Large and small firms both face difficulties of appropriation, although the large ones may be better in capturing and internalizing the benefits. The same logic applies to externalities and spillovers.

However, the risk and term of the investment strongly affect the cost of capital: the risks of investing in established SMEs and large firms are much lower. Investors also feel that it is easier to assess investment risks for this type of firm. Banks in particular look at the track record of firms (e.g., profitability, sales growth, etc.) and also like to require tangible assets (e.g., real estate, plant and equipment, and the like) as security for loans, which they can seize and sell in the case of default on the loan to cover part of the losses. It is, therefore, the start-up and other early-stage SMEs that require the attention of policymakers so that they can access funds to help them develop. In instances where established SMEs are taking on the commercialization of larger projects that cannot be covered by their asset base, these companies would also fall into the area of abovementioned attention.

As governments around the world have recognized the critical role of private R&D, particularly by SMEs, as a key linkage in the chain of commercializing technology, they have designed a wide variety of programs to encourage and support the transfer of technology to the business sector. These initiatives occur within a wide spectrum of policies that fall into four broad categories: (i) Business environment policies that occur within general macroeconomic conditions: the design and execution of the legal and regulatory framework, and the tax regime. (ii) Financial support in the form of debt, equity, and guarantee to bridge the financing capital gap for start-up technology companies; (iii) Financial support for innovation policies such as R&D commercialization, and encouragement of clusters, industrial parks; and, (vi) Education: Training and nurturing programs—such as Lifelong learning and Higher Education Institutions (HEIs).

THE BUSINESS ENVIRONMENT IN POLAND

Poland stands out among economies in transition as having experienced seven years of uninterrupted growth at an annual rate averaging over 5 percent. The country's growth performance was related to a combination of relatively favorable initial conditions and external factors. Among the most important and relevant for the knowledge-based economy are:

- Low entry barriers for new firms, facilitating a redistribution of labor from state-owned to new, privately-owned enterprises;
- The establishment of a commercial banking sector and securities markets subject to strict regulation and supervision, and the implementation of a financial restructuring program that provided the incentives to banks and enterprises to resolve non-performing loans; and
- Extensive legal and institutional reform in support of the market and private sector activity.

Although further progress continues to be made, Poland's legal environment still contains significant barriers to knowledge economy development. Their impact is indicated by the

findings of the project conducted by a leading Polish economic think-tank CASE in 2002 on micro-enterprises (Balcerowicz 2002). Among 17 factors hindering the operations and development of their businesses, entrepreneurs surveyed in this project indicated burdensome regulations as the most important barrier. Two constraints that are seen as especially burdensome are taxes and social contributions and labor market legislation. Extensive transactions with the public administration place additional constraints on firms' efficiency. (See Table 3.2).

Table 3.2 Doing Business in Poland

	Poland	Czech Republic	Hungary	Slovak Republic	OECD Average
Starting a Business (2004)					
Number of procedures	10	10	6	9	6
Duration (days)	31	88	52	52	25
Cost (% of GNI per capita)	20.6	10.8	22.9	5.6	8.4
Min. Capital (% of GNI per capita)	2474	47.4	96.4	50.3	47
Hiring & Firing Workers					
	Poland	Cz Rep	Hungary	Slov Rep	OECD Av.
Flexibility of Hiring Index	33	17	46	34	49
Conditions of Employment Index	92	63	92	89	58
Flexibility of Firing Index	39	27	23	60	28
Employment Laws Index	55	36	54	61	45
Enforcing Contracts					
	Poland	Cz Rep	Hungary	Slov Rep	OECD Av.
Number of procedures	18	16	17	26	18
Duration (days)	1000	270	365	420	213
Cost (% GNI per capita)	11.2	18.5	5.4	13.3	7.1
Procedural Complexity Index	65	65	57	40	49
Getting Credit					
	Poland	Cz Rep	Hungary	Slov Rep	OECD Av.
Public Credit Registry operates?	No	Yes	No	Yes	
Public Credit Registry coverage (borrowers/1000)	0	10	0	2	43.2
Public Credit Registry Index	0	60	0	48	58
Private Bureau coverage (borrowers/1000)	543	136	15	0	443.5
Closing a Business					
	Poland	Cz Rep	Hungary	Slov Rep	OECD Av.
Actual time (in years)	1.5	9.2	2	4.8	1.8
Actual cost (% of estate)	18	38	38	18	7
Goals of Insolvency Index	70	22	38	71	77
Court Powers Index	67	0	33	67	36
Country Characteristics					
	Poland	Cz Rep	Hungary	Slov Rep	OECD Av.
GNI per capita (US\$)	4570	5,480	5290	3,970	23,149
Informal economy (% GNI)	27.6	19.1	25.1	18.9	16.8
Population	38,641,000	10,224,000	0,187,000	5,404,000	41,068,094

Source: World Bank's Doing Business database. (2004) <http://rru.worldbank.org/doingbusiness>

This less than optimistic picture of the Polish legal environment is confirmed by the work of Kaufmann et al. (2003). These researchers have developed a group of indicators on the quality of governance, and one of these indicators is a measure of regulatory quality. Among relevant findings: First, Poland lags behind neighboring new member states when it comes to this indicator (and its level is far below those of the Czech Republic and Hungary, which are now on at par with the laggards within the EU). Second, Poland is the only country that showed no improvement during 1998–2002 (in fact, its position worsened in that period). Third, the comparison of Poland with Bulgaria is especially troubling, since it shows that some second-tier transition countries are catching up faster than Poland. Finally, even the EU average, to which Poland aspires, is a moving target, as even the weak performers among its members have made significant improvements in recent years—thus, leaving Poland farther and farther behind.

Business Incorporation

The burden of government regulation on Polish businesses, which was modest in the early 1990s, is now reported to be significant. As mentioned above, there are fewer than 200,000 businesses registered as limited liability companies in the country. SME owners attribute this to the high cost of setting up new limited liability companies, which is estimated at US\$12,500. Entrepreneurs tend to prefer trading under the civil code, which, while cheaper in the short term, involves unlimited personal liability. For start-up SMEs that are seeking to raise money for risky ventures, it is clearly inappropriate to use vehicles that have this kind of liability.

While the registration process is perceived as relatively easy by SMEs, the burden emerges when businesses have to acquire licenses and permits. During 1991–97, the scope for obtaining licenses and permits was significantly broadened. In 1997, the government launched a campaign to de-bureaucratize the entry and operation of new firms. This led to the 1999 Law on Business Activity, which reduced from 30 to 8 the number of areas of economic activity requiring a license, and repealed compulsory inspections in 11 business areas. While a step forward, the degree to which requirements have been reduced is unclear and as, in many cases, licensing requirements have been replaced by permits (Balcerowicz 2002). In 2004, according to the World Bank *Doing Business* database, to start a new business, a Polish entrepreneur had to complete 10 procedures, which took an average a total of 31 working days and cost about 21 percent of Gross National Income (GNI) per capita, or US\$ 1160.¹⁰ The *Doing Business* database suggests that the cost of obtaining all necessary permits in Poland does not exceed those in new EU member countries in terms of GNI per capita. However, in terms of time required, Poland ranks at the bottom, significantly longer than the times listed for EU countries. The implementation of a one-stop shop as well as e-registration and relevant government-to-business services could greatly improve the business environment for SMEs. Nevertheless, the relatively low cost challenges the general perception by entrepreneurs who complain about increasingly burdensome entry regulation. The ongoing Foreign Investment Advisory Service study on Administrative Barriers to Investment is expected to shed concluding light on the time and cost of business entry and operation in Poland¹¹.

Under the European Union's eEurope program, Poland is supposed to introduce an electronic system of registration by 2005. However, work on the implementation of this project is seriously delayed: the country lags behind numerous other Accession countries, and there are serious doubts as to whether it will make the 2005 deadline (Salik 2003). It seems, therefore, that the review and simplification of administrative procedures as well as the rapid computerization of public administration are important factors for improving Poland's business climate in general and for knowledge economy development in particular.

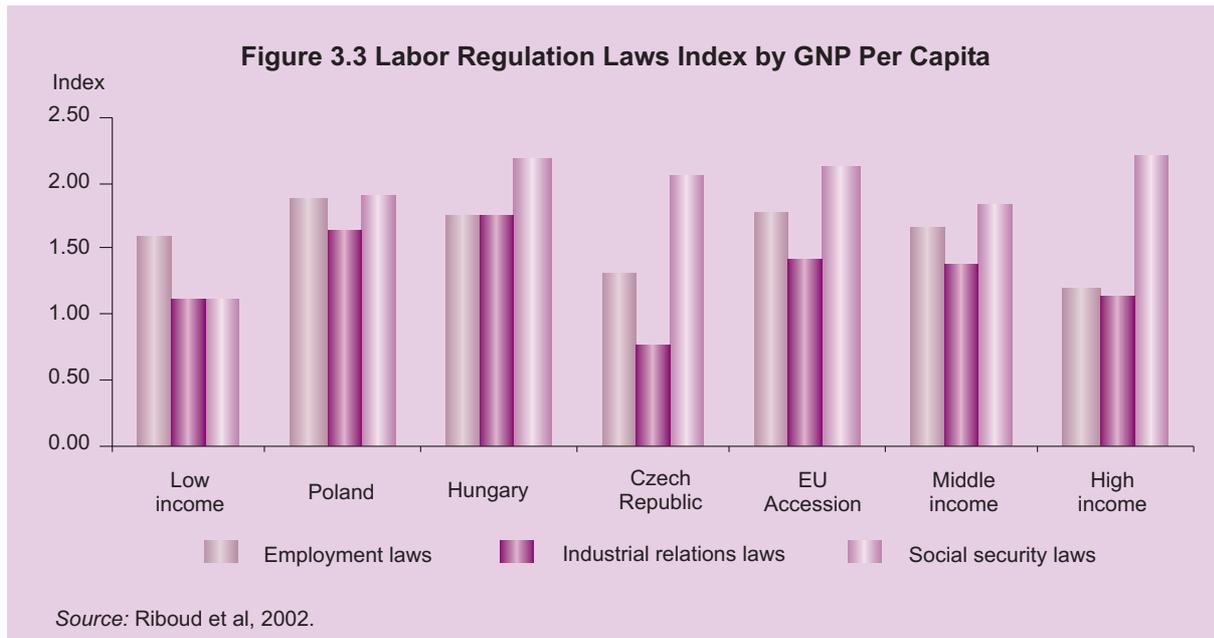
Labor Market Rigidities and Costs

In view of the volatilities and high risk they face, technology-oriented SMEs require flexibility in hiring and firing practices, working hours, and retraining of their employees.

The degree of labor regulation is moderate considering the national income. The overall degree of regulations in Polish labor markets is similar to that of Hungary and higher than that of the Czech Republic (Figure 3.3). With respect to employment protection and industrial relations,

¹⁰ "Doing Business in 2004: Poland Country Profile." Investment Climate Department, World Bank. Also available at <http://rru.worldbank.org/doingbusiness>.

¹¹ World Bank, Poland Investment Climate Assessment, 2003.



Poland's regulations are slightly higher than the middle-income average. In fact, Polish labor laws provide the *highest level of protection dealing with collective dismissals*.

To achieve higher flexibility in labor markets, the Polish government recently (2002–03) introduced new labor legislation. The amendments significantly cut employers' financial burdens involving labor costs, including costs of overtime work, leaves of absence, fixed-term employment, workplace safety, and other benefits. The new laws extend employers' authority for managing labor relations by reducing government intervention, and allow greater flexibility in employment contracts than at any time previously. For micro-and small firms with fewer than 20 employees, for example, employers are not obligated to have remuneration bylaws.

Polish social taxes are not only a serious barrier for flexible and stable employment, but they also hamper the development of personal entrepreneurship. The Polish entrepreneur from the very first day of activity has to pay a lump-sum social contribution. The amount of this payment is related to the level of the average wage in the economy; however, due to serious changes in wage statistics and legal regulations, the increase of this payment in the last three years was much higher than the rise in wages. The current level of this payment seriously limits the ability of start-ups to carry out activities in the official economy. There is not an easy solution to this problem: the social security contribution is not a tax per se, since part of it is linked with future pension (defined contribution scheme). The lump sum social security is used because it is simple and manageable. Lowering social security payments for start-ups would create yet another loophole in the tax / ZUS system (e.g. some old companies would quickly re-register themselves to use the loophole). A possible solution to be considered is to "regionalize" the social security payments according to the average wage in each of the regions (voivodships). However, regionalization could lead to re-registration of activities in the regions offering lower rates.¹²

Intellectual Property Rights (IPRs)

The importance of effective intellectual property rights enforcement in developing the innovation potential of countries such as Poland has been confirmed by a number of recent research projects sponsored by the World Bank. These projects explored the relation between protection of

¹² We thank Marcin Piatkowski and Ryszard Petry for their contributions to this point.

IPRs and FDI in various countries, including the transition countries (Mansfield 1994, 1995; Smarzyńska 2002). In broad terms, the conclusion of this research was that IPR regimes that fail to protect patents effectively are a disincentive to investment in innovative activity in countries with such lax regimes. These researchers found that in four technology-intensive industries—pharmaceuticals, chemicals, and the machine and electrical equipment industries—potential investors are very sensitive regarding IPR regimes in countries that are investment candidates. The amount of FDI involving firms in these industries is positively correlated with their perceptions concerning IPR protection. The perception that IPR protection in a given country is weak may dissuade a firm (in these industries as well as, in fewer cases, others) from investing in that country. If the firm does invest, the IPR regime affects this investment; in particular, the firm is unlikely to invest in R&D. Similarly, the firm will have a lower propensity to transfer technology to a foreign subsidiary (that is, the subsidiary in the country attracting the investment), and when such transfers occur, they usually involve obsolete rather than cutting-edge technologies.

Polish legislation in the area of IPR protection was recently brought into line with international standards. This process of legislative harmonization began when Poland signed the Treaty Concerning Business and Economic Relations with the United States on March 21, 1990. This agreement obliged Poland to introduce patent protection of products and production processes for pharmaceuticals and other chemical compounds.

In 2000 the Agreement on Trade-Related Aspects of IPRs¹³ (the TRIPS agreement) became fully binding in Poland. The Industrial Property Act voted by the Polish Parliament in 2000 was adopted according to the TRIPS agreement. Moreover, in accordance with its association agreement with the European Union, signed in 1991, Poland was obliged to harmonize its legislation with that of the EU and to sign the Munich Convention. (Adopted in 1973, the convention deals with the granting of European patents, and although it is not a part of the *acquis communautaire*, it determines EU standards in this area). Indeed, the main goal behind the passage of the Industrial Property Act of 2000 was the harmonization of Polish legislation with relevant European law. This goal was not, however, realized completely at that point, and as a result the law was extensively amended in 2002. Polish law can, therefore, be considered to conform to international and EU standards.

In spite of the harmonization of Polish IPR legislation, much could still be done to improve the quality of this legislation. According to a Polish expert on the subject, Michal du Vall of the Jagiellonian University in Krakow, the current law is not transparent—it is too complex and covers too many areas. In the world's most developed countries, such legislation is divided into several acts, which cover specific areas/subjects. In Poland, a single, extremely lengthy piece of legislation covers all aspects of IPRs, and even lawyers often have difficulties interpreting it. Successive amendments have rendered the law less and less transparent. For this reason, du Vall advocates dividing the legislation into separate acts (Gorzyński and Woodward 2003).

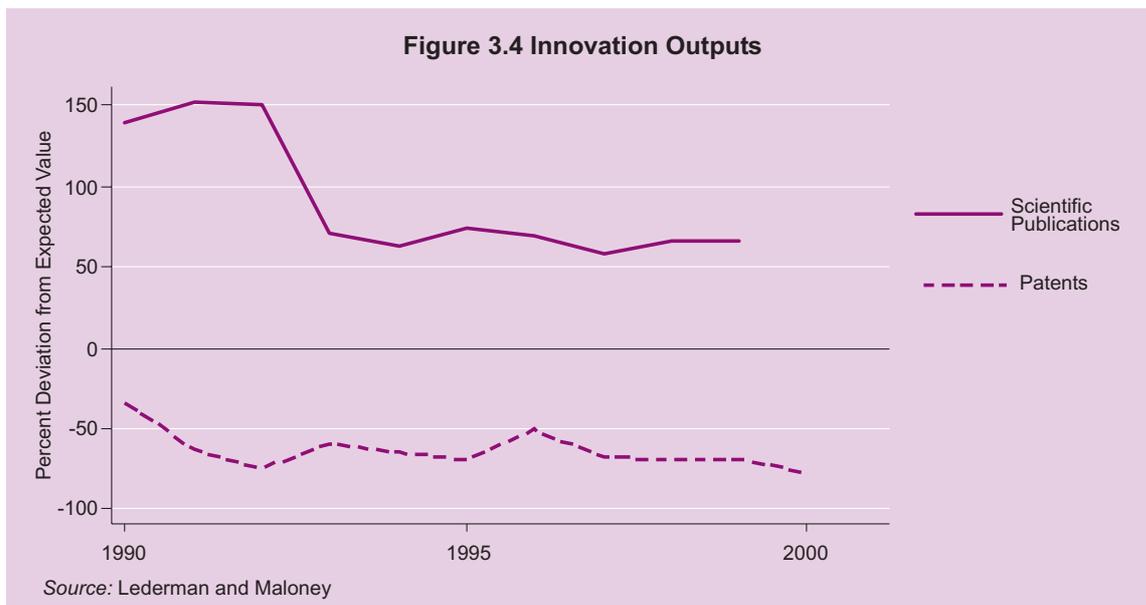
In HEIs, the guidelines concerning IPRs are an impediment for applied research, commercialization and developing linkages with business because they vary institution by institution. The Law on Industrial Property establishes clearly that, in general, innovative research that is carried out in the work place is owned by the employer. Although the next paragraph in the law does allow for the regulation of this issue through a specific contract, such arrangements remain a matter of goodwill. A few years ago the Ministry of Education, MENiS, encouraged HEIs to introduce special rules on this subject that would define the division of profits from innovations and patenting. However, although some technical universities did follow these suggestions, most, especially the liberal arts universities, were less interested and were reluctant to comply. We recommend that the Government of Poland take decisive action to encourage universities to develop a clear and common approach that incentivises the researchers by giving

¹³ This agreement is Annex 1C to the 1994 Marrakesh Agreement Establishing the World Trade Organization (WTO).

them the right to any commercial revenues from patents that their research generates. The Government could also seek to influence the arrangements by inserting a specific clause in the research allocations to ensure incentives for the researchers in work they are funding. All of these have only passive benefits unless there is also a proactive approach to commercialization, which justifies the investment in a patent.

A fact that is certain to be of major importance in the future is the continuing work in the EU on the introduction of a “Community Patent.” This patent would allow inventors to obtain, with just one application, a single patent that is legally valid throughout the EU at a fraction of the existing cost of doing so. Currently, patent protection in several European countries costs around five times as much as in the United States or Japan (European Commission 2003). Building institutions to improve the enforcement of IPRs is discussed in the next section of this chapter.

In March of this year, the European Parliament passed a new directive prepared by the European Commission on intellectual property rights enforcement. The purposes of the directive are to harmonize European IPR legislation and to combat the rapid growth of piracy. During parliamentary debates on the subject, critics from both academic and industry circles said the proposed directive went far in increasing the severity of penalties for infringements of IPRs (including unwitting ones), introducing sweeping changes which transform infractions previously treated as civil cases into criminal violations. These measures were, however, defeated and not included in the final text of the legislation. However, the directive does contain provisions allowing companies to raid offices and homes, seize property and petition courts to freeze the bank accounts of those they believe to be engaged in piracy.



Finally, we look again at the World Bank database presented in Chapter 2, which in addition to tracking innovation inputs over time, is tracking innovation outputs by following two indicators: the number of patents granted by the U.S. patenting authority and the number of scientific publications. Figure 3.4 benchmarks research outputs in comparison with the average outputs in countries with the same levels of GDP, the same size labor force and the same value of exports to the United States since the 1960s.¹⁴ The graph shows how far Poland is from the average

¹⁴ The data on patents granted by the U.S. Patent Office to innovators residing around the globe and the number of scientific publications provided by the U.S. National Research Foundation were collected by Lederman and Saenz (2003). The series plotted are the residuals from a regression on GDP and Population and their squares. See Bosch et al. (2003) for technical details about the methodologies and data.

of similar economies (the zero line). As mentioned in Chapter 2, a negative number on the vertical axis is evidence of underperformance. Poland's performance in U.S. patents is below the average of countries with similar characteristics and has declined through the 1990s. In scientific publications, Poland is significantly above the average although a significant decline occurred in the early 1990s. Poland has only recently begun actively interacting on the world stage, which might explain the anomaly of over-performance in articles, but underperformance in patents. In comparison, The Knowledge Management Institute (KMI) in Krakow developed a Technology Assessment Index which indicates "...low productivity of knowledge personnel employed in Polish firms and institutions as clearly shown by the low number of published research papers and patented ideas, ...the relatively low amounts spent on patent rights and copyrights". (KMI, 2002, page 91)

Building Enforcement Institutions (Including Enforcement of IPRs)

Another, and probably much more significant IPR issue is enforcement. Here, we are concerned primarily with problems in the operation of the judicial and patent systems. According to the Ministry of Justice, there were around 900,000 economic lawsuits in 2000, which amounted to 12 percent of all lawsuits. The average duration of such cases is around 14 months; however, in large cities it is much longer (e.g., 19 months in Warsaw and 17 months in Krakow). According to surveyed entrepreneurs, this is due to the indolence of the courts' clerks and officers, overgrown bureaucracy, and the low level of judges' qualifications (PARP, 2002).

The importance of the judicial system is demonstrated by the fact that 63 percent of SMEs surveyed declared that they had at least one case in court. The majority of these firms (over 60 percent) filed these suits in order to recover remittances (PARP 2002). The low efficiency of the judicial system is also confirmed by the World Bank *Doing Business* database (see Table 3.2) according to which 1000 days are needed to enforce a contract, as opposed to 270 days in Czech Republic, 365 in Hungary, 420 in Slovak Republic and 233 in OECD countries. Of course, such extensive remittance-recovery periods decrease the effectiveness of investments and significantly increase the costs of running a business. As mentioned before, such costs are particularly burdensome for SMEs, and therefore for innovative start-ups as well.

There are 28 Regional Patent Information Centers (RPICs), of which 19 are fully prepared to join the patent information network under the auspices of the European Patent Office (EPO). Compared to the EU countries, the network is very well developed. The RPICs are mainly located in libraries at universities in the largest cities, with only a few exceptions. The operational costs of the RPICs are partially covered by the host organizations and partially by the Polish Patent Office, UPRP. In Table 3.3, we present a brief overview of the strengths and weaknesses of, and opportunities and threats facing the Polish patent system.

Proposals Regarding Enforcement Institutions

1. The effectiveness of UPRP, the Polish Patent Office, needs to be strengthened and a special system of patent courts introduced. Investment in the computerization of the Regional Patent Information Centers is needed (e.g., the establishment of an Intranet linking the Patent Office and the RPICs) in order to facilitate access to the information currently available only on the UPRP servers. The staff of the RPICs needs further training (not only by people from the UPRP but also other agencies, especially agencies that support SMEs and are familiar with business issues).
2. An educational campaign in the SME sector promoting the RPICs should be conducted in cooperation with PARP, chambers of commerce, and industrial organizations.

Table 3.3 The Polish Patent System—SWOT

Strengths	Weaknesses
<ul style="list-style-type: none"> – Well-developed network – RPICs are well equipped and the staff is well prepared – good cooperation with academia (as majority of RPICs are located at universities) – good relations with PARP (Polish Agency for Entrepreneurship Development) 	<ul style="list-style-type: none"> – Northeastern Poland is not adequately covered by the network – low level of financing of RPICs – no cooperation with the business sector
Opportunities	Threats
<ul style="list-style-type: none"> – cooperation with the Polish Agency for Enterprise Development (also within the framework of the National Operation Program) on the field of education and popularization of the issues related to the IPR – inclusion of the RPICs in the EPO network (possible co-financing) – promotion of RPICs within the Regional Innovation Strategy (RIS) projects 	<ul style="list-style-type: none"> – no interest from business associations – low awareness of public administration on the subject – creation of an alternative network (within the PARP network or EU-financed initiatives) – no financing from public administration – poor service quality

Source: CASE, 2003

3. RPICs should be included in the European Patent Office network.
4. Steps should be taken to expedite and improve the functioning of the courts; these steps include computerization and other investments and changes in procedure for appointments to the judiciary.
5. Because of the importance of collateral in obtaining loans, computerization of asset registries, particularly land ownership registry, is significant for improving Poland's business environment.

Effect of Bureaucracy and Corruption on Innovation

Innovation and entrepreneurship in Poland is hampered by the extensive bureaucracy of national and regional administrations. According to a survey for the EBRD *Transition Report*, Polish entrepreneurs and managers of private firms spend around 9.5 percent of their time exclusively on contacts with local and central officials and other public regulators (EBRD 2002).¹⁵ In comparison, the survey reveals that Russian managers spend 9.0 percent of their time on such contacts, Hungarians and Slovaks 7 percent, and Czechs only 2.5 percent (Table 3.4). While some of that time may be spent constructively, it is safe to assume that much, if not most, of it is devoted to bureaucratic matters. The clear conclusion is that there are too many administrative regulations, and administrative procedures are too complicated. Moreover, public administration at both the central and local levels is highly inefficient, as it is poorly equipped (the computerization of public administration is seriously lagging behind in Poland, *especially in the courts*) and the qualifications of administrative staff are inadequate.

¹⁵ EBRD Transition Report (2002).

Table 3.4 Time Spent by Managers on Contacts with Public Officials (% of total working time)

Poland	9.5
Czech Republic	2.5
Hungary	7.0
Slovakia	7.0
Russia	9.0

Source: EBRD Transition Report (2002).

Because innovative projects and companies are usually rather small and new, the costs of bureaucracy for them are disproportionately high. Additionally, these companies very often operate in highly-regulated sectors (e.g., ICT, health care), doubling the burden of bureaucracy on the development of innovations in Poland.

Recent comparative empirical research has demonstrated the negative effect of corruption on the economy (Mauro 1996; Pak Hung Mo 2001;

World Bank 2001). In an econometric analysis of the channels and effects of corruption, Pak Hung Mo identifies a strong negative effect of corruption on the level of human capital, an area of particular importance for the knowledge economy.

According to a research survey conducted in 1999 by CBOS, the Public Opinion Research Center, the most corrupt area of Polish life is the health care system, indicated by over 67 percent of respondents, followed by the judicial system (49 percent), local administration (39 percent), and central administration (25 percent) (Open Society Institute [OSI] 2002). Public procurements are particularly rife with corruption. We can see, therefore, that corruption is present in areas that are of key importance for the development of innovative activities (for example, the health care system is crucial for the pharmaceutical and medical equipment industries, and public procurements play an important role for the computer and software industries that are computerizing public administration).

In conclusion, the level of corruption in Poland is a serious obstacle to the development of innovative projects and firms, as it significantly increases the costs of business activity, and in particular those of new and small firms. A successful anticorruption campaign is one of the main challenges facing Polish policymakers. The main activities in this area should be aimed at, improving the transparency of administrative procedures, decreasing bureaucratic barriers, and computerizing public administration (e.g., introducing e-procurement). The new law on public procurement, currently in the parliament, introduces online auctions for purchases of up to 60.000 euro. This is seen as a first step towards public e-procurement.

This chapter reviewed the business environment as it affects the incentives for innovation in Poland. Having established the role of the firm at the center of innovation, it focused on the incentives of enterprises. Specifically, we discussed business incorporation, IPRs, the effects of labor market rigidities and government bureaucracy. As firms operate within the context of their location, regional disparities were explored. However, within the context of this Assessment, we can only point out the nature of the disparities and can hardly provide specific proposals for solutions. It is assumed that the ongoing studies by the Ministry of Economy with the support of the EU will focus on the regional disparities discussed in the literature cited and outlined in this chapter. The next chapter will focus on the funding of innovation while Chapter 5 will discuss the building of institutional infrastructure required to support innovation. The other two constituent elements of the knowledge-based economy are discussed in Chapters 6 and 7, focusing on learning systems and information and communication technologies, respectively.

4. ENCOURAGING PRIVATE FUNDING OF R&D

The design of programs to encourage private funding of R&D has exercised the minds of policymakers in developed and developing countries. Countries such as Canada, Finland, France, the United Kingdom, the United States, and Australia have all contributed practical examples of ways in which governments catalyze the flow of risk capital for R&D- and innovation-related activities. This chapter considers the *supply of funds* or financial support options for R&D, while Chapter 5 explores the demand for funds coming from new ideas and projects, and the institutional options for encouraging R&D and innovation. There are also constraints on the *demand for funding*; these can arise from insufficient skills to prepare and present projects at a very early stage, and from shortages within firms of some of the key business skills necessary to maximize the commercial benefits of innovation. More important, lack of innovative ideas and projects is the reason for low demand for funding. The institutions required to elicit new ideas will be discussed in the next chapter. An argument can be made that it is the lack of ideas or projects which is the missing link in Poland's NIS. However, in a background paper for the KEA, Grudzewski and Hejduk et. al. (2003) relate the low levels of indigenous innovation to the lack of early stage funding for innovative SMEs in Poland. According to the Knowledge Management Institute in Krakow (2002), the lack of venture capital funds has a "detrimental effect on opportunities to apply the expertise and creativity of individual entrepreneurs, and in effect, on the innovative character of the entire economy". Therefore, based on this recent research on the issue of funding, in Chapter 5, we consider it important to discuss first, the supply of funding and second, the demand for funding.

The Commercialization Cycle

Financing difficulties are particularly acute for technology-oriented SMEs at the formation and earliest development stages. Limited tangible assets reduce their opportunity for collateral-based lending from retail banks, which is the predominant source of external finance. The ability of new entrepreneurs from a technology/scientific background to attract external equity finance—that is, formal VC—is prejudiced by their frequent lack of commercial experience and the absence of an established track record of successful enterprise; the economic value of IPRs created by the company is unproven at that point, even though initial investment costs, particularly R&D, have already been incurred. Consequently, owner-managers of technology-oriented SMEs are heavily dependent on personal financing (including family resources) for initial capitalization, in addition to relying on trade credit and, to a lesser extent, government grants. By far the largest source of capital for technology-oriented SMEs is equity, which has three major providers. The first is the owner of the business; this person can perhaps raise funds by mortgaging his or her house and obtaining equity or quasi-equity from friends and family.

The second provider is the business "angel" investor. These are often ex-entrepreneurs and chief executive officers (CEOs) who are willing to make small investments in start-up companies because they understand the industry or see the market potential for the product or service. So they provide cash and know-how, which are the two aspects that are most difficult for the entrepreneur to obtain. The United States, for example, has a long history of experienced businesspeople investing time and money in fledging businesses.

The third major provider of equity is the venture capital institution (VC). Generally this is an entity or someone who provides equity for young, unquoted companies with high growth potential and high commercial uncertainty.

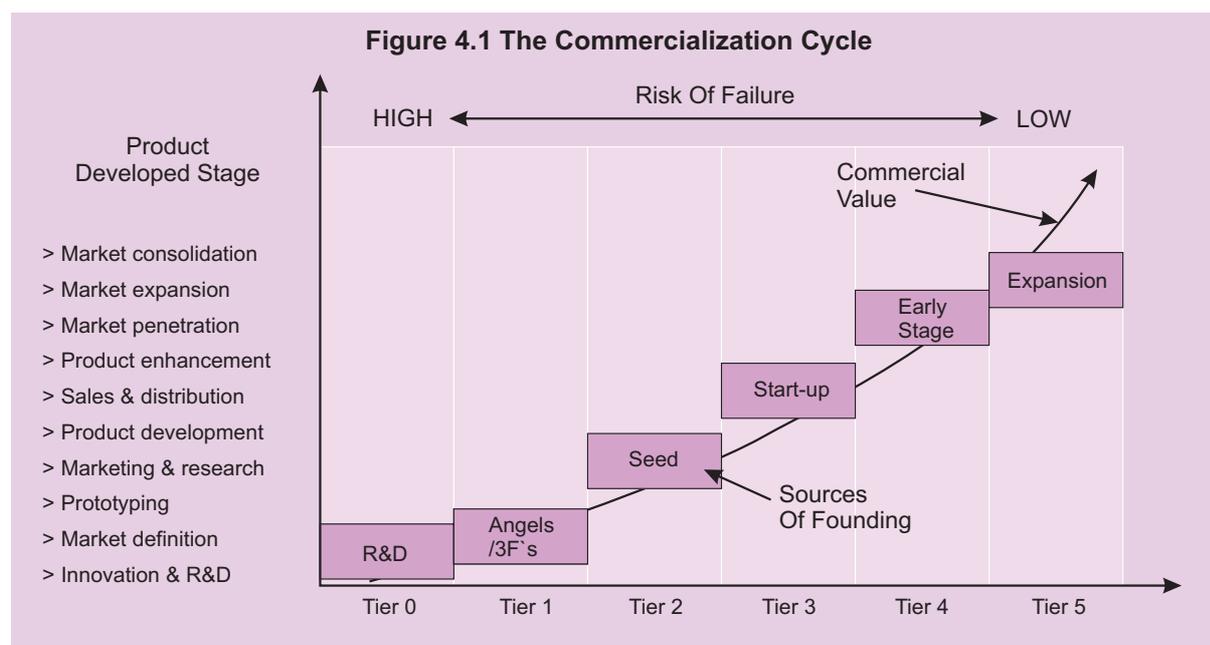
4. Encouraging Private Funding of R&D

Central to the logic of VC investing is the ability of VCs to realize their investment with a return that reflects the risks that they took and the fact that the investment was illiquid for some period. The availability of equity capital to technology-oriented SMEs is therefore driven to a large extent by whether investors predict that money invested will be returned to them within a reasonable period and with a profit. If investors cannot identify an exit strategy, they will not invest.

The sale of the equity in a company, by existing investors to a new group—that is, the exit—can take a number of forms but the essential characteristic is that the early investors sell their shares in the SME to a later round of investors, or strategic partners, or in a few cases through the public stock markets.

While public stock markets in developed countries, such as the United States, sometimes provide an exit for investors in technology-oriented SMEs; in Eastern Europe,¹ less than 3 percent of private equity investments in companies in 1998 and 1999 were through initial public offerings (IPOs) on the stock market, compared to 38 percent of companies being sold to strategic partners. Other exit routes involve management buyouts, which are less popular with investors because they do not yield particularly high returns and sale to later-round venture funds.

In explaining the absence of VC or private funds for technology-oriented SMEs most commentators refer to the gap in the market as illustrated in Figure 4.1.



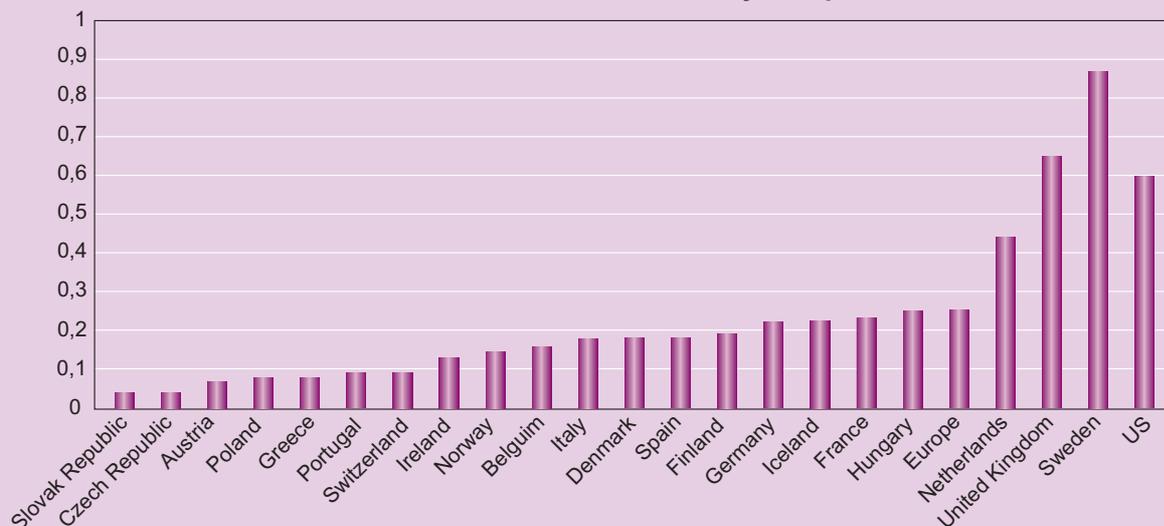
THE POLISH VENTURE CAPITAL INDUSTRY AND THE EQUITY GAP

The Polish VC industry, which has Enterprise Investors as one of the most successful funds in Eastern Europe, is quite well developed; it has returned over US\$300 million to its investors and raised a further US\$660 million to fund new opportunities². Subject to further investigation, the pipeline of potential innovative investment opportunities could be significant. The relative size of Poland's VC industry is illustrated in Figure 4.2, which also compares VC private equity

¹ Leeds and Sunderland (2003).

² Enterprise Investors at www.ei.com.pl

Figure 4.2 Venture Capital Private Equity Investment as % of GDP in 2001—Cross Country Comparison



Note: Private Equity, providing equity capital to enterprises not quoted on a stock market, refers to all stages of industry, such as Venture Capital and Buyouts, while Venture Capital refers to early stage (=seed and start-up) and Expansion finance.
Source: European Venture Capital Association

investment as percentage of GDP in 2001 in selected countries. Poland comes ahead of the Czech Republic and Austria but lags behind Hungary and the European average.

The public markets in economies such as Poland provide capital only to the largest domestic companies. The Warsaw Stock Exchange (WSE) has approximately 20 large companies, including banks, which are traded actively. In order to cater to smaller companies, the WSE has set up an Over-the-Counter (OTC) stock market where SMEs can list shares and raise money.

But this market is not active because it does not suit the SMEs or the financial institutions. The SMEs find compliance with the listing particulars and reporting requirements too expensive; many small companies report that compliance alone requires three additional staff members in their main office. Polish financial institutions, which are prohibited from investing in unquoted companies, including VC funds, shy away from investing in quoted SMEs because the potential investment size of, say, US\$ 2–5 million is too small to support the monitoring costs and would give them a disproportionate share of the equity.

For the VC industry in Poland this means that there are few exit routes via which it can retrieve its investments. As a result the main focus of VC investments is companies that could appeal to domestic and international strategic partners. These tend to be larger local companies with sales in excess of US\$20 million that, if purchased, would enable buyers to gain significant local market share in a particular industry. Smaller companies with new technologies that have not established themselves in the market present an unattractive risk to venture capitalists seeking to sell their investments to strategic buyers.

The *gap in the equity market* is particularly pronounced in Poland because the VC market has been designed to invest in larger deals. The VC industry has raised US\$ 1.5 billion from its investors on the basis of a commercial model that requires VCs to invest in large deals (US\$5 million and above). As a result the type of VC that is offered in the Polish market is mainly expansion capital. However, the market reality is that the VC funds have difficulty finding deals in their target range, particularly in the current downturn; for example, less than \$50 million was invested by the industry in Poland in 2002.³

³ IFC Private Equity Conference, Washington DC, May 2003.

From a cost point of view, VC funds cannot afford to look at smaller deals. The relationship between the amount of funds raised and the target number of investments is key to understanding why venture funds will not address technology-oriented SMEs.⁴ A second problem occurs once the investment is made; the operating cost of monitoring, say, 100 deals of US\$ 500,000 is probably 10 times as costly as the cost of monitoring 10 US\$ 5 million deals. Therefore, the fund is forced, by the mathematics of its own operating costs, to pursue larger deals.

From the practical standpoint of daily operations there are two further reasons why this sector is under-serviced in Poland. The first is that the money raised by venture capitalists from investors was committed with larger deals in mind across a broad cross-section of commercial sectors. Many of the incorporation documents of existing funds expressly prohibit investment in unproven technology-oriented SMEs and have a lower limit in terms of deal size. While some of these problems could be overcome by going back to investors to seek a waiver, VC funds would need a compelling story to convince investors that it is worth investing in small and unproven technology deals.

The second reason relates to the skills a seed fund would need to pursue investments in various sectors. Technology investing is very specialized because the fund managers must be able to understand a variety of technologies. Some Polish venture funds, such as MCI, advertise as seed capital providers for the technology industry, with investments of \$100–500,000, which would appear to be what is required. But while MCI does meet the required size criteria, its focus is on proven technology that has been commercialized in the EU and the United States. The fund does not seek technology start-up investments from universities and research institutes because it believes that such investments are too risky and it does not have the expertise to address the “unproven” technology issues.

The Polish VC industry cannot address technology-oriented SMEs at the moment because of the way it is structured and because it lacks the expertise to evaluate high technology risks. Therefore, despite the large pool of unutilized VC in Poland, the equity gap at the seed capital level is likely to persist. To make the Polish capital markets more accessible to smaller companies, we propose simplifying the listing procedure for smaller companies on the WSE so that it is not so costly and time-consuming. We also propose that pension funds and insurance companies be allowed to invest a small proportion of their funds, say 2 percent, in the pre-IPO stage alongside VC money and in smaller cap companies once they are on the capital market.

GOVERNMENT PROGRAMS TO ENCOURAGE PRIVATE R&D

There is a wide range of policy instruments that affect innovation and R&D—from direct measures involving the transfer of funds to individual organizations and/or firms to indirect measures such as tax incentives for R&D or public-private partnerships to support the raising of start-up capital markets by innovating companies. In an ideal world, all these measures should be combined into a system combining several types of complementary schemes. However, due to fiscal constraints and limited capacity of the civil service, a more narrowly focused program is proposed. In this chapter we will consider the arguments for and against the following seven measures that we consider most relevant, in the order listed below:

1. Tax incentives;
2. Matching grants;

⁴ For example, if a fund has \$50 million under management and it receives a 2 percent management fee, it has US\$1 million to cover its costs. Probably \$ 700,000 per year would go toward covering fixed operating costs, such as salaries, office expenses, developing a pipeline of opportunities, etc. and US\$300,000 would go toward covering due diligence on, say, three deals. Whether the deal size is \$500,000 or US\$5 million the cost of due diligence would be roughly the same but if the venture capitalist went after smaller deals it would run out of operating budget.

3. Conditional reimbursable loans;
4. Government-owned and -managed VC funds;
5. Partial-risk guarantees; and
6. Government risk-sharing in privately run VC funds.
7. Government procurement for R&D

We argue that loans, and government-owned and -managed funds are not appropriate for Poland and that guarantees are an attractive but extremely risky option. Regarding tax benefits, the Government needs to consider the advantages of such benefits vis-à-vis the added complexity into an already complicated tax system. We do not propose Government procurement as an attractive measure in the immediate future because procurement is subject to high risk of corruption⁵. Subject to fiscal considerations and several other caveats, we propose matching grants and government risk-sharing in privately-managed VC funds.

An example of the use of the abovementioned instruments, Figure 4.3 shows the allocation of the Finnish “Tekes” R&D Funding in 2002. It is noteworthy that out of 381 million Euros of total funding 38 percent is directed to universities and institutes and 62 percent to companies.

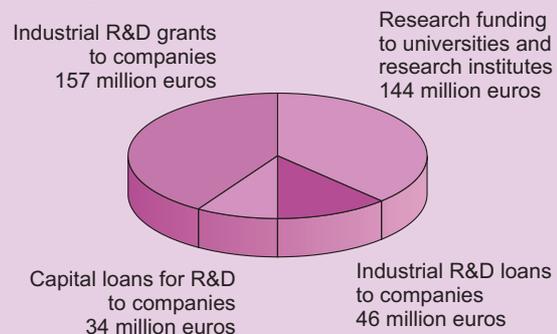
Currently, the enterprise sector in Poland, in particular SMEs, has very limited access to KBN grants. There are two channels: first, enterprises can apply together with a JBR within the framework of the targeted funds (*fundusze celowe*). Second, SMEs can apply in the KBN for a status of a scientific institution (*jednostka naukowa*). There are only few companies, which managed to apply and obtain such a status. The only channel available to SMEs is to apply for funding of R&D through PARP (Polish Agency for Entrepreneurship Development). Companies may apply for grants within the framework of the PARP’s program “Innovations and Technologies for the Enterprise Development” (*Innowacje i technologie dla rozwoju przedsiębiorstw*). The program is financed by Phare Program and the Polish government. The budget of the program amounts to 9,33 millions Euro. Grants vary from 1,500 to 10,000 Euro. The companies may also apply to PARP for the “Loans on Innovation” (*Pożyczki na innowacje*). The maximum level of a loan is 2 million PLN. The instruments described in this section, builds upon the EU report, *Raising EU R&D Intensity*, with the view that the proposed instruments qualify as EU schemes.

Tax Incentives

According to the EU Raising R&D Intensity, Fiscal Measures Committee, “...fiscal incentives are recommended to be used to support private R&D because these schemes have the potential to address a wide range of firms, including SMEs, and leave the decision as to the content of the research to their discretion. If well designed, fiscal schemes can contribute to raising the overall level of investment in business R&D...” The report further argues that although schemes based on corporation tax are the most widely used type of schemes, notable exceptions are Finland and Germany where this general trend is overruled by policy considerations to simplify or not further complicate the overall tax system.” (EU 2003, Fiscal Measures, page ix).

⁵ Procurement for the Lockheed Martin is not discussed in this report and should be treated separately.

Figure 4.3 Finnish Support to R&D



Source: Tekes, Annual Review 2002

Tax benefits for R&D are not new in Poland: the “Guidelines for Innovation Policy in Poland” issued by KBN in 1994 broadened the application of an existing tax benefit, recognizing R&D expenditures as a cost. A new benefit was introduced: deduction of expenditures on patents, licenses, and other know-how purchases up to 50 percent of income. This KBN document also introduced accelerated depreciation on R&D capital assets. Several surveys found that “tax benefits exemptions are difficult to use, especially by private SMEs.”⁶ ⁷

Fiscal incentives for R&D can be designed in many different ways, using corporation tax, the company’s share of wage tax (and associated social security premiums), or personal income tax regimes as a basis. How appropriate they are depends on local conditions and overall fiscal policy. Tax incentives, however, can promote tax avoidance behavior and may create an unsustainable motivation for investing in VC funds. If a country is going to have a tax credit, then it is necessary to define R&D for purposes of the credit. The US regulations regarding this definition of R&D are voluminous⁸. For many Accession countries such as Poland harmonizing the overall tax system probably may have greater priority than complicating it with R&D incentives. *In conclusion, the Government faces a trade off between tax credits as a means of stimulating R&D and other instruments (see below on grants) which do further complicate the tax code.*

Matching Grants

Grants to firms, or only to SMEs, to perform R&D could be a simpler (compared to tax incentives) direct measure—more or less equivalent to a fiscal incentive but distinguished from that by a selection mechanism that applies criteria to applicants and imposes conditions through a contract with those chosen to receive funding. For example, the matching grants could be targeted only to technology-oriented SMEs. The combination of the selection process and the contractual obligations creates an instrument that has a variety of forms and that can be fine-tuned to meet a wide range of objectives that can be defined at the outset and verified during the process. European governments have used grants to mainly target SMEs in general technology development programs although measures continue to be open to larger firms in a few sectors such as aerospace, transport, and energy.

An important trend has been the development and exploitation of linkages between firms, sometimes along the supply chain. Many other types of actors can be involved at the project level including the science base and users of technology. The variety of actors may also be reflected in collaboration between sponsoring ministries or agencies—an increasing trend as countries attempt to increase the flexibility of their innovation support systems. However, grants to consortia of actors (firms, institutes, universities) may pose difficulties because they cover

⁶ See Okoń-Horodyńska and Jasiński (2002).

⁷ There are many facets underlying the way in which a fiscal policy is designed to stimulate business R&D. The general fiscal environment will have a significant effect on which type of taxation regimes is appropriate. For example, other things being equal, the benefit from a tax allowance in a country with a low level of corporation tax will be smaller compared to another with a higher level. Choices to make relate to the selection of the target group (by size of firm, for instance) and the definition of the eligible R&D expenses (current R&D expenses, R&D labor costs, total R&D expenses, innovation expenditures, collaborative or outsourced research). Examples of policies that reduce the taxable income of a company are accelerated depreciation schemes for investments made for R&D activities. Another major decision concerns the question of whether fiscal policy reduces the taxable income of the company (in the case of allowances), or whether it reduces the corporation tax liabilities (in the case of tax credits). A special R&D allowance makes it possible for a firm to deduct more than 100 percent of its current eligible R&D expenditures from its taxable income. Tax credits, on the other hand, enable firms to deduct a percentage of their R&D expenses directly from their tax liabilities.

⁸ It was rumored that a large company claimed a tax credit for the cost of developing a new hamburger. Investment banks have tried to claim the credit for the costs of developing financial products. Some companies strive to classify quality control as R&D since “the employees are wearing white coats.”

multiple recipients doing different tasks. The grants need to meet the timescale of the various participants and allocate resources among the parties.

The main weakness of grant schemes relates to the “selection problem”, i.e. the problem of civil servants “picking winners.” A further potential weakness of a grants scheme is its capture by lobby groups or by regular users who exploit a developed capacity to succeed in the applications procedure.

The example of the Israeli program might be relevant in the context of this selection problem. Qualifying firms there submit grant applications for specific R&D projects, these are reviewed by a Research Committee, and if approved (about 70 percent are) the applicants receive a grant of up to 50 percent of the stated R&D budget for the project. Successful projects (i.e., those leading to sales) are required to repay the grant, as a royalty from revenue, up to the dollar-linked amount of the grant.⁹ In this scheme the sharing of risk with the firm alleviates, although it does not eliminate, the negative consequences of “picking the winners” by the public sector.

Overcoming the selection problem remains a challenge in Poland in view of the bureaucracy and corruption risks described in Chapter 3. Excessive administrative procedures can make the grant program too complicated and thus unattractive for SMEs. As mentioned in Chapter 3, public procurement is particularly affected by corruption, which does not bode well for grant allocation systems.

Our conclusion on grants is that good practice appears to be using them to provide incentives for developing new networks and collaborative linkages. The value of grants can be diminished if the complexity of applying for grants makes them less accessible to SMEs, which in turn tends to favor larger, more experienced firms. Several surveys of enterprises found that the largest interest in R&D financial support measures was in “purpose oriented research grants and... investment reliefs” (Okon-Horodyńska and Jasiński 2002)

The possibility of making grants conditional upon collaboration with the VC industry (possibly making the due diligence of a VC manager a prerequisite for the grant eligibility) will be explored in the next subsection. The risk sharing embedded in a matching grants scheme depends upon the ratio of private and public participation; the grant could be 50% or could be more attractive by changing the mix i.e. the Government could provide say 70% and private parties provide 30%.

Conditional Reimbursable Loans

Conditional reimbursable loans are grants that are repayable if the supported innovation is successful. These are only feasible when the R&D is targeted at products or services that will be commercialized within a short period.

On the positive side, loans are well-placed at the prototyping stage because the risk profile is clear and there is an opportunity to use intellectual assets as collateral. At least for the funding agency the incentive to promote commercialization is greater as reimbursement is a clear performance measure.

Points to watch are that the loans are properly recorded in the books of the company and that success is declared at the appropriate time rather than hidden to avoid repaying the loan.

⁹ Actually the original payback schedule was as follows: 3 percent of revenues from sales of the products developed for the first three years; 4 percent in the next three years, and 5 percent from the seventh year onward. This schedule has been revised a few times, and the Israel’s Treasury has long been pressuring the OCS to increase these percentages, and even impose interest payments.

Our conclusion on conditional reimbursable loans is that their repayment is dependent on successful commercialization of the product or service. Therefore, the administration of such instruments should be put in the hands of the private sector, such as banks and VCs that are familiar with the commercial operations of the business.

Government-Owned and -Managed Venture Capital Funds

By providing the capital and managing the VC funds, governments act as the investors in “seeding” the VC industry, in “high priority” sectors. These programs tend to be driven by specific country needs, such as regional development or export revenue generation, and by high-risk start-ups—and are generally viewed as being at best partially successful because in many instances the funds achieve poor returns. Two examples are provided here:

Australian Direct Government VC Funding. The government directly participated in VC funding through its federal and state development banks. The main problem with government-run funds is that the government officials do not have the management expertise to develop and assess VC deals.

Hungary’s Direct Government VC Funds. The Hungarian Government set up two innovation funds targeting high-risk innovative technology-oriented SMEs. After these funds failed to get profitable returns for their investment, they were closed down.

Our conclusion about government-run VC institutions is that these are not successful and should be transferred to the private sector.

Partial-Risk Guarantees

On the policy continuum we now move from direct government intervention to indirect intervention—in other words, using the private sector to administer the policy instrument. Guarantees of bank loans to R&D were introduced during 1994–2000 as part of the KBN 1994 program mentioned above while the regulations on preferential credits were only introduced in 2000.¹⁰

Guarantees¹¹ are the financial instruments that many governments choose to use to catalyze investment in R&D via public sector bodies offering to cover or share part of the risk associated with technology-oriented SME investments. These guarantees work by transferring some or all of the risk of investing to a third party (the guarantor). A loan guarantee is the promise of the guarantor to pay the loan if the borrower cannot or does not repay. Losses are covered by the public budget and therefore should be considered as a subsidy or state aid. Such public loan guarantee schemes are frequently used to help technology-oriented SMEs to gain access to long-term loans. Austria, Germany, Denmark, and Finland all use these guarantees to support technology-oriented SMEs.

Equity guarantees are another policy option. They cover some of the risks of failure (loss risk) associated with equity investments. They have been developed in several European countries in recent years to support the equity financing of small, young, and new technology-based firms by venture capitalists. Another type of equity guarantee protects the capital of financial investors in VC funds. In the Austrian Capital Guarantees scheme, for example, investors in VC funds are

¹⁰ See Okoń-Horodyńska and Jasiński (2002, p. 134)

¹¹ The section on guarantees relies heavily on Raising EU R&D Intensity, Report to the European Commission by the Independent Expert Group.

offered guarantees to encourage them to invest in such funds¹². This type of equity guarantee, which applies to portfolios rather than to individual equity investments, supports the fund-raising efforts of VC funds and enhances the availability of risk capital on capital markets.

Counter-guarantees are financial instruments that allow guarantee providers to share risks. The provider of the counter-guarantee accepts a specified proportion of the risk from the guarantee originator, typically receiving a portion of the guarantee fee in return. The European Investment Fund (EIF) is a major provider of counter-guarantees to national and regional guarantee programs through the European Commission's Multi-Annual Programme (MAP) to support SMEs. Counter-guarantees allow guarantee agencies to pool their strengths; the guarantee originator often has better knowledge of local conditions, while the counter-guarantee agency often has more financial resources. In sum, however, since the fiscal contingent liability of such guarantees is difficult to assess at the initial stage of R&D or project cycle, given the fiscal situation of Poland, we find it difficult to propose this option.

Government Risk Sharing in Privately-Run VC Funds

A preferable role for governments is seeding the VC industry through investing in privately-managed funds. In these public-private partnerships, governments mitigate some of the risk inherent in technology-oriented SME start-ups while the venture capitalist provides commercial and managerial expertise. In time funds graduate from using government support in order to avoid the restrictions placed on the fund by government. This type of initiative can take many forms:

- ***Seeding the VC Industry.*** By participating in a privately managed VC fund, the government lends credibility to the fund and acts as a catalyst for other investors to participate. This works well if the VC industry is experienced and there are attractive opportunities. Israel's Yozma fund is an example of this approach. In 1992, the Israeli government provided US\$100 million divided among 10 private funds. Each fund manager raised a matching amount of private funding. The funds made investments of US\$300,000 to 750,000 in hundreds of companies. By 1997, the government felt that it had achieved its goals and sold the Yozma fund through privatization.
- ***Leveraged returns.*** In this scheme the government, either by subscribing for ordinary equity shares or providing grants, co-invests with private investors but takes only a small part of the return, thus "leveraging" the upside potential for private investors. The Australian Innovation Investment Fund program, for example, provides up to two-thirds of the capital for the VC funds but takes only 10 percent of the returns with the remaining 90 percent allocated to the private investors and management. In exchange, fund managers are required to invest a portion of their fund in SMEs and early-stage companies. Israel's Yozma program and the U.S. Small Business Investment Company (SBIC) program have variations on this basic approach. These programs have proven very successful in countries where there are opportunities to achieve very high returns.
- ***Downside protection.*** Guarantees to VC investors by governments have had the least satisfactory results among programs mentioned here. While these programs can mitigate risk and attract commercial capital they distort investment decisions. Facing limited losses, venture capitalists tend to be less rigorous in assessing the downside of deals. By guaranteeing

¹² In more technical terms, the investor can buy protection against losses ("downside protection") by paying a risk-adjusted guarantee fee. In this instance, the guarantee is structured as a "put option," which gives the purchasers the right to sell an underlying asset at a specified price after a given period of time, and the investors the right to sell their shares to the guarantor at the end of the investment cycle of the VC funds (normally 8–10 years).

a certain return to investors and/or taking a subordinated position in the distribution of the funds' profits, the government protects investors against major losses of principal. The Dutch Private Participation Guarantee Order Scheme guaranteed 50 percent of the losses of venture capitalists investing in certain types of firms. While it did attract private funds it also generated considerable losses for the government, which resulted in the scheme being closed down.

PILOT SEED CAPITAL TRUST

To demonstrate how public-private partnership can elicit private capital to fund R&D, we propose designing a pilot scheme, using several of the policy instruments outlined above to address the allocation of funds to the commercialization of R&D. The pilot scheme will target a gap in the financing market at the seed capital level, which is too expensive for the commercial sector to address it—so the government needs to explore ways to stimulate the market through public intervention. If this option is selected, it is critical that it be linked to funding for technical assistance to train the VC industry in technology investment so that it can devote sufficient energy and expertise to this pilot. Moreover, while considering this proposal, an assessment of the potential “pipeline” or “deal flow” needs to be conducted. It is very difficult to identify or estimate in advance a flow of potential ideas or deals for a VC. One source of information could be the pipeline of projects solicited by MNIi when the Lockheed offsets were negotiated.

In order to address this gap in the market it will be necessary for the government and possibly donors, such as the EU via Structural Funds or the International Financial Institutions, to provide a catalyst to encourage the commitment of effort and funds by private-sector venture capitalists¹³. A pilot scheme to do just that is described in Box 4.1. In designing the scheme, the objective should be to keep the concept as simple as possible and to construct an entity that does not involve a large operating structure or high costs. It is also essential to create a structure that would involve minimal government interference.

Box 4.1 The Trust

A new limited liability company would be established (the “Trust”).

Developmental and Investment Objective: The objective of the Trust would be to galvanize international financial institutions and private equity funds for new technology start-up investments. The Trust would provide matching equity funds, on a deal-by-deal basis, in the ratio of 2:1, alongside the existing pre-qualified funds (see under Pre-qualified VC Funds below) of Polish VC firms that invest in new technology start-ups.

Capital Commitments: The Ministry of Science (MNIi) and the Government of Poland would invest US\$20 million and the international financial institutions and local institutions would invest US\$10 million. Individual VC funds would contribute on a 1:2 basis, deal by deal, increasing the overall size to US\$ 45 million. Any existing, or new and properly formed private equity fund could draw down from the Trust on a 1:2 basis in amounts of \$65,000 or greater (i.e., if the VC invests \$35,000, it would be allowed to draw down \$65,000 from the Trust). In addition, it may be possible to attract debt to the Trust structure from international financial institutions or organizations such as OPIC. These funds would be lent to the high technology start-ups—if their business plans were able to show that they could support debt.

Commitment Period: The Trust would be set up for a period of 10 years at the end of which the money would be returned to the government.

Investment Policy: The Investment Policy of the Trust would be to invest equity in innovative high technology start-up ventures, predominantly to commercialize developments from Polish universities and institutes of higher learning alongside private funds with the decision making and investment monitoring being carried

¹³ Andrzej Góralczyk, Chief Productivity Advisor of CXO Magazine for Top Management, proposes to allocate offset funds to seed professionally managed Venture Capital. See Góralczyk, July 2003.

out by the private funds. The policy would be to focus on several key sectors: the most likely sectors would be life sciences, new materials, application of technology developed in the physical sciences, information technology, and environmental sciences. The investee companies would be start-ups in the main with less than 20 employees and probably negligible assets with the exception of their IPRs.

Pre-qualified VC Funds: To access money from the Trust, VC funds would have to pre-qualify; the process would consist of several requirements including membership in the Polish Venture Capital Association, a track record of successful investments in Poland, and some experience with technology investments. Each pre-qualified venture fund would be expected to designate a technology investment officer who would receive additional training by being seconded to technology investors in the EU. This training would be covered under the Business Enhancement Grant discussed below. In addition, a prequalifying VC fund would be expected to form an advisory board consisting of business people with specific high technology experience; this board would approve investments.

Investment Instruments: These would be in the form of purchase of newly issued ordinary shares from the company, *pari passu* with the private equity funds.

Investment Amounts: Initial investments into companies would generally be US\$ 100,000–500,000, with the possibility of follow-on investments of up to US\$ 1 million per entity. The average investment size is expected to be \$600,000—a potential of 75 separate investments.

Trust Management: The Trust would be administered by three trustees, one from the Ministry of Science, a second from an IFI, and a third from the Venture Capital Association of Poland. The Trust would be based in Warsaw but the activities would be throughout Poland, as required by the private VC funds. The Trust is purely a mechanical device and would not make subjective decisions about investments. If a qualifying VC fund submits an investment proposal in the proper form that meets the Trust's investment policy criteria, and the fund is investing matching funds on a 1:2 basis, the Trust would automatically release matching funding. Decisions to release funds would be communicated to the private equity fund within 14 days of submission.

Returning Money to Investors: Upon the sale of investments, original capital commitments would be returned to the Trust, the IFI, and the private fund on a *pari passu* and dollar-for-dollar basis. After this money is returned the next payout would be the accrued 7 percent interest amount on the IFI investment. After that is paid, all proceeds would go to the private equity fund. This arrangement means that the private equity fund would receive a leveraged return for investing in high technology start-ups, but not downside protection.

Trust Start-Up Expenses: The Trust would pay for any out-of-pocket expenses, such as legal expenses incurred in relation to the establishment of the Trust, up to US\$ 100,000.

Trust Operating Expenses: Certain expenses directly related to the operation of the Trust (such as accounting, auditing costs, bank charges, Board and Investment Committee members' reasonable time and out-of-pocket travel expenses, etc.) would be borne by the Trust. These Trust expenses are not expected to exceed US\$ 100,000 annually.

Venture Capitalists' Fees: Venture capitalists involved in this scheme would be permitted to charge the recipient company a one-off 2 percent fee on the Trust monies invested.

Business Enhancement Grant: The Trust, with the assistance of the IFI, and outside consultants as necessary, would apply to the EU for a grant to help fund the cost of preparing the investee companies for market entry. It is expected that the Trust would raise the equivalent of US\$ 10 million by way of an EU grant. To the extent that the Trust is unable to raise grant funds, technical assistance funds would be provided out of government/MNil funds, thus reducing the overall size of the fund to US\$ 20 million.

Using the grant funds, the Trustees would allocate up to \$50,000 per initial investment and the balance of the grant would be used for appraising follow-on investments. This money would be for the use of the VC manager to procure, as required from outside third parties, a number of services to support investee companies. These services would be similar to those provided to start-up high technology companies by incubators and accelerators but they would be purchased individually from top practitioners at the discretion of the private fund manager. These practitioners would be pre-qualified, with fee structures approved in advance by the Trust.

4. Encouraging Private Funding of R&D

The Pilot Trust received considerable attention during the public consultation process and was discussed in detail with a number of organizations and individuals specializing in venture capital and technology commercialization. Commentators on the Pilot Trust, as outlined above, expressed the following concerns:

1. The Trust, as currently constituted, would offer the opportunity of co-investing to a wide group of 'qualified' investors. This might diffuse the experience of investing in high tech opportunities and therefore be counter productive to the task of building institutional capability. An alternative would be to consider making these funds available to one or two new venture capital funds, on a matching funds basis, so that the development of expertise is focused in a limited number of institutions.
2. Greater emphasis should be placed on post-investment technical assistance. To this end the Business Enhancement Grant should be made available for post-investment technical assistance.
3. Practitioners from the venture capital industry felt that fees of 2% would have to be increased substantially if new funds were to be created. However, the proposed matching basis of 2:1 was considered generous and some practitioners felt that the ratio should be 1:1.
4. Management of the Trust was considered to be a potential problem area. Most commentators felt that management control should not be placed in the hands of ministries or industry associations.
5. Investing in hi-tech opportunities is not limited to start-ups so the Trust should consider later stage investing, and co-investing with companies in the private sector that are already focused on research, such as pharmaceutical companies.

The team has also considered an initiative by the Government of Poland to set up the National Capital Fund as a 'fund of funds' with initial capital of €35 million to invest in 5 seed capital funds aimed at SMEs. The seed funds could receive between PLN 5 and PLN 50 million provided they have raised a matching amount from the private sector. In addition to matching funds the National Capital Fund would provide an expense subsidy of 5% to the seed fund managers to contribute to the high cost of preparing small companies for investment.

The Pilot Trust, as outlined above, could operate successfully alongside these seed funds. The implications of the policy, currently being formulated by the Government, with regard to private equity funding for smaller companies for the Trust Fund will have to be considered more carefully when such policy is more clearly formulated.

CONCLUSION

Our basic proposal to the Polish government is that it should consider a mix of measures based on the fiscal cost vis-à-vis effectiveness in eliciting private R&D. These measures are partially substitutes and partially complements: they can be used in a varying mix. In general, a country would need a broad diversified scope, addressing the different needs of the innovation process and business universe. Although this report proposes that Poland initially focus on: (i) matching grants and (ii) a pilot seed VC fund, the diverse scope and complexity of innovation support systems needs to be recognized.

Following the specific proposals at the conclusion of each section above would imply that:

1. Tax benefits based on corporation tax are the most widely used type of schemes but, as recognized by Finland and Germany, which do not use them, tax incentives would introduce even more complexity into an already complicated Polish tax system.
2. Regarding conditional reimbursable loans, our proposal is that since repayment is dependent on successful commercialization of the product or service, the administration of such instruments should be put in the hands of the private sector, such as banks and VCs that are familiar with the commercial operations of the business.
3. About government-run VC institutions, our proposal is for these to be transferred to the private sector, since they are not successful.
4. Guarantees could be a useful tool, *if used correctly*, and provided that the private sector is significantly at risk in terms of the commitment of its own capital. If the government does choose this option, decision making and management should be located in the private sector, which should share the downside with the government. It is worthwhile to allow the private sector a large portion of the upside. However, since the fiscal contingent liability of such guarantees is difficult to assess at the initial stage of R&D or project cycle, given the fiscal situation of Poland, we find it difficult to propose this option.
5. Our proposal on grants is that good practice appears to be using them to provide incentives for developing new networks and collaborative linkages. The value of grants can be diminished if a complex application process makes them less accessible to SMEs, resulting in favorable treatment for larger, more experienced firms. The possibility of making grants conditional upon collaboration with the VC industry was explored above under Conditional Reimbursable Loans.

We believe that the most successful policy interventions have been public-private partnerships where private agents, such as commercial banks or VC fund managers, have responsibility for implementation and share the risk, while the government either reduces risk and/or enhances returns in exchange for the right to dictate some of the investment criteria, such as deal size, investment stage, or sector. This principle could be applied to the two preferred options that we propose: a combination of matching grants and/or the Pilot Seed Trust presented in Box 4.1. However, we stress that these funding methods must be combined with other tools. Building the institutional support will be discussed in the next chapter and building learning systems will be covered in Chapter 6.

5. BUILDING INSTITUTIONS FOR R&D AND INNOVATION

As we argued in Chapter 2, Poland needs to develop its absorptive capacity by increasing indigenous R&D in order to benefit from foreign direct investment (FDI) and from the technology embedded in high-technology intermediate inputs imported by Polish industry. We will first describe the existing institutions, focusing on government research units (JBRs), and on higher education institutions and then review various models of institutions that have been used to support innovation in other countries

STATE RESEARCH INSTITUTES (JBRs)¹

It has been argued that cooperation between industry and potential sources of innovative technologies such as universities, polytechnic institutes, industrial R&D institutes, and the Polish Academy of Sciences (PAN) is low in Poland.² As a result, after 11 years of systemic transformation in the country, government research institutes (or *jednostki badawczo-rozwojowe*, JBRs) still constitute a government-run enclave in the economy; known in Poland as ‘R&D units’. JBRs operate under the Act of Law dated 25 July, 1985 (with subsequent amendments). The Law grants the same rights to research institutes as well as other R&D centers and allows all R&D centers, design offices and centers to obtain the status of a governmental research unit, which has led to a surge in the number of JBRs.

Despite the new legal framework, organizational and ownership transformations have been delayed, and have hardly made any impact.³ Although such institutes as well as research facilities at universities and polytechnic institutes could have partnered with SMEs that often cannot afford their own laboratories, such cooperation is rare. The JBRs prefer to concentrate on cooperation with their traditional clients instead—large industrial producers in the state-owned or formerly state-owned sector; moreover, they are highly dependent on government grants.

In addition, most entrepreneurs usually lack both the financial resources to pay for R&D services and any awareness of what the institutes could possibly offer them, as R&D institutes generally fail to engage in marketing or promotional activity on any significant scale.

As mentioned above, one of the fundamental weaknesses in the Polish knowledge economy is the very low level of R&D spending by the private sector. The many reasons behind this were described in Chapter 3; here we focus on the structural issues of the orientation of public research infrastructure and funding. In common with most developed economies Poland has a rich infrastructure of industrial research institutes that receive funding from the public budget. Their golden age lasted 25 years; from the early 1950s to the mid-1970s. Most of the branch R&D units were built during this time, mainly in the manufacturing industry. Many of them were established through the transformation of prototype or design offices previously located in enterprises. They were planned as a substitute for, rather than a supplement to, the companies’ in-house R&D, as a centrally-planned and state-owned “outsourcing” of in-house R&D. However, for structural and funding reasons these now have little or no incentive to work closely with industry. Indeed,

¹ Most of the description of the JBRs is the contribution of Jan Kozłowski based on his paper (Kozłowski, 2003)

² This paragraph is based on Gorzyński and Woodward (2003) who cite Radosevic (1999); Gorzelak et al. (1995); Kraslawski and Gajewski (2000).

³ Stance on Privatisation of JBRs adopted by the National Chamber of Commerce (April 2003).

their funding causes them to move precisely in the opposite direction with an emphasis on the quality of academic output rather than commercial relevance.

A unique feature of public research funding is that it is an integrated stream that provides funding to all types of researchers from one source. This integration was put in place during the early stages of transition and resource allocation process has been primarily controlled by the academic community. Broadly speaking, Polish researchers who benefit from this funding stream are found in three types of institutional structures. The three groups are the Polish Academy of Sciences (PAN), the research-based higher education institutions (universities), and the government research institutes (JBRs). In all three cases the funding mechanisms provide both funds to cover core establishment costs and competitive project-based funding for which research teams bid. Evaluation of both core and project bids uses traditional academic research output indicators, primarily publications in refereed academic journals, and currently gives no weight to industrially or socially related activities. There has recently been a change to broaden the base of decision making by returning the final budget allocation decision to the Ministry of Scientific Research and Information Technology, MNIi, setting the scene for broader influences to again be taken into account.

The JBRs are also in a peculiar governance position as their funding comes from the MNIi while their ownership and historic client base lies in other ministries, most significantly the Ministry of Economy. There have been some positive signs with a few units becoming a vehicle of modernization of Polish industries (such as *Instytut Techniki Okrętowej*, shipbuilding). Most have not done so and have adjusted to the new economic climate by reducing their size and using their assets, primarily surplus property to generate revenues to ensure their survival.

Compared to advanced economies, there are a very large number of Polish industrial laboratories (most of which deal with machinery and equipment, textile, chemicals/chemical products, and office, accounting and computing machinery) and a small number of public services laboratories. Also compared to most of the EU countries, most of these public research laboratories are less diversified in activity. Government research units seem to be more geographically concentrated than other parts of the R&D and innovation system, which possibly hampers their relations with regional innovation policies. Today governmental research units employ 12,210 researchers (22 percent of all researchers in Poland, in full-time equivalents [FTEs]) (Kozłowski, 2003).

Initially the purpose of JBRs was to act as knowledge-generating units for the branches of industry they covered—such as Institute for Industrial Design, Institute for Welding, Institute for Wood Industries, etc. Funding through the MNIi stream has caused them to split from their industrial branches and currently they have little incentive from their main client to conduct industrially-relevant research—as they are encouraged to orient to pure academic research by the evaluation criteria of the project-funding mechanisms.

In terms of significance in the Polish R&D infrastructure, branch research institutes are the largest in number—some 232 establishments with 136 in the JBR category—and consume more than one-third of the overall public allocation for research. The allocation to the JBRs has been stable over the last decade with proportionately more of the budget going to PAN and university-based research units. (See Table 5.1)

The following characteristics give some indication of the activities of the government research units. Out of the 166 JBRs in the MNIi database, 103 reported revenues from business activity (sale of production output and sale of services). Revenues from overseas sources were reported by 77 JBRs. Four JBRs earned more than US\$ 1,000,000 (in 2001). Forty-one percent of all JBRs rely on budgetary funds as a main source of funding, while for 56 percent sale of products and services is the main source of income (as of 1999). Forty-nine JBRs introduced technological innovations in production in 2001.

Table 5.1 R&D expenditures by type of institution, in current 2002 prices, 1995–2002

Types of units	1995			1999			2001			2002		
	No. of units	Budget % of GDP	PLN mil (2002 prices)	No. of units	Budget % of GDP	PLN mil (2002 prices)	No. of units	Budget % of GDP	PLN mil (2002 prices)	No. of units	Budget % of GDP	PLN mil (2002 prices)
Polish Academy of Sciences	81	0,08	478,1	81	0,08	558,0	81	0,08	630,4	81	0,08	587,2
Higher education institutions	104	0,17	1 009,9	115	0,20	1 431,0	121	0,21	1 609,0	119	0,20	1 533,8
Branch R&D units:	253	0,31	1 819,1	240	0,28	2 038,5	232	0,24	1 824,1	257	0,23	1 756,9
- Research institutes	128	0,24	1 413,5	136	0,24	1 750,6	136	0,21	1 583,7	139	0,19	1 511,4
- R&D development centers	80	0,05	301,5	76	0,03	240,4	68	0,03	195,3	62	0,02	130,1
- Others	45	0,02	104,1	28	0,01	47,5	28	0,01	45,1	56	0,01	115,4

Source: GUS Yearbook.

Output and activity indicators demonstrate the prominent role of the top 10 institutes in each group of the following activities:

- Three institutes that received the largest numbers of patents—*Instytut Chemii Przemysłowej im. prof. Ignacego Mościckiego*, 97; *Centrum Mechanizacji Górnictwa “Komag,”* 90; and *Instytut Ciężkiej Syntezy Organicznej “Blachownia,”* 68—received over 10 percent of total patents while two-thirds of all units registered at least one patent in the period 1998–2003.
- The top 10 institutes accounted for nearly 60 percent of all publications.
- The top 10 institutes received as many as 78 percent of all citations with the top three achieving 62 percent.
- The top 10 institutes participated in approximately 40 percent of research projects under the Fifth Framework Program, with the top three involved in 17 percent.

In the mid-1990s a detailed study was conducted under the Phare-funded *Scitec* program and proposals were made to focus resources on those parts of the JBR sector that were judged to have both relevance to the future of Poland and high quality researchers and research programs. The proposals of this report were never acted upon, partly because at that stage it was not clear how their relevance to the future of Poland could be judged in the light of the radical industrial transition taking place. A subsequent ‘Report on the Current Status in R&D units reporting to the Ministry of Industry and Commerce’ discusses 124 R&D units out of 136 existing ones and claims that more than 1/3 of the units are strong and key to national interests, another 1/3 could be liquidated or absorbed by other research institutes and further 1/3 are of average importance in Polish S&T. A second study in the same Phare program also proposed that the evaluation criteria and strategic direction of these institutes be in line with their purpose—conducting industrially-relevant research—and oriented to achieving excellence in their particular branch of the economy rather than on purely academic evaluation measures. This report was also not acted upon and academically-oriented criteria were emphasized instead of industrially-relevant work—with the consequences we see today.

State Research Institutes in other countries

In most countries in Central and Eastern Europe and the Former Soviet bloc, state research institutes have undergone radical changes during the decade of transition. The most far-reaching changes occurred in Hungary, the Czech Republic and in the Baltic states.

In Hungary, there were about 25–30 such research institutes in the 1980s, of which only 3 or 4 remain today, although completely changed. Researchers from restructured research units were mostly hired by foreign investors in telecommunication, banking and insurance. More importantly, many of the former employees founded small firms, frequently spin-offs from the old institutes. Few engineers left for the academic sector. The state research units no longer get any government support, unless they apply for and win research grants as any other institution. Privatization proved to be unrealistic: only the infrastructure, mainly the land, was saleable in most cases. Three units were successfully privatized: the Drug Research Institute was purchased by foreign investors and the Plastics Research Institute by its former client. The third, AUTOKUT, car research institute, survives thanks to the relatively big foreign-owned car industry in Hungary; and was bought out by its former managers.⁴

In Estonia, the problems with the state research units were much more complex than in Russia or Central and Eastern Europe because they were primarily financed from Moscow's central funds to cater to the needs of the Soviet military-industrial complex. With changes in this sector, this source of funding completely dried up in the Baltic States. "Most applied research institutes in the Baltic States were actually branches of all the Soviet Union research institutions, with the central institution usually being located in other republics. Some were separate institutes and some were branches of central institutes, directed from the respective central ministries of the USSR. Along with the separation of the Baltic States from the USSR, most bonds to Moscow and co-operative ties with Russians researchers and engineers were cut."⁵ After independence in 1990–1991, the R&D structures of the Baltic States had to be re-framed according to the demands and possibilities of small independent national states with limited natural and human resources. Interestingly, the survivors were the institutions that managed to adapt to a specific niche, like contracts from the West or successful spin-offs. In the last years of Soviet era the total number of branch institutes was 23. Ten years later, only 7 (including 6 agricultural) had survived. "The other R&D institutions, as well as construction and technology units at various enterprises, have changed their legal status, forms of organization and fields of activity."⁶

The Future of the JBRs in Poland

Recently the Minister for the Economy wrote to the 119 JBRs for which the Ministry is responsible and outlined possibilities for their future status and development. Specifically, these could include but need not be limited to:

- Privatization—moving through a variety of routes to private ownership and funding.
- National Institutes—where a few could reconstitute themselves because of their orientation to public purposes. For example, those with competencies in health, environment, and defense branches could become significant long-term providers of research services for the public sector.

⁴ Information provided by Judith Mosoni-Fried.

⁵ Janis Kristapson, Helle Martinson, Ina Dageyte, *Baltic R&D system in Transition*, 2003, p. 56–58, 176–177,

⁶ op. cit.

5. Building Institutions for R&D and Innovation

- Centers for Advanced Technology—where through an aggregation of existing competencies and the development of new research areas a few JBRs could focus on branches with high priority growth opportunities.

While the possibility of changes in these directions and others have been formalized by the Minister's proposals, implementation of any of these solutions are just now beginning to take shape as a consequence of recent organizational change with the creation of a Department for Innovation within the Ministry of Economy.

In autumn 2003 the inter-ministerial team for ownership transformations developed a structural transformation program for all state research units. The discussion document stresses the urgent need for change: "Such a structural ownership transformation program should focus on a variety of forms for JBR to operate under plus a gradual, evolutionary introduction of those changes." The document proposes, among other things, to limit the number of dispersion of JBRs through consolidation (mergers); change the organizational and ownership structure of JBRs, especially those reporting to economy-related ministries; and limit the subject-based funding in favor of object-based funding and sale of research (especially in economy-related ministries).

As regards ownership transformations and structural transformations, the document proposes commercialization (i.e., gradual transition to supervision of the Treasury Ministry prior to privatization), privatization, transformation into a state-owned company, or liquidation. Other forms under consideration include consolidation and preservation of the JBR status, preservation of the JBR status, consolidation and acquisition of the Government Research Institute (GRI), GRI status, incorporation into another JBR, transformation into a PAN institute, incorporation into a PAN institute, incorporation into a government-run HEI, and finally, creation of business organizations following the model of Dutch government's national research institute, TNO, or German Fraunhofer Gesellschaft. Generally speaking, the number of JBRs is expected to be reduced from over 200 to 50 at most.

We believe that it is urgent to take the opportunity to make changes along these lines and encourage action among better institutions that have the potential to play a valuable role in the regeneration of industrially-focused research and the fostering of networks.

This is entirely in line with the strategies followed by the other EU member states; the equivalent institutions across Europe have been encouraged to become relevant to the business sector to the point that they get their main funding from business—through joint projects, service provision, or core membership fees. Examples include the Fraunhofer family of institutes in Germany, the Danish Technology Institute in Denmark, and the many equivalent institutions in the United Kingdom. This is also compatible with the Regional Innovation Strategies that are currently being prepared and the general thrust of the KEA. The EU institutes mentioned above have been changing at varying paces over the last 20 years and have taken that long to move from dominant public budget funding to primarily private sector funding.

The relevance of this shift cannot be overemphasized in Poland as the biggest challenge is encouraging privately-funded R&D to expand from its present paltry level. Having a high quality infrastructure with pump-priming investment from the public budget that is oriented to working with Polish firms will encourage a faster build-up of private R&D spending. It will also enable Poland to participate more fully in EU S&T Framework programs as they require public and private partnerships to improve the chances of findings with commercial potential being used for competitive advantage.

HIGHER EDUCATION INSTITUTIONS (HEIs)

With respect to the possibilities for involvement of universities in technology transfer, Polish universities suffer from many of the problems often observed in the West—for example, universities are seldom well prepared for cooperation with business and lack the necessary administrative flexibility, professionalism in drawing up contracts, and general awareness concerning business practices. (Quevit 1997).

Moreover, KBN concept and procedures (such as the evaluation of project proposals and of project results) did not encourage innovation in tertiary education. The same evaluation procedures apply to PAN and, most surprisingly, to JBRs as well. This is partly due to tradition but also to the fact that there is little demand (pull) from Poland's industry/enterprises, which makes verification of applied projects more difficult compared to basic science projects. Project-based funding is awarded competitively and goes directly to applying research teams, rather than to the HEIs, thus weakening the capacity of central management of HEIs to adopt a central strategy for research. Only a small part of KBN funding (usually less than 20 percent) comes via MENiS for distribution by central university authorities. Therefore, incentives have to be found at the level of the main research teams.

The main disincentive to change the current academic orientation in higher education is the career path of a Polish researcher, which is based on publications in internationally-acclaimed journals. Patents or industrial innovations count significantly less, if at all. There are no clearly defined and stable rules for the evaluation of patenting and innovations as elements of a researcher's work. Each KBN research discipline group defines its own criteria and values to be attributed to patents as compared to scientific publications and other activities. At the institutional level basic and applied research are evaluated in a similar way, without taking into account the specificity of each mode.

The newly proposed Law on Higher Education does not allow professors to hold multiple jobs due to the abuse of multiple appointments in the present system and this could be viewed as a welcome development. But there is a danger that this regulation could constrain healthy linkages with industry. The ban in the draft law is directed at multiple jobs in competing HEIs, which tend to be, for the most part, private. It is true that if this provision in the draft law were to be introduced, an academic would have to seek the rector's approval for any kind of a job, which is normal practice in many countries. We hope that appropriate jobs in enterprises contributing to innovation and research would be considered acceptable activity. However, currently there are no incentives, no encouragement, and no tradition of undertaking such jobs and of achieving career goals through business-related work. We recommend that the draft Law on Higher Education explicitly allow employment of academic staff in business related to their academic activities.

In addition to limited resources to spend on R&D, the available funds are spread too thinly across multiple, inefficient institutions. Education institutions are missing the so-called third leg that relates to business and purpose-funding activities. Donations to HEIs and research establishments from corporations are theoretically possible as is the establishment of foundations or chairs supported by business for specific research activities. A business or an individual can in theory support academic activities and qualify to receive a 15 percent tax deduction. However, in practice this does not often occur.

Recommendations:

- **Create research and commercialization units** in the core management of the HEI or R&D institute. These units would provide advice and active help to academic staff to capture

resources for research from nontraditional sources, manage intellectual property rights, and pursue commercialization objectives on behalf of the academics and the academic institution.

- **Develop active networks** both internally across the main research teams in the HEI so that there is knowledge of the commercial potential of their work and between them and the relevant innovative firms in the areas of research in which they are strong
- **Review** the collaborative research projects in Poland to date with a view to finding out what has worked, and benchmark this with premier HEIs in Europe to be able to disseminate good practices.

R&D COMMERCIALIZATION COORDINATION AND SUPPORT

Business Clusters

In some countries, namely Taiwan, the Republic of Korea, India, and Ireland, business clusters have emerged in industrial parks (e.g., Hsinchu Science-Based Industrial Park in Taiwan or the Hyderabad IT corridor in India). The parks have specialized infrastructure, low-cost real estate, research facilities, incubators, and other support services. Over time, these clusters have resulted in productive SME sectors where the informal dissemination of knowledge among firms and the growth of supplier and customer networks have created a momentum within the industries for FDI, investment, and entrepreneurship. The debate about clusters has evolved from an infrastructure-oriented instrument, to a more virtual, and electronic arrangement. In a recent public debate in Italy—which has built its success in traditional industries around the model of SME clusters—the entire discussion was about the new business model for innovative firms, and have it move from a local clusters paradigm into a “virtual” model. In the latter, a firm (small or large) is in control of a web of relations with service providers, markets, machinery producers, competitors, consultants, providers of ideas, and new products, beyond its location. This seems to emerge as one of the key features of the new cluster model and together with the business association model, it has allowed a remarkable expansion of firms for their production, market needs, and investments.

Clusters have not yet appeared in Poland. However, the Lockheed Martin offset program includes plans for an accelerator at Łódź, while Motorola and Intel have set up R&D facilities in Krakow and Gdańsk, respectively—which suggests that over the next several years we may begin to see clusters develop in these areas.

Training

Management and employee training programs that range in scope and subject from full university-based MBA programs to local seminars are frequently supported by governments. Training programs are important because of their short-term impact of addressing specific skill requirements (i.e., quality assurance, financial control) and for their long-term impact of increasing employee skills and promoting entrepreneurship. Likewise, the development and availability of relevant training programs available to adults through a broad range of institutions (not necessarily all academic) and using distance or open delivery methods, will be an important part of a comprehensive training strategy. Likewise, the development and availability of relevant training programs available to adults through a broad range of institutions (not necessarily all academic) and using distance or open delivery methods, will be an important part of a comprehensive training strategy.

Lack of entrepreneurial and business skills among engineers with advanced technical training is a problem in particular. The inclusion of entrepreneurship modules, including familiarity with VC and high technology start-ups, within advanced technical and scientific education, as well as the inclusion of technology-understanding modules in business school curricula would help solve these problems. The problem of availability of risk capital for commercialization of R&D is not just one of supply, it is also one of demand. SMEs and potential start-ups need more education and advice on the availability and appropriateness of external risk capital.

Providers of risk capital to the scientific community also need specialist training. Assessing technology risks is a highly specialized area of VC. The shortage of suitably qualified and experienced early-stage venture investors is a serious constraint, though affecting only a small number of job positions.

Equally crucial is the development of skills in the management and commercialization of intellectual property in the academic community—both research units and universities. There is embryonic competence in this area in universities but its current orientation is administrative and concentrates on legal ownership rather than commercialization—which is precisely where skills must be strengthened.

Incubators and/or Accelerators

Most developed countries and many developing ones provide advisory services for SMEs on a range of issues through regional or local business development or assistance centers (a developed-country example is Small Business Development Centers in the United States, and a developing-country example is Brazil's SEBRAE support centers). The services provided by these centers include one-stop access to government resources, business plan development, strategic advisory, operational advisory, quality assurance implementation, and research or technology support. Programs access resources from the government, university business schools, and professional service providers. In general, these types of programs work best where assistance is leveraged with access to financing to pursue the goals defined by the assistance. Grudzewski and Hejduk (2003) support the creation of science and technology parks in order to stimulate innovation in Poland. They suggest to focus on key areas, such as biotechnology, material engineering, medical equipment, and telecommunications.

Incubator programs have been tried in a number of countries (e.g., Israel, Ireland, and Finland to name a few) with varying success. Generally, they increase the quantity and quality of the deal flow for early-stage, formal venture investors by converting more research projects into potentially viable business proposals. But they are expensive and entrepreneurs can become dependent on subsidized support.

For example, in 1993, Israel launched a network of small-scale business incubators in part to allow Russian émigré innovators to develop their ideas away from market pressure while assisting them with the basic elements of Western-style commercialization. Further detail on this program is provided in Annex 4. Israeli incubator projects received up to \$225,000 for two years and subsidized support services. To qualify for the incubator program, a project had to be organized as a company and aim its product at the export market. Each project was required to obtain matching funds equal to 10–15 percent of the government grant. Upon leaving the incubator program, projects were expected to attract commercial support. Incubators were backed by research institutes or universities to provide technical expertise to the project and to facilitate access to commercialization.

Generally the Israeli program is viewed as one of the most effective incubation programs, although it has had mixed results. On the plus side it has produced over 450 technology start-up firms, half of which have raised over US\$ 200 million in equity financing. However, the quality

of the incubators varies significantly according to the quality of the management and this has affected outcomes. Some entrepreneurs became dependent on the subsidized resources and failed to graduate to independent business. And finally, the program was expensive, with an estimated cost of around US\$ 32 million⁷ per year for four years.

In Finland, there is a network of cooperating public-sector institutions, including SITRA, TEKES, FINNVERA, and SPINO, which have more than 10 years experience supporting technology transfer and spin-offs; however, not much is known about the cost-effectiveness of these programs.

In the United Kingdom, a joint fund—the White Rose Fund—was established in 2000 by the Universities of York, Leeds, and Sheffield. The £2 million capital for the fund was allocated to the university consortium through a competitive bidding process from the U.K. government in which the commitment of the three universities to actively seek out possibilities from their top quality research programs was the main selection criteria. The fund is targeted at early-stage biotechnology businesses. It is based on IPRs developed by research staff of the universities, and managed by external professionals who propose investment after full technical and commercial analysis. Concurrently the joint university team is seeking out technology with commercial potential from the academic base in the three universities to put them forward to the managers for commercial analysis. The focus of this fund is more on financial investment from the seed capitalist, however, than the support and nurturing process, which is assumed to take place within the universities. It is too early to tell whether this approach is successful, or whether further investment needs to be made in the nurturing process.

Other new approaches worth considering include mixed private/public sector-funded large-scale pan-European technology transfer accelerators (TTAs) for broad technology themes. These would act as virtual incubators, divided into technology segments. Output, in the form of intellectual property rights, “clean” in terms of ownership structures and well-defended scope, would be sold to VCs and other acquirers. TTA concentration and learning economies within sectors would deepen technology expertise among venture capitalists and make technology transfer more commercial.

Incubators are well known in Poland, not always positively, having been introduced during the 1990s by a variety of assistance programs that sought to accelerate the formation rate of new enterprises, increase the survival rates of businesses during the difficult early years of their life, and encourage their rapid growth.

The tool was used as a positive labor market strategy in general SME stimulation programs and achieved some degree of success. Incubators were also used in programs looking to utilize the high-tech knowledge base of Poland, which was primarily linked to technical universities and funded by donor programs. These, by and large, were not a success and failed to create a viable set of commercialization agencies upon which Poland would be expected to build to improve its innovation potential. The reasons for their failure are varied, the main ones are as follows:

- Peripherality—they were never embedded in any of the host R&D centers as they were externally funded on a project basis rather than being part of the institutions’ core mission and funding.
- Irrelevance—the main emphasis in the early years was to strengthen the independence of the research sector from influences other than pure academic excellence so commercialization was not valued within the research community and these types of initiatives were not welcomed by the academics.

⁷ This figure includes an initial investment of US\$ 225,000 in each company.

- Short term—donor funds were usually available only for a short project period and had unrealistic expectations regarding the time it would take for self-funding to be achieved.
- Over-valuation—the output of the Polish research base to business was not valued realistically, and the many difficult and expensive steps that need to be taken to commercialize research findings successfully were overlooked.
- Weak business skills—the incubators did not have experience in commercialization, which meant that the few entrepreneurial academics with really relevant ideas could make just as much progress on their own. As a result they avoided the incubators and developed their ideas independently. This isolation was reinforced because of broadly negative attitudes among academic peers; would-be entrepreneurs maintained a low profile, pursuing their research as a private activity outside the mainstream.
- Poor business environment—business and financial communities were not experienced in and lacked the incentives to help research commercialization. Among the most significant tools that was absent was seed and start-up funding.

These experiences have, however, created a small cadre of people with real experience of technology and commercialization, and a broader awareness of the time, effort, and additional tools it takes to achieve success. Many of them also visited successful centers in Europe and the United States, which means they have had direct but limited experience with good practice elsewhere. In all cases a major problem with bringing the experience to Poland was perceived: almost universally, the successful models benefited from serious establishment funding from public budgets over the medium to long term, and there was little likelihood that this could be provided in Poland.

Seed funding is crucial but only one of the needed ingredients so, first, it has to be available and, second, it needs to be coordinated alongside other offers and tools to cover the other necessary ingredients. An essential objective of the program must also be to stimulate a sustainable market for business services—including the provision of finance for new technology-based businesses—as this is the best guarantee of long-term sustainability.

The general conclusion about incubators and accelerators is that they require public funding since they do not produce the commercial returns that would sustain such an activity. However, a key design element for the successful graduation of companies from the accelerator to commercial viability is involving the seed capital provider in the selection of accelerator candidates. Incubators and science and technology parks are another possible way to enhance public-private collaboration. However, as the experience from Poland and other countries shows, these initiatives have to be carefully designed to be successful and some have fallen into the trap of being little more than subsidized real estate ventures. The best ones, however, have made crucial contributions to accelerating the commercialization of new technologies and generating new businesses.

6. LEARNING SYSTEMS FOR A KNOWLEDGE SOCIETY

As learning systems are an integral part of the National Innovation System, this chapter focuses on Poland's education and training systems. Internationally, learning is increasingly perceived as "a fundamental key to wealth creation and competitiveness in the current global information economy."¹ Access to good education and to just-in-time labor market—relevant training is vital if all Poles are to have opportunities to develop the knowledge, skills, and attitudes needed in order to prosper in a Europe that is increasingly based on technology and reliant on the rapid exchange of information

SOME INTERNATIONAL COMPARATORS

At a first glance it would indeed seem that Poland, with its strong academic and intellectual traditions, has the capacity to develop a skill-based high-technology role through further development of its human capital. However, some recent international learning assessments have produced data that give rise to concerns regarding the readiness of the Polish education system at all levels to prepare individuals to exploit the opportunities to be offered by Poland's EU membership and respond to the ever-changing demands of a knowledge society.

- (a) Evidence from the International Adult Literacy Survey (IALS) conducted by Organization for Economic Co-operation and Development (OECD), and Statistics Canada in the mid-1990s demonstrated that close to 75 percent of the Polish population aged 16–65 years performed below the level deemed necessary by labor market experts and employers to function competently in an information and literacy-rich workplace (OECD and Statistics Canada, 1995)².
- (b) The data collected for the IALS also showed that both the general and the employed population in Poland participated less frequently in organized adult education and training programs during the year before the interview compared with the populations of other, mostly Northern European nations (OECD and Statistics Canada, 2000).³ More recent data collected in 2002 for the European labor market survey confirm this picture. Only 0.33 percent of all adults aged 35–54 without completed upper secondary education participated in any form of education or training during the four weeks prior to the survey. The comparable estimate for the EU-15 was 2.28 percent.⁴
- (c) In the 2000 survey conducted by OECD under the Program for International Student Assessment (PISA), Poland was ranked 24 out of 31 countries in reading and mathematical literacy skills and 21 in scientific literacy skills, behind the high human development countries (OECD, 2003). The 2003 *Literacy Skills for the World of Tomorrow—Further results from PISA 2000 Report* shows considerable variation in levels of knowledge and skills between students, schools and countries. In Poland, the marked difference for students going into vocational education and those destined for a more academic education emerges from detailed analysis of the results.

¹ A Borderless World, OECD, 1998.

² OECD and Statistics Canada (1995), *Literacy, Economy and Society: First Results of the International Adult Literacy Survey*. Paris and Ottawa.

³ OECD and Statistics Canada (2000), *Literacy in the Information Age: Final Report of the International Adult Literacy Survey*. Paris and Ottawa.

⁴ Commission of the European Communities (2004), *Progress Towards the Common Objectives in Education and Training: Indicators and Benchmarks*. Commission Staff Working Paper SEC(2004)73. Brussels.

(d) The 2003 Global Competitiveness Report, which surveyed the quality of technology stocks of human resources and took into account economic creativity (*inter alia* familiarity with new technology and a high level of competence in English) provided a ranking of the EU acceding countries as shown in Table 6.1.

Table 6.1 Country Growth Competitiveness Ranking

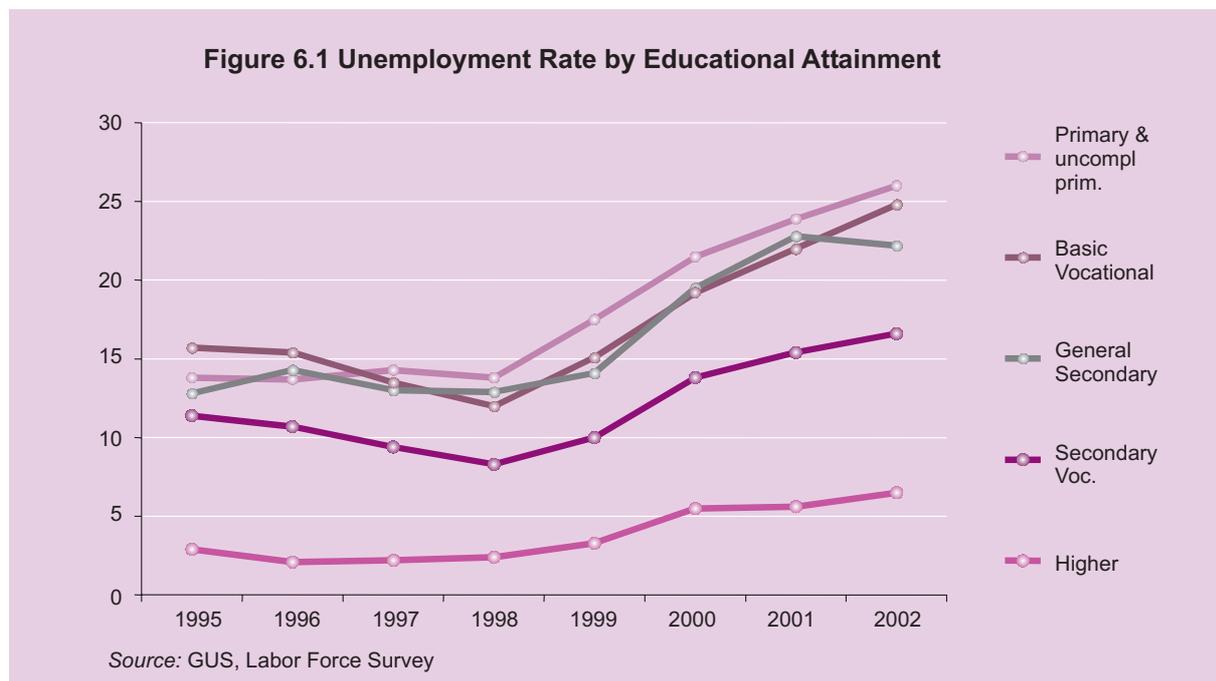
EU Accession Countries (2003)

Estonia	22	Slovak Republic	43
Slovenia	31	Poland	45
Hungary	33	Bulgaria	64
Latvia	37	Turkey	65
Czech Republic	39	Romania	75
Lithuania	40		

Source: Global Competitiveness Report 2003, www.weforum.org

A CHANGING LABOR MARKET

Changing labor market demands for skilled workers in Poland over the last 10 years have major policy implications for the education and training system, as highlighted in Figure 6.1. Graduates with higher and secondary education do better in the labor market, while those with primary or incomplete education are more likely to be unemployed, with the graduates of basic vocational education schools doing worst of all. With the anticipated increase in knowledge-related employment opportunities in parallel with other developed economies, this trend is expected to continue over the coming years with even fewer jobs for poorly-qualified blue-collar workers and those leaving schools without formal qualification.



International labor market research indicates that, in modern labor markets, individuals can no longer expect to be employed by the same enterprise for their entire working life; they must expect to change jobs and to learn new skills regularly and often. Moreover, it is not possible to predict with any degree of accuracy what skills will be needed in the labor markets of the future. Within companies, jobs specifications themselves change rapidly with a great emphasis placed on flexibility and a willingness to take on new tasks and assume responsibility for learning on the job. "Successful businesses are looking for employees who can adapt to changing needs, juggle

multiple responsibilities and routinely make decisions on their own.”⁵ In addition to scientific knowledge and technical and entrepreneurial know-how, the education and training system needs to produce school leavers and graduates with problem-solving, teamwork, and communications skills coupled with the business skills and risk-taking attitude needed for entrepreneurship. Curricula at all levels of education systems worldwide require constant realigning in order to respond to the competitiveness requirements of knowledge-based economies.⁶ In an innovative society, absorptive capacity, i.e. the availability of well trained human capital will be necessary in order to generate and disseminate new knowledge.

Poland’s General and Vocational Education System

Since 1999, Poland has undertaken some reforms of its education system, which may, in time, go some way towards addressing the lack of preparedness for the needs of a knowledge society as demonstrated in the various international surveys discussed above. A program of educational reform has resulted in certain changes to the structure of the system, especially in relation to the provision of more flexible modular and market-relevant courses in the “profiled lyceums” with significant curricular branching at the secondary level, although there are perceptions that more reform of the curriculum in all schools is needed in order to teach transferable skills and improve learning outcomes. The introduction of new structure and policies, to date, is aimed at broadening educational services, offering a diversity of educational pathways and a smoother passage of students through the entire system, better access to vocational qualifications and more responsiveness to the labor market. Specifically, the provision of vocational education aims to provide shorter teaching cycles, a good general education, broadly profiled vocational training and comparability of qualifications. It is anticipated that the knowledge gained in first level vocational schools, primarily geared for students who wish to become independent and start working as quickly as possible, will permit students, who wish to continue to learn, to gain professional qualifications in shorter cycle colleges, in extramural forms or during both professional work as well as their further education in universities.

It is hoped that the new structures that are being put in place, with their stress on the integration of the content of general and vocational education and on preparing young people for a constant readiness to learning new skills and knowledge can be expected to respond to the need for a life long learning system which is discussed in the final section of this chapter.

TERTIARY EDUCATION IN POLAND⁷

Since the early years of transition, an almost insatiable demand for more places in higher education has created new challenges and new threats for the Polish tertiary education sector. This section examines the effects of that demand on the tertiary education sector in Poland together with the effects of new legislation that, since 1990, has granted significant autonomy to Higher Education Institutions (HEIs). The number of students studying in HEIs in Poland has increased more than fourfold over the last 10 years (see Table 6.2), resulting in participation rates that are equal to OECD averages.

The result of this increase in demand has been an approximate 30-percent increase in the number of public institutions and a mushrooming of non-public HEIs from approximately 15 in 1992 to more than 250 in 2003, with a marked acceleration in this expansion after 1997.

⁵ “Learning for the 21st Century. Report and Mile Guide for 21st Century Skills.” www.21stcenturyskills.org.

⁶ E-Europe-2002—An Information Society for All.

⁷ The analysis and discussion on tertiary education in this chapter are based on the World Bank/EIB Review of Polish Tertiary Education. 2004 (forthcoming).

Table 6.2 Participation Rates in Tertiary Education in Poland

	1990/91	1995/96	2000/01	2001/02	2002/03*
Student # in '000s	403.8	794.6	1584.8	1718.7	1800.5
Participation Rate in %					
Gross**	12.9	22.3	40.7	43.6	46.2
Net	9.8	17.2	30.6	32.7	35.0

Data for 2002/03 is based on National Census Data

**Note: Gross participation rate is based on the number of students, regardless of age, enrolled at a given level of education divided by the total population that corresponds to the age group specified for that level.

Net participation rate is based on the number of students in a specified age group (corresponding to legislated standards) enrolled at a given level of education divided by the total population in the same age group. Source: GUS, Education Statistical Yearbooks.

Source: Education Statistical Yearbooks, Polish Central Statistical Office

Based on OECD benchmarks, the range of investment across education levels would be expected to be 4–6 percent of GDP in Poland. In comparison, the ratios are 5.2 percent for Hungary and 4.7 percent for the Czech Republic, while the OECD mean is 5.5 percent.⁸ Expenditures on tertiary education would generally be expected to represent between 15 and 20 percent of all expenditures on public education.⁹ In practice, Poland's public allocations by education level are comparable to those for the OECD (see Table 6.3). In 2000, Poland spent 72 percent on primary and secondary education, 18 percent on tertiary education, and 10 percent on preschool education. However, given the growth in higher education, Poland has the lowest per-student outlays in all the OECD countries for which comparable data are available. Even when differences in GDP have been taken into account, per-student spending on tertiary education is less than half of the OECD average.

Table 6.3 Structure of Public Education Expenditures by Level and Type of Education, 1995-2000

Level of education	Percent of total education expenditures allocated by level						1998 comparisons	
	1995	1996	1997	1998	1999	2000	Poland ^a	OECD ^a
Preschool	10.8	10.3	9.9	10.0	10.1	10.1	10.0	9.6
Primary education n	51.2	50.1	50.5	50.5	47.0	41.1	..	..
Lower secondary ^b	..	..	..	..	1.9	8.4	..	..
Upper secondary:	21.2	21.7	21.7	21.8	21.5	22.9	72.3	69.3
<i>General</i>	5.3	5.6	5.8	6.1	6.2	7.0	..	..
<i>Vocational</i>	15.9	16.1	15.9	15.7	15.2	15.8	..	..
Tertiary	16.8	17.9	17.9	17.7	19.6	17.6	17.7	21.2

.. Not available.

Note: The table excludes expenditures not allocated by level, such as extracurricular activities, teacher training, transport of students, and administrative costs of the Ministry of National Education and Sports (MENiS), dormitories, and correctional facilities. In 2000 teacher training constituted 0.4 percent of total education expenditures; other expenses not allocated by level amounted to 10.3 percent.

^aThe Poland and OECD figures are public expenditures on education as net percentages of the share going to tertiary institutions for research and development activities.

^bIn 1999 Poland split the eight-year primary school into the six-year primary school and three-year lower secondary school.

Source: Toward a Fiscal Framework for Growth: A Public Expenditure and Institutional Review. World Bank, 2003.

⁸ UNESCO (<http://portal.unesco.org/uis/TEMPLATE/html/Exceltables/WEI2002/table11.xls>).

⁹ World Bank (2002, p. 66).

State support for tertiary education in Poland comes from two main sources: a major part from MENiS for basic activities of HEIs including staff salaries and infrastructure investment, and a smaller portion from the MNI (KBN) for research projects. Non-public institutions do not receive any state support for teaching. In Poland HEIs are quite autonomous (relative, say, to Hungary or to Slovakia) with the principle of budget fungibility well established and authority of spending resting squarely with the rector and the governing body.

The research funding streams from KBN provide both funds to cover core establishment costs (so-called statutory funding) as well as competitive project-based funding for which research teams compete. The core funding is based on the institutional evaluation procedure. Entire institutes are the subject of evaluation and funding in the case of the Polish Academy of Sciences Institutes and state research institutes. When it comes to HEIs, by contrast, departments within the university receiving their funding directly from KBN are evaluated. Faculty deans decide about the allocation of research funds, although often university senates work out the general policy guidelines for faculties.

OUTCOMES OF A DECADE OF REFORM IN HIGHER EDUCATION

Since the early 1990s, new degree programs and courses have been developed and the Polish system re-oriented to reflect more closely the Anglo-European structure of tertiary level qualifications, as promoted subsequently by the Bologna process. In this structure three levels of degrees are codified: the licencjat (Bachelor), magister (Master) and doctorate (Ph.D.). The process of actually implementing the new degree structure is progressing slowly but steadily with more and more faculties adopting it. Student choice has also been accommodated by allowing for different types of study, full-time diploma as well as evening and extramural programs.

The introduction of the licencjat degree as part of the alignment of Polish higher education with the pre-dominant European system of HE has facilitated the development of professional education. The process has been speeded up by the introduction of the Law on Higher Professional Schools in 1997. The new schools, set up by the MENiS together with local authorities, are intended to produce graduates oriented toward the labor market. However, neither the licencjat degree nor the professional schools have been really accepted as being of equal value to traditional academic studies by the Polish academic community, by employers and by society at large. Higher professional schools are perceived by their leadership and staff as well as by students as a requirement for the second level of university education—the master's degree. This is demonstrated by the way in which the schools market themselves, underlining the fact that their diploma allows students to continue to study for a master's degree. Also, research shows that the majority of students enrolled in the professional schools plan to continue their studies towards a master's degree¹⁰. Any review of job advertisements in daily newspapers confirms that employers prefer graduates with a master's degree and do not consider the licencjat degree as a fully-fledged diploma.

While Ph.D. studies have existed in Poland for several decades, increasing the number of doctoral students is a priority for MONES and the State Committee for Scientific Research (KBN). The number of Ph.D. students grew from 2849 in 1993 to 30 991 in 2002. Ph.D. students have access to research funding in the form of special KBN grants. The form and content of doctoral studies are being transformed.

Since the early 1990s, international linkages have been established at the institutional and individual levels through the active participation of universities, faculties, departments and individual researchers and students in various EU exchange programs. The flow has been

¹⁰ Maria Wójcicka, *Diversification in Higher Education*, Nauka i Szkolnictwo Wyższe, 2/18/2001

predominantly from Poland to the EU-15 countries. Academic networks between Poland and the EU and USA are flourishing. The European Credit Transfer System (ECTS), which facilitates the comparability of diplomas and increased mobility of Polish students throughout the EU, has been introduced although, under the present law, it is not obligatory.

Figure 6.2 Absolute Increase in the Number of Students and Difference in Profile Between Non-Public and Public Schools in 1995 and 2002



One major positive development that has resulted from the last decade of reform in the tertiary education sector has been the significant diversification of the programs and courses offered in public HEIs. In addition to a larger number of students studying more and more varied courses, the two diagrams shown in Figure 6.2 provide additional information about the

institutional transformation of tertiary education in Poland. Not surprisingly, there has been a large and predictable growth in business and social sciences courses with the larger proportion of that growth in non-public HEIs. There is also growth in mathematics and IT teaching and training in the non-public sector. However, it is important to note that non-public HEIs do not offer Engineering /Technical/ Scientific courses in any appreciable numbers so that the growth that has taken place has mainly been in courses that are quick to deliver and relatively cheap to run, presumably because they do not require an investment in laboratories or other expensive equipment.

Quality Assurance

In common with other countries that have experienced a rapid expansion and increased participation rates in tertiary education, Poland has suffered from some unfavorable, although hardly surprising, outcomes, most notably a perceived dilution of quality. While there are examples of non-public HEIs which provide innovative courses of recognized quality, there are other non-public institutions where a rapid response to market demand has come at the expense of acceptable standards. Lately, in Poland, there has been considerable criticism of non-public HEIs and as to why, instead of creating healthy competition, their operation often creates many ethical and quality problems. One hypothesis is that non-public HEIs in Poland, with only few exceptions, do not stem from new or innovative educational and/or managerial concepts but were created within the old HE system mostly as ‘cooperatives of academic teachers’ motivated by financial reasons. They are not established as independent enterprises with their own staff, capital investment, academic mission and development strategy. They are based on ethically questionable employment rules as academic teachers, employed permanently in public HEIs, often teach additional hours in non-public HEIs and very often teach in more than one non-public institution. This means that they use the same curricula and teaching materials in addition to their time. If they become administrators in a non-public sector institution, their loyalty is in question and fair competition between public and non-public schools is not possible. The ongoing process in the higher education sector in Poland could be described as a rather uncontrolled privatization of public Higher Education.

Moreover, it is not just in the new non-public institutions that quality-related problems have arisen. In public HEIs, fee-based courses have created a different set of problems. Professors are reported to be doubling (or quadrupling) their inadequate incomes from the public institutions by taking multiple teaching posts in non-public HEIs, which is hardly reassuring for students who are paying for these courses in distinctly inferior conditions. Non-paying students in public HEIs get priority because they are the best students selected in competitive admission procedures and hence get the most attention and time of the teaching staff even though the diplomas issued by the school are the same for all groups of students. Overcrowded lecture halls and outdated equipment and laboratories in public HEIs have also had a negative impact on the quality of educational provision.

In order to respond to concerns about the quality of tertiary education, the Polish Government established the State Accreditation Commission (PKA) a fully independent body which took over responsibility from the General Council on Higher Education in 2002 and which has a statutory responsibility to ensure the quality of teaching in Polish HEIs. A fuller discussion of the role the PKA and other bodies play in the provision of effective quality assurance in tertiary education is attached as Annex 2.

Governance of Higher Education

In Poland, the combination of academic traditions with an autonomous legal and financial framework encourages a relatively inward-looking and independent culture. HEIs tend to

concentrate on academically oriented education and basic research without much reference either to the labor market or to the business and innovation environment.

While Polish HEIs enjoy more autonomy than many other OECD countries for a range of academic and budgetary functions, including the distribution of financial resources, there are no legal channels through which outside stakeholders can influence the course content or governance of HEIs. Degree courses are organized mainly on the basis of academic disciplines and do not always reflect the realities of the business or innovative environment. The situation of higher professional schools is somewhat different as they are established jointly by MENiS and the local authorities who do remain involved. Mindful of the need to respond to the expectations of the labor market and employers, some HEIs have created career offices which have become quite active during the last few years, developing not only typical career services but also creating strong links to the business community

Financing of Tertiary Education

The Constitution of the Republic of Poland guarantees that education is free of charge in public sector institutions. However it also states that by a legal Act charges may be made for some educational services provided by public higher education institutions. The overall response to the growing demand for higher education has been the creation of paid studies in public universities and of non-public HEIs. As financing of higher education from the state budget did not grow proportionally to the growth of the number of students, it is estimated that the process took place at the cost of students and their parents (this group financed growth through tuition fees) on one hand and on the costs of the staff of HEIs (more students per academic employee, more working hours). In 1998, a preferential Student Credit program was introduced; however, superficially, at least, it would seem that the credit and loan program is not designed to attract significant amounts of private financing into the tertiary education system..

The problem of financing mass tertiary education is not unique to Poland. Indeed, in no country in the world can mass tertiary education be funded entirely by taxes, not just because the resulting high tax rates create incentives that are not consistent with economic growth, but also because the people who predominantly go to university are students from backgrounds with higher-than-average incomes. In plain words, a taxation system that would make poorer members of the community contribute to the education of middle-class children would not be equitable. Since in all societies a university degree is an extremely valuable asset and one denied to the majority of taxpayers, equity suggests that all full-time and part-time beneficiaries of all higher education should pay a much larger proportion of the costs than they currently do. However, the political economy implications of introducing tuition fees are potentially quite difficult as was discovered recently in a number of European countries.¹¹ Therefore, the proposals that follow are predicated on the premise that the Polish government would mount a public relations campaign to explain to the electorate that reformed funding of tertiary education, if properly implemented, will provide an opportunity for any gifted young Pole to gain access to an intellectually world-class institution and that this opportunity will not be diminished by the fact that s/he comes from a poor family.

¹¹ Hungary had a system of tuition fees in the mid-1990s but this was abolished in 1998. Ireland attempted to reintroduce tuition fees in 2003 and abandoned the attempt after public protests rendered it politically impossible. The United Kingdom introduced tuition fees some years ago in conjunction with a student loan scheme in an attempt to resolve the issue of who pays for the high participation rates in tertiary education in that country. This process has been fraught with difficulty and is a perpetual source of acrimonious debate in the media.

Proposals on financing tertiary education:

This report proposes that the Polish Government give consideration to the following policy options to address the financing of tertiary—and, by extension, life-long—education in both public and non-public HEIs:

- Request all public HEIs to develop multi-annual development plans and capital investment programs and fund only capital costs of institutions where this can be justified on the basis of explicit criteria;
- Allocate State expenditures for public HEIs based on an agreed set of criteria with respect to efficiency and quality enhancement;
- Provide, through the funding regime, incentives to encourage institutions to be efficient and achieve economies of scale through combining courses, sharing facilities and staff between faculties, and to develop cost-saving and income generating activities;
- Develop a funding formula, suitable for Poland, whereby public financing for tertiary education can be allocated as part of a consultative process between MENiS and HEIs;
- Ensure that the funding regime creates competitive pressures, enhances innovation and improves linkages between science, applied research and the world of work;
- Introduce an improved method of student loans and grants conditional on the accreditation of institutions, non-public and public, with special provisions that target, through credits, grants or other scholarship schemes, needy or disadvantaged students;
- Leverage additional private funding through tuition, private endowments and donations from the business community.

Linkages to Research and Development and Responsiveness to Innovation

The current operating practice of tertiary education institutions does not encourage innovation in Poland. As discussed in greater detail in Chapter 5, there are special challenges for the tertiary education sector to respond to and promote a culture of innovation necessary for Poland to flourish in the global economy.

Some specific **proposals** to improve the linkages between HEIs and the scientific and business communities that have assisted the transfer of technology in other countries are:

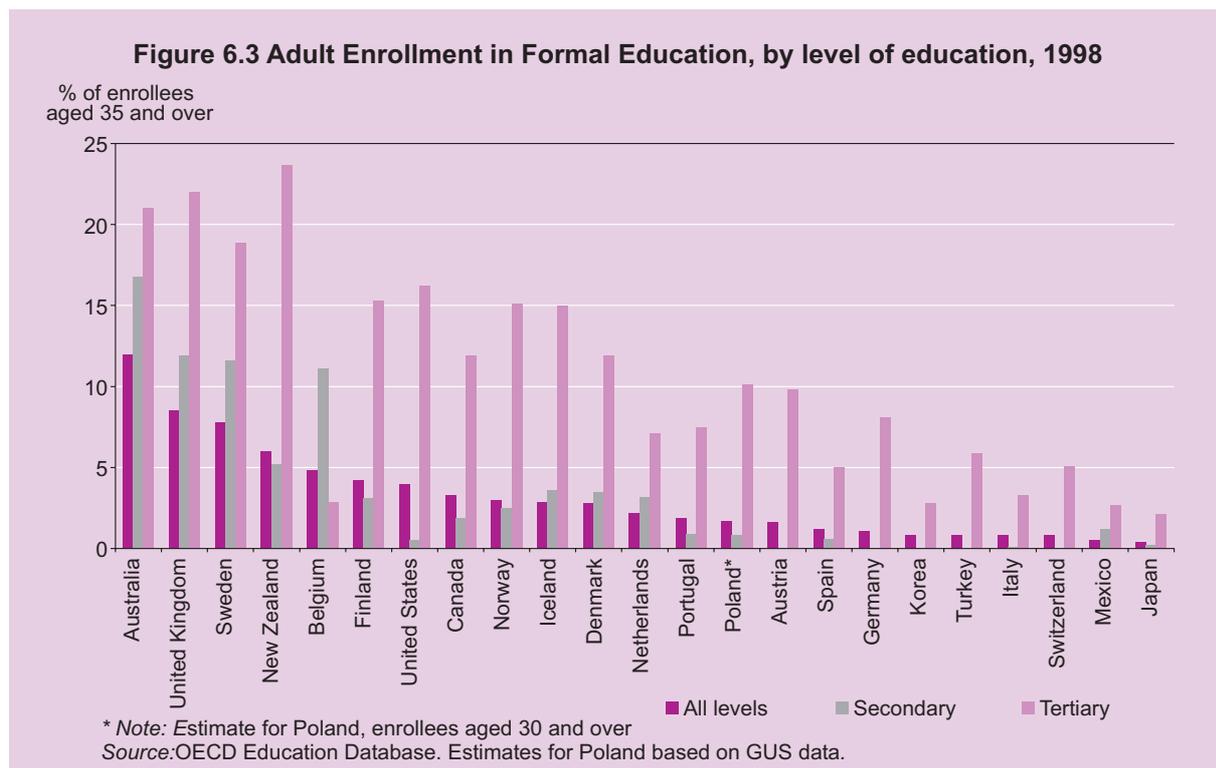
- **Broaden the Governance structures to involve external stakeholders:** The introduction of Governing Boards with wider non-academic participation would be an important step towards ensuring public accountability, supporting internal university management structures, and assuring public transparency of university budgets and resource use. However, the draft law on Higher Education does not include a provision which would allow business people, members of local authorities and other qualified and interested stakeholders to serve on Boards of Governors in public and non-public HEIs. Modification of the Law in this respect is recommended.
- **Identification of incentives** that are feasible within the Polish economic context for existing HEIs to transform. These incentives would stress cooperation across all three core activities (teaching, research and wealth creation). IP should be taken as seriously as the publications side of academic outputs in addition to being a potential source of revenue. The exploitation of intellectual property for individuals, which would be explicit from the start of the research work, is one key incentive.

- **Strengthen or Create Research and commercialization units**—in the core management of the HEI or R&D Institute that provide advice and active help to academic staff to capture resources for research from non-traditional sources, manage IP rights and pursue commercialization objectives on behalf of the academics and the academic institution;
- **Linkages with the business sector** should be further encouraged by creating opportunities for students to have a “stage” in business as part of their university course.

A LIFELONG LEARNING STRATEGY FOR POLAND

In current OECD definition, lifelong learning no longer refers simply to recurrent or adult education but encompasses all purposeful learning “from cradles to grave”.¹² Moreover, in knowledge societies, individuals acquire new knowledge and competencies through a wide variety of settings, not only in formal education and training institutions (i.e., schools, colleges, universities and training institutes), but also in the workplace and in informal and non-formal contexts.¹³ In countries with high levels of human development it is recognized that, in order to ensure equity, learning opportunities should be made available through a multiplicity of venues

A recent report concludes that there are currently inadequate provisions for Lifelong learning in Poland, as defined by OECD.¹⁴ Adult participation rates in both formal education and in training are relatively low by international standards, as the following Figure 6.3 and Figure 6.4 illustrate.

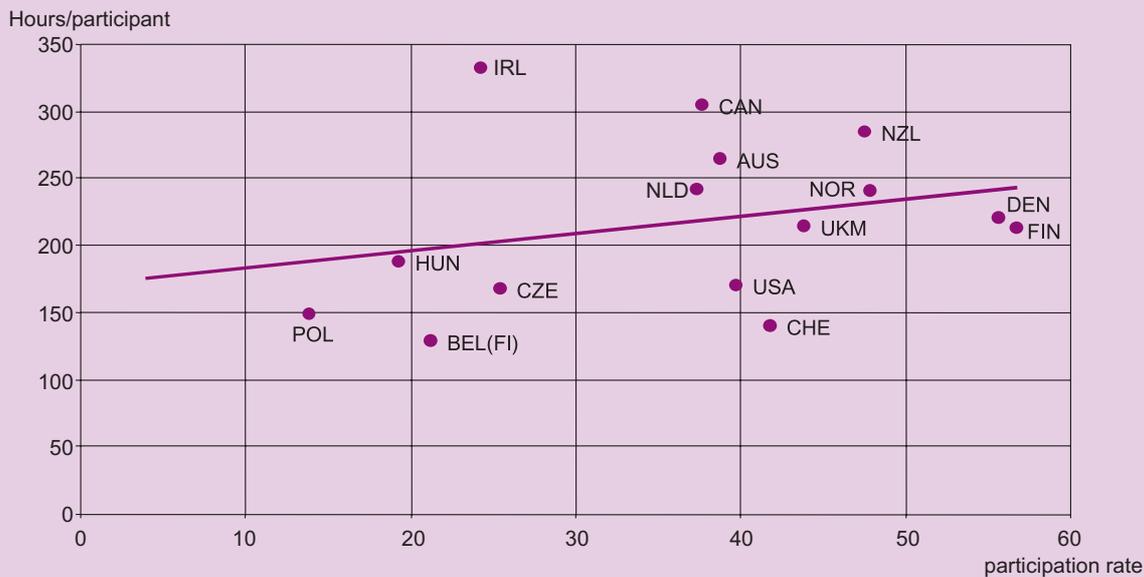


¹² OECD, Paris: Policy Brief: Life Long Learning page 1. Paris 2004.

¹³ “Workers must be equipped not simply with technical know-how but also with the ability to create, analyze and transform information and to interact effectively with others. Moreover, that learning will increasingly be a life-long activity.” In “The Evolving Demand for Skills,” remarks by Alan Greenspan at the U.S. Department of Labor National Skills Summit, April 11, 2000.

¹⁴ “Modernization of Adult and Continuing Education as an Integral Part of Lifelong Learning in Poland.” Albert Tuijnman, 2002. Report commissioned by the Ministry of National Education and Sports.

Figure 6.4 Adult Participation in Continuing Education and Training - 1998.



Source: OECD Education Database, OECD and Statistics Canada, Literacy in the Information Age, 2000., Paris

In 2003, mindful of the need to address this issue, MENiS, with the participation of the key Ministries (Economy and Labor, Science, Communications), developed a Lifelong learning Strategy for Poland that was adopted by the government in July 2003. Moreover, the Ministry of Economy, Labor and Social Affairs has made excellent progress in the analysis of in-company training opportunities, the development of 40 occupational standards and qualifications frameworks and the creation of a range of about 88 modular training programs for unemployed persons or those wishing to change or update their skills. The [draft] Employment Law has provisions for the development of labor market training instruments, which address EU requirements for Lifelong learning for adults.

Information and Communication Technologies

Information and Communication Technologies can serve as an invaluable tool in addressing the modernization of the education and training system and in increasing access to better-quality and more varied learning services and materials. ICTs are especially important in the creation of a Lifelong learning system accessible to all. Moreover, given the acute problems of rural areas and economically depressed urban areas, the potential of ICT to address the issue of equitable access is of key importance in Poland. Emerging evidence from the Living Standard Assessment that is currently being conducted by the World Bank in Poland indicates that the decline in labor market opportunities for the unskilled labor force, especially in rural areas, is directly contributing to growing levels of poverty. "Digital education" is addressed in the Ministry of Economy's plan of action, *ePolska* for 2001–06; however, that discussion does not go far enough. The provision of access alone is insufficient; educational differences underlie the different rates of penetration of ICT and the Internet.¹⁵ Such basic issues confront Poland as the cost of equipping schools and training centers with ICT, of training teachers and trainers in the use of ICT, and the availability of suitable educational materials in Polish, as well as the urgent need to develop special measures to alleviate the risk of the increasing digital divide between the well-off in the cities (who have access to computers and the Internet) and the poor in depressed urban and rural areas. Finally,

¹⁵ World Employment Report, 2001: "Education Matters Most of All." ILO.

distance and open education services need to be developed to take advantage of the delivery potential of ICT. Chapter 7 discusses the feasibility of using tele-centers to overcome the “access gap.”

Proposals for the Implementation of a Lifelong Learning System

As we have seen there exists a range initiatives from different branches of the Government providing an agenda for action. However, the development of the necessary coherent implementation plan for this ambitious agenda represents a challenge for Polish policymakers. A concrete implementation plan with specific actions and timelines will be necessary in order to attract the appropriate support from EU Structural Funds.¹⁶ Greater cooperation between the various concerned Ministries is urged together with attention to the following necessary steps to orient education and training services to the needs of a knowledge society:

- The development of different curricula with emphasis on flexible team-based approaches to enable students to cope with novel and uncertain futures rather than emphasizing academic knowledge of a fixed body of facts relevant to the subject being studied;
- The introduction of explicit entrepreneurship modules in many courses, in training institutions and at both undergraduate and post-graduate levels;
- The adaptation of the academic environment to different student cohorts to facilitate a wider age range including mature first time students, the retraining of older graduates in new technologies and approaches, and a more mixed attendance pattern with a significant number of part-time students who take modular courses and often have accreditation of prior and experiential learning;
- The creation of incentives to attract employed individuals to update their skills and/ or to embark on new education and training courses in order to ensure continuing employment in companies of the future;
- The harnessing of the growing potential of ICT to introduce different teaching methods—for example, increasing personalized delivery (distance and e-learning solutions) and building a growing proportion of real life experiences into courses through participative, group problem-solving, and project-oriented approaches.

CONCLUSION

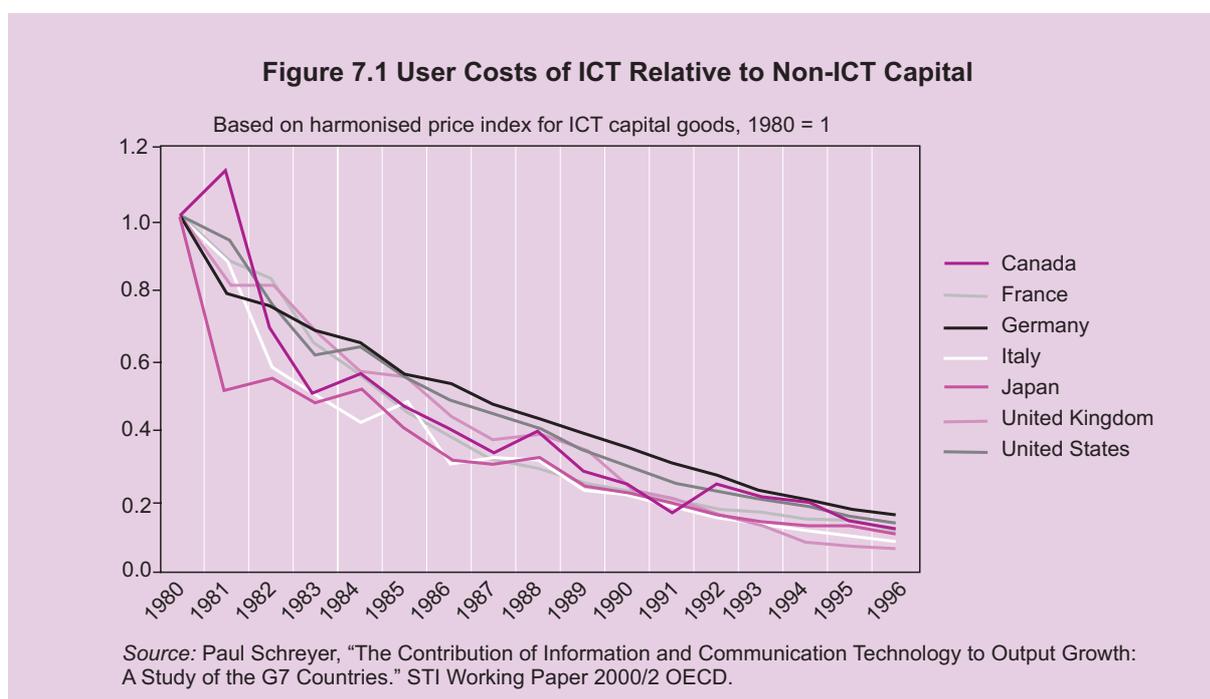
It is evident that Poland needs improved education and training policies to build a knowledge society. The accumulation of the analysis in this chapter suggests that, in spite of strong traditional academic performance, the country’s education and training systems need to be realigned at all levels. A different kind of learning is needed, in part to facilitate the transfer of new technologies, but also to foster the flexible thinking and skills required in an economy that values innovation and the ability to analyze and absorb information and act autonomously. Specific suggestions were made above to improve the linkages between HEIs and the scientific and business communities that have assisted the transfer of technology in other countries. Some elements of the design and delivery of learning services within a lifelong learning framework were introduced. The uses of ICT in reforming education were discussed and in the next chapter we will explore the feasibility of using tele-centers to overcome the “access gap.”

¹⁶ Agreement on an implementation plan for the LLL Strategy awaits the finalization of the Law on Higher Education.

7. BUILDING THE ICT INFRASTRUCTURE

THE ICT CONTEXT

Information and Communication Technology¹ is playing an ever-increasing role in all economies. ICT is a general purpose, ubiquitous set of technologies that is used in all activities and is significant both as a component and the “toolkit” of the knowledge economy. At its heart is the expanding processing and memory power of microchips. ICT is also characterized by rapidly falling prices in comparison with other capital types, as strikingly shown in Figure 7.1.

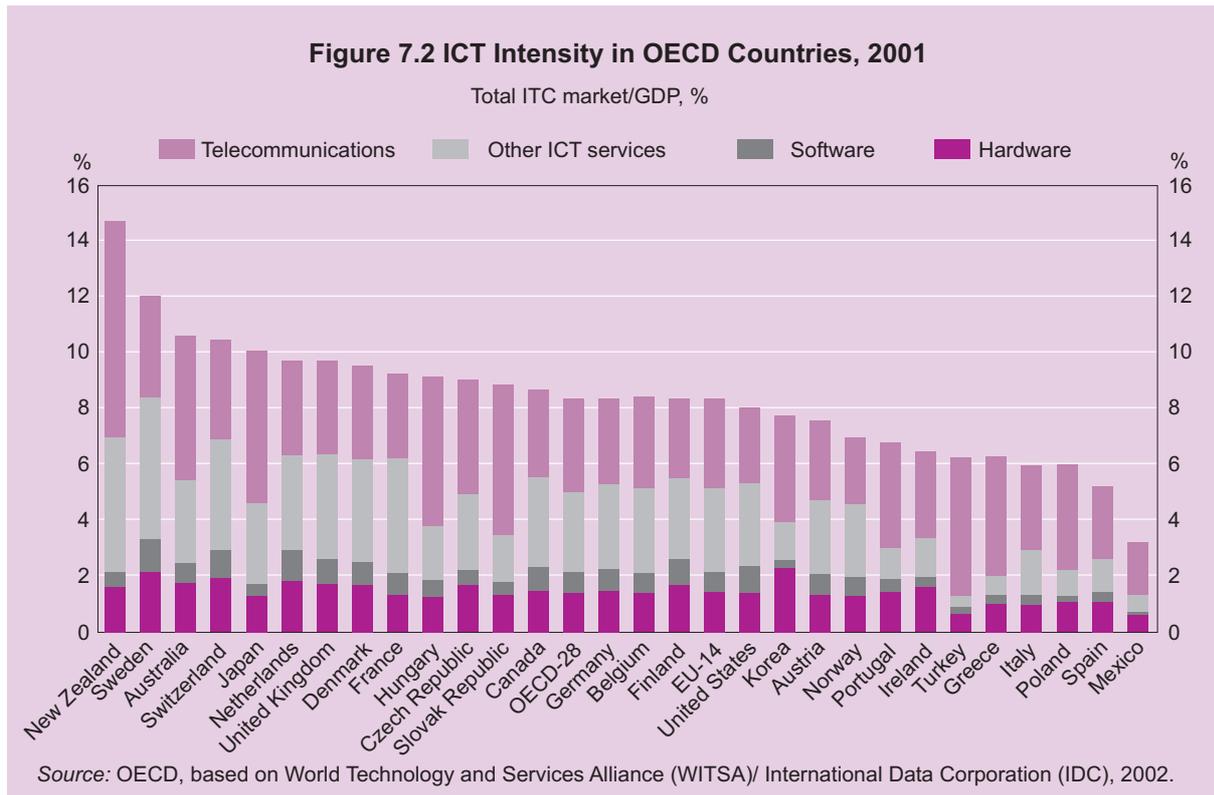


Falling ICT prices relative to other assets, together with their general applicability, have stimulated the substitution of ICT for other forms of capital and labor.² Consequently, these technologies have been applied across a great range of activities and more intensively in any given activity (capital deepening), particularly in OECD countries. An important component of ICT are electronic communications networks where, following liberalization, prices have also been decreasing.

For these reasons, investments in ICT by business and government in OECD countries have become significant and range from 10 to 30 percent of all investment. ICT accounts on average for more than 8 percent of GDP (see Figure 7.2), which shows that in Poland the share is about

¹ ICT, as defined in the Information & Communication Technology Sector Strategy Paper of the World Bank Group (April 2002, http://info.worldbank.org/ict/ICT_ssp.html), consists of hardware; software; networks; and media for the collection, storage, processing, transmission, and presentation of information (such as voice, data, text, images).

² The falling prices of ICT products also have implications for terms of trade between trading countries and the distribution of the global value chain of ICT production. These issues will be discussed later in this chapter.



6 percent. Worldwide, the phenomenal growth in the number of mobile telephone customers is exceeded only by the growth in the number of users of the Internet; both are constituents of ICT.

Another set of countries—Ireland and countries of East Asia—is also associated with the developments in ICT. These countries are largely producers of ICT while OECD countries are more associated with the application and use of ICT. The average share of ICT production in GDP for the period 1996–2000 for Ireland, Malaysia, Singapore, Taiwan, and Thailand was 16.2 percent; the figure was 1.7 percent for Australia, Switzerland, the United Kingdom, and the United States³—a factor of nearly 10.

ICT and Innovation

The OECD countries have another characteristic that supports the development of ICT—R&D and innovation. The ICT sector is itself R&D- and innovation-intensive. Even though the proportion of ICT production in GDP in OECD countries is low, in absolute dollar terms it is high. Further, though East Asia and Ireland are important producers of ICT, the nature of the global ICT production value chain is such that ICT-related R&D and innovation tends to be centered in OECD countries—notwithstanding some significant exceptions. And the toolkit of ICT R&D and innovation is ICT—that is, ICT is the primary input to R&D in the ICT sector, thereby providing an in-sector market for ICT products. Similarly ICT is the toolkit of non-ICT R&D and innovation, given its functions of processing and diffusion. For example, ICT is an input to R&D in biotechnology.

In this light the OECD comments, “ICT has also played a role by accelerating the process of knowledge creation: the mapping of the human genome would not have been possible without modern computing technologies. It has also enabled faster networking, and made science more

³ Bayoumi and Haacker (2001).

efficient”⁴; and “ICT use by firms is closely linked to the ability of a company to adjust to changing demand and to innovate. Users of ICT often help make their investments more valuable through their own experimentation and innovation, e.g. the introduction of new processes, products and applications.”⁵

The ability of OECD countries to take up ICT has been enhanced by the endowment and developing level of appropriate skills embodied in human capital. The growth of the service sector with its knowledge- and information-intensive activities established a growing demand for “knowledge workers” in the 1990s: “the rise in the number of knowledge workers ...accounted for nearly 30 percent of net employment gains during this period. Wages have followed a similar pattern.”⁶ Clearly the basic education and skills acquisition systems in OECD countries have supported the adoption of ICT. (However, firms in OECD countries have had to recruit skilled workers from other countries when the local supply of skills fell short of demand).

In more recent times the abovementioned issues could benefit from additional leadership assumed by governments to accelerate the adoption of ICT through e-government, e-learning, e-health, and similar initiatives and by regional initiatives such as e-Europe and e-Europe+. These same factors are critical to the rate of ICT take-up in Poland and their contribution to the development of the knowledge economy.

Linkages between ICT and Productivity

This section will discuss the linkages between ICT and productivity: while in Chapter 2 we discussed the effect of R&D on productivity, in this section we will try to determine whether there is evidence in Poland for a causal relationship in which ICT investments cause an increase in productivity. A recent study by the Polish economic think-tank TIGER⁷ found that in Poland “ICT investment contributed on average 0.47 of a percentage point or 8.9 percent of GDP growth and 12.7 percent or 0.65 of a percentage point contribution to labor productivity between 1995 and 2000. This relatively large apparent impact of ICT capital is due to an extraordinary acceleration in ICT investments between 1993 [and] 2001 induced by—on the one hand—rapidly falling prices of ICT products and services and—on the other hand—large demand for ICT fueled by high economic growth in the 1990s and substantial built-up demand due to under-investment in ICT infrastructure.” Recent studies have found that there is correlation between ICT investments and labor productivity growth in the USA, Australia, Czech Republic, Hungary and Poland in 1995–2000 (van Ark et al. 2002; Piatkowski, 2003). Still, these authors find only a correlation but cannot identify the direction of *causality*: is it that highly productive industries invest in ICT or that ICT increases productivity?

A study prepared by CASE, as background paper for this KEA, examines effects and spillovers⁸ arising from the ICT sector. Manufacturing industries are classified into ICT producers and ICT users.⁹ ICT-producing industries increased their productivity on average by nearly 10 percent

⁴ OECD (2001, p. 41). “The New Economy Beyond the Hype.”

⁵ OECD (2003, p. 9). “Seizing the Benefits of ICT in a Digital Economy.”

⁶ OECD (2001, p. 55).

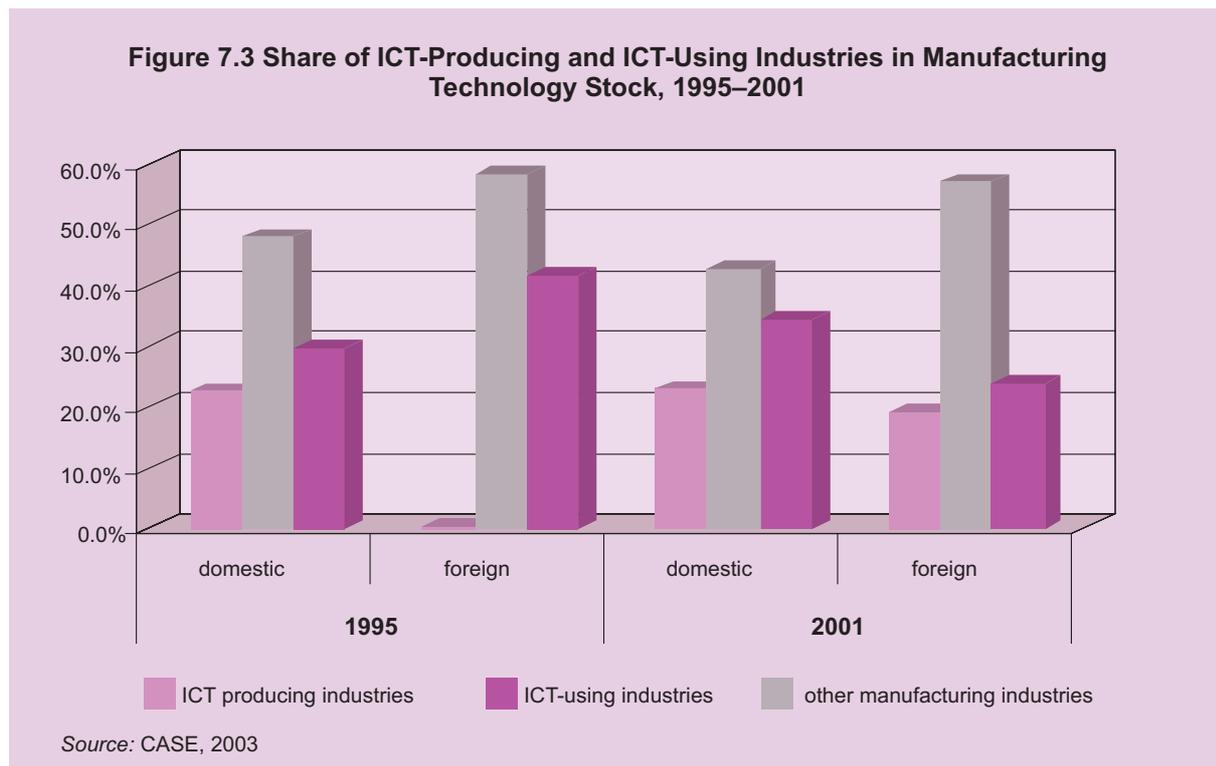
⁷ Piatkowski (2003).

⁸ As mentioned in chapter 2, spillover effects (from neighboring countries or industries) arise when production affects the economic activity of other local firms or their employees. Positive spillover effects occur through the supply of new information, new technologies, managerial practices, and so on. Thus the “social” gain is larger than the profit or productivity gain made by the “source” company.

⁹ The group of ICT-producing industries was selected according to OECD (2000b) (after Pilat and Lee 2001) and consists of the following ISIC Rev. 3 industries: office, accounting and computing machinery (30); insulated wire and cable (313); radio, television, and communication equipment (32); medical appliances, instruments, and appliances for measurement (3,312); and industrial processes control equipment (3,313). The following group of ICT-using industries was selected according to the intensity of use of ICT products in their own production

annually during 1994–2000; the majority of this expansion took place during the period 1997–99. ICT producers strengthened their importance in relation to manufacturing as a whole; their share in the manufacturing value added almost doubled in the analyzed period (from 3.1 percent in 1994 to 5.8 percent in 2000). The accumulation of R&D, particularly rapid in foreign owned-firms, contributed to economy-wide productivity improvements. Again, as in the studies mentioned above, a more sophisticated statistical analysis is required to establish causality, if any, and to determine whether the correlation between productivity growth of ICT-producing and ICT-using industries is not explained by other variables. *Spillovers* from the ICT-producing sector to other branches of the economy depend on the amount of ICT production used as intermediate goods in the production of other sectors. Certain service sectors—wholesale and retail trade, telecommunications, finance, insurance, and other business services—are usually the most important users of the ICT producers' output. In the manufacturing sector, one does find ICT producers that use ICT output from other branches most intensively. For example, about 80–90 percent of all intermediates employed in the production of office, accounting, and computing equipment as well as in the manufacturing of radio, television, and communication equipment comes from the above-described ICT-producing industries.¹⁰

Another important source of productivity gains lay in intensive investment in R&D. ICT-using industries accumulated around 50 percent of the manufacturing technology stock in 2000 (see Figure 7.3), and the activity of foreign firms was also worth noting. ICT-using industries, together with ICT-producing firms, accumulated over 68 percent of total manufacturing technology stock. This suggests that productivity of these two groups of industries should be increasing in the near future.



The impact of the application and wider diffusion of ICT is to improve the microeconomic competitiveness of enterprises, the efficiency and responsiveness of governments, and the

process: motor vehicles, other transport equipment, and production of machinery n. e. c. (non-else classified). Between 3 and 10 percent of intermediates used by these industries are ICT products. This group of industries does not include ICT-producing branches.

¹⁰ Calculated on the basis of the input-output table of Polish industries for 1998 provided by GUS.

inclusiveness of communications between all parties. ICT stimulate productivity growth wherever it is applied in a business setting and as mentioned earlier, because of the continuing decline in the price of ICT products (e.g., computers, memory, and Internet access), the technologies are being applied more intensively to any single activity and to a wider range of activities.

Even traditional activities such as agriculture and transport (now known as logistics) are experiencing the impact of ICT. For example, competition among supermarkets leads them to pay particular attention to the quality of their fresh products and the timeliness of deliveries. Consequently ICT are applied upstream to the growers of fruit and vegetables and to the logistical systems that deliver these items from the farm to the supermarket shelf.

Public Policy on ICT: Public Support for Diffusion and/or Production?

A case is being made for government policies to promote the use and diffusion of ICT. Even more controversial are policies to promote production. We do not share the views advocating proactive support for ICT *production* in Poland. ICT does not enhance the productivity of activities that do not use ICT. Although ICT-using and ICT-producing sectors may generate some growth in the non-ICT-using sectors by increasing demand for the products of that sector (or imports), this effect is indirect and probably small. Discussing this policy debate and arguing against the promotion of ICT production, OECD states: “The third, and most compelling, point is that several countries characterized by high ICT investment and use, as well as high multi factor productivity [TFP] growth, do not have a large ICT [production] sector. And one or two other countries that do have a large ICT [production] sector have not been among the high growth countries of the 1990s.”¹¹

It should be noted that ICT use is quite possible without ICT production—for example, the Republic of Korea manufactures more microchips than does the entire EU, but this has not prevented EU players from using ICT. Australia has little in the way of ICT production but significant ICT investment yielding productivity gains and growth. Some of Australia’s East Asian neighbors have large ICT production capabilities but ICT goods and services are not widely diffused in their economies—they do not reap productivity gains in ICT use and do not experience growth. Even Ireland is now trying to leverage its skill acquired in ICT production into ICT use as some of its ICT production facilities are moved to new offshore locations. In sum, the case for a specific ICT production policy is unproven. In any event, for Poland any specific ICT production policy would need to fall within the parameters of the EU’s State Aids legislation.

ICT IN POLAND

Performance

The Polish Agency for Foreign Investment, PAIZ,¹² report states that “The ICT sector is relatively small in comparison with Poland’s overall economic potential”. In fact, Poland has experienced a demise and rebirth of its ICT sector¹³.

Poland, like the other transition economies of Central and Eastern Europe, has experienced, to some extent, the planned distribution of ICT activities, an orientation towards military

¹¹ OECD (2001, p. 38).

¹² PAIZ, (2002) “Programme for pro-investment activities for the ICT sector in Poland”, Warsaw

¹³ See Radosevic, S., (2002) “The electronics industry in central and Eastern Europe: an emerging production location in the alignment of network perspective “School of Slavonic & East European Studies, Working Paper No. 21.

applications together with the geo-political consequences of the Cold War, such as restrictions imposed by the Coordinating Committee for Multilateral Export Controls, CoCom. Within the planned distribution, Poland had relatively more responsibility for microcomputers, industrial control and peripherals (with other countries supplying components). The transition broke up and dislocated this interlinked chain. Following the reduction of trade barriers, local production companies began to face rigorous competition which exposed their weakness in technology and management—hence the initial “demise”. In Poland the sales of domestic ICT companies fell from \$725 million to \$480 million between 1990 and 1991¹⁴. However, local assembly of personal computers (PCs) (in which Poland had a pre-existing strength) flourished on the back of imported sub-assemblies to produce ‘unbranded’ but competitive PCs for the local market.

The ICT production sector has now been rejuvenated largely by an influx of FDI, which has partially reversed Poland’s import reliance, so that it is a net exporter in some sub-sectors (e.g. TV sets)¹⁵. Poland is relatively more specialized on consumer related ICT production than other countries in Central and Eastern Europe. Czech and Hungary have higher ICT production shares in GDP than Poland (van Ark, Piatkowski et al. (2004). Poland’s value of ICT production is about one third, and its exports one sixth, of that of first placed Hungary,¹⁶ which is relatively more specialized on electronic data processing products.

The issues addressed in Chapters 2 to 6 are central to the ‘rebirth’, continued and expanding production of ICT in Poland where its immediate peer for FDI is the successful Hungarian economy.

Accession and the EU Context

In March 2000, the EU member states set for themselves the ambitious objective “to become the most dynamic knowledge-based economy in the world by 2010.” This led to the eEurope Action Plan (and other supporting initiatives) to accelerate the development of an information society for all. The eEurope+ initiative, to which Poland is a signatory, set similar targets for the Accession countries. To give some indication of the magnitude of the challenges, the EU averages of Internet connections were 38 percent of households and 90 percent of businesses with more than 10 employees, as of December 2001.¹⁷ The EU set a target for household Internet penetration at 50 percent for end-2002. These targets are related to the diffusion and use of ICT.

The eEurope+ initiative effectively set the minimum objectives of an e-Poland initiative. Poland has yet to implement a comprehensive e-government strategy and thereby assume a firm leadership role. Regarding ICT usage and diffusion. CASE and PMR¹⁸ have demonstrated that the near 100 percent diffusion of PCs and Internet access in firms employing 50 or more and levels exceeding 80 percent in companies employing 10 or more. Surveys indicate that the percentage of the Polish population using the Internet has increased dramatically from 5.7 percent in January 2000 to 15.7 percent in February 2002 (the EU estimates a higher rate) and appears to have passed 25% percent as of the end of 2003. However, the level, quality, and type (in most cases, dial-up) of access is substantially below the EU average and in need of improvement in comparison to peer candidate countries (as illustrated by Figure 7.4 taken from the 4th Report on Telecommunications Services in Accession Countries¹⁹). The same report found Internet usage costs (dial up) in Poland are the second highest in the countries considered. Household

¹⁴ The Warsaw Voice—Business, “Crank up the volume” No 20, 19 may 1996

¹⁵ It should be noted that the rapid take of a new generation of flat screen TV sets is causing plants producing CRT sets to close.

¹⁶ Reed International Research (2001), “The Yearbook of World Electronics Data”, London.

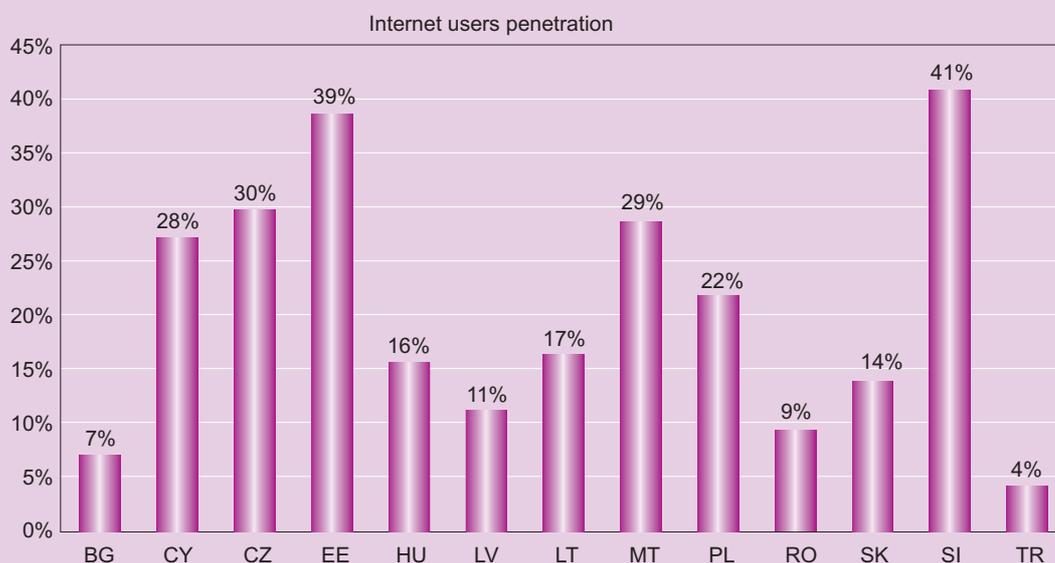
¹⁷ European Commission (2002), “eEurope Benchmarking Report.” COM (2002) 62 final.

¹⁸ <http://www.polishmarket.com/index.php>

¹⁹ IBM (2003) for the European Commission, “4th Report on Monitoring EU Candidate Countries (Telecommunications Services Sector).”

access is 13%, ahead of Latvia but behind Hungary, Estonia, the Czech Republic and Slovenia. One Internet Service Provider (ISP) holds 90 percent of the fixed line market, the highest share among all Accession countries.²⁰ Market structure and price are closely correlated.

Figure 7.4 Internet Users as of June 2002—Accession Countries



Source: IBM for the European Commission.(December 2003)

The regulatory environment has an important role to play in accelerating the rate of expansion of ICT infrastructure. The Polish telecommunications market—with a particularly vibrant mobile sector—has been progressively liberalized. All remaining exclusive rights expired on January 1, 2003. Liberalization is the most important means of promoting access to communications networks and thereby the diffusion of ICT. New entry should ensure greater choice, new services, competitive prices, better quality, and higher levels of access. As yet the impact liberalization in Poland for fixed line communications has failed to deliver the expected benefits.

Furthermore, the rural population may prove less attractive to new entrants than the more lucrative business and big city customers. The way in which the market develops in general, and addresses the rural issue in particular, will depend on the effective transposition of the EU “electronic communications” package of directives and other regulations supporting the knowledge economy, by parliament and effective implementation by the independent regulator.

Network Readiness for ICT and the Knowledge Economy

The World Economic Forum has produced a Networked Readiness Index (NRI),²¹ which “captures key factors relating to the environment and the readiness and usage of the three stakeholders in ICT (individuals, businesses and governments), and can be used to understand the performance of a nation or even a region with regards to ICT development.”

²⁰ IBM (2002) for the European Commission, “2nd Report on Monitoring EU Candidate Countries (Telecommunications Services Sector).”

²¹ http://www.weforum.org/pdf/Global_Competitiveness_Reports/Reports/GITR_2002_2003/GITR_Rankings.pdf.

Currently there is some room for improvement in Poland's ICT performance. The country was ranked 39th for 2001/2002²² out of 82 countries considered. It performed worst in terms of network access (48th), information infrastructure (56th), network policy (42nd), and ICT policy (56th) in the NRI sub-indices where these indices largely reflect the poor regulatory and policy environment. (See Table 7.1)

This study (as well as the United Nations Conference on Trade and Development—UNCTAD) places Poland behind peer Accession countries in ICT development and diffusion, indicating that network access is a vital issue for policymakers in Poland.

Infrastructure

The extent of access to communications networks defines the boundaries for the use, diffusion, and contribution of ICT. The concept of the “digital divide” is widely understood as the negative outcomes of asymmetric access to communications networks. The digital divide exists between countries and within countries, especially regarding urban and rural areas. Those on the wrong side of the divide do not have access to ICT, and this absence produces adverse economic and social outcomes. Increasing access is the key challenge to the telecommunications sector in Poland.

A World Bank report²³ on private participation in infrastructure listed the top 10 projects in Europe and Central Asia. Of these, two are in Poland and both are in telecommunications—*Telekomunikacja Polska S.A.*, TPSA, and Poland's leading mobile telephone operator PTC. Poland is relatively rich in electronic networks and information infrastructure. The networks include those of:

- Polish Post, TPSA (the dominant fixed line operator), Polish Radio and Television;
- Three GSM mobile operators, each with Third-Generation UMTS licenses;
- Alternative carriers (e.g., Netia, Dialog);²⁴
- Cable television operators;²⁵
- Energy utilities and railways; and
- Research and academic institutes.

The fact that some of these electronic networks do not offer services may reflect the disinterest of management. Alternatively, the failure to participate may reflect obstacles to market entry—

²² See <http://www.weforum.org/site/knowledgenavigator.nsf/Content/Poland+KN+sessions>.

²³ World Bank, “Private Participation in Infrastructure—Trends in Developing Countries in 1990 to 2001,” July 2003.

²⁴ As of June 2002, these alternative providers accounted for over 8 percent of all lines in Poland.

²⁵ Cable television reaches 55 percent of Polish households. This high level of potential information infrastructure represents a considerable (and apparently missed) opportunity.

Table 7.1 The Networked Readiness Index in 2002

Country	Score	NRI Rank
Finland	5.92	1
United States	5.79	2
Singapore	5.74	3
Sweden	5.58	4
Iceland	5.51	5
Canada	5.44	6
United Kingdom	5.35	7
Denmark	5.33	8
Taiwan	5.31	9
Germany	5.29	10
Netherlands	5.26	11
Israel	5.22	12
Switzerland	5.18	13
Korea	5.10	14
Australia	5.04	15
Austria	5.01	16
Norway	5.00	17
Hong Kong SAR	4.99	18
France	4.97	19
Japan	4.95	20
Ireland	4.89	21
Belgium	4.83	22
New Zealand	4.70	23
Estonia	4.69	24
Spain	4.67	25
Italy	4.60	26
Luxembourg	4.55	27
Czech Republic	4.43	28
Brazil	4.40	29
Hungary	4.30	30
Portugal	4.28	31
Malaysia	4.28	32
Slovenia	4.23	33
Tunisia	4.16	34
Chile	4.14	35
South Africa	3.94	36
India	3.89	37
Latvia	3.87	38
Poland	3.85	39
Slovak Republic	3.85	40
Thailand	3.80	41

Source: The World Economic Forum, 2003

a regulatory matter. TPSA had some 11.9 million customers at the end of 2002 (the number declined in 2003) providing a fixed tele-density of 30 percent (that is, 30 fixed lines per 100 population), which is about half the EU average. The three mobile operators had 13.8 million at the same date representing a mobile tele-density of 36 percent (it is likely that the figure has now surpassed 40 percent), while the EU average is around 80 percent. Further, it should be noted that many people in Poland and elsewhere have both fixed and mobile access (among U.K. households, for instance, 73 percent have both).

In the context of EU Accession and these low penetration rates, Poland's relative wealth of information infrastructure has not been exploited to its maximum potential. Fixed line access remains a critical factor in the development of the knowledge economy, until new technologies such as radio technology, WiFi or WiMax (with broad geographical reach)²⁶ could replace fixed lines. However, the access problem in Poland is not only about technology but about the monopolistic market structure. The obstacle to the deployment of alternative technologies by potential new suppliers is the dominant position of TPSA and its attitude to competition and its exclusive rights. The supervisory body, URTiP, is not strong enough to facilitate entry of new competitors which require, a regulatory framework and preventing TPSA from using its monopoly by setting excessive interconnection charges. In addition, there is nothing, except lack of incentives, which in turn is due lack of competition, to stop TPSA itself from deploying Wi-Fi, radio or any other technology to increase access to rural areas.

Extending access to enable diffusion, in general and in particularly in rural areas, is a key challenge, underscoring the importance of managing the liberalization process.

CASE has compiled data for the household sector from official statistics, presented in Figure 7.5, demonstrating the variance between social and economic status and access to the Internet and ICT. Clearly the self-employed are the most "wired" while pensioners and farmers appear disadvantaged. CASE also observes that "The regions best equipped with PCs are Małopolskie, Pomorskie and Mazowieckie (21.7 percent, 21.2 percent and 21.1 percent of households respectively), while the worst equipped are Świętokrzyskie, Warmińsko-Mazurskie and Podkarpackie (12.2 percent, 13.1 percent and 14.3 percent respectively)." These percentages make abundantly clear that access is an issue that needs to be addressed.

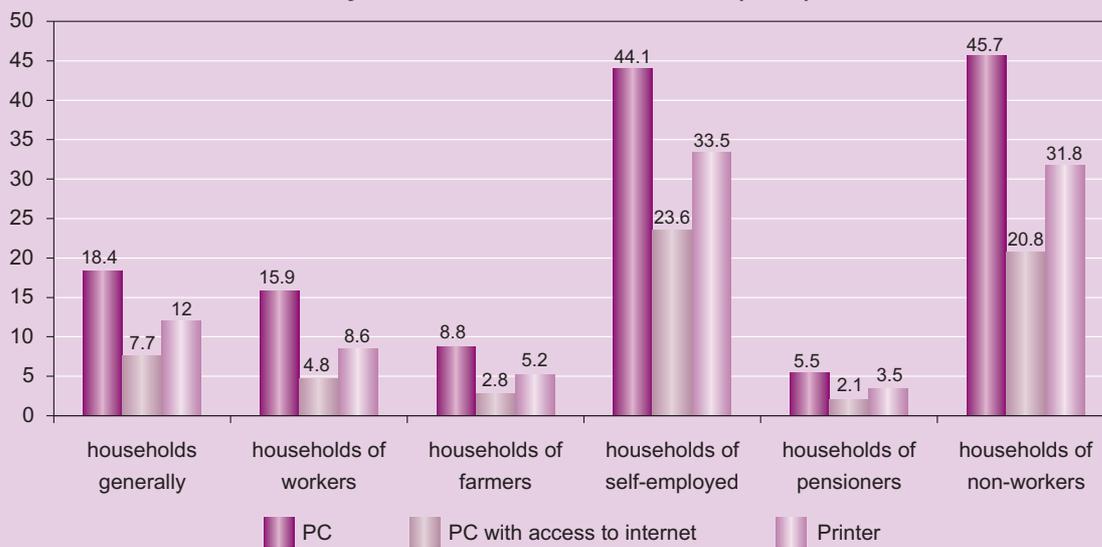
As noted earlier, Internet access charges in Poland are expensive. Based on survey data, the European Commission found that the average cost in the 13 Accession and candidate countries for 20 hours of Peak Dial up as a percentage of the average Monthly Household Income was 9.8%. The figure for Poland for the same service was 20.5% of Monthly Household Income, a sum only exceeded by Bulgaria (20.7%)²⁷. The above results from CASE regarding social and economic status. Internet usage may be increasing but this level of charges, to the extent that they are indicative of all Internet charges, clearly limit the duration of usage and retard the development of KE in the household sector. Why are Internet charges higher than in the comparable Accession countries? It was already pointed out that TPSA appears to supply 90% of the Polish Internet market. The Polish research company PMR reports²⁸ that TPSA's network digitalization is the lowest when compared to the Czech Republic, Estonia, Hungary, Slovakia, and Slovenia; as reported above, all except Hungary have higher Internet penetration rates than Poland.

²⁶ The Economist, Mar 11th 2004 writes that for people in rural areas, for whom broadband access—via cable networks or supercharged telephone lines—is often unavailable, WiMax could possibly provide access

²⁷ See http://www.emcis2004.hu/dokk/binary/30/17/3/eEurope_Final_Progress_Report.pdf

²⁸ http://www.polishmarket.com/et_feature_4.php.

Figure 7.5 Percentage of Households With PCs, Printers and PCs With Access to the Internet, by Social and Economic Status (2001)



Source: CASE, based on GUS (2003).

Unlocking the Market and the Regulatory Framework

The Polish electronic communications market has been progressively liberalized since 1992. Significantly, despite this process, TPSA still retains over 90 percent of fixed line customers. Normally, an incumbent can expect to lose 5 percent market share per year (in a growing market) until it reaches a plateau.²⁹

The second IBM report to the EU on telecommunications in Accession countries noted that international long-distance calls in Poland were three times as expensive as in member states, and eight times as expensive when making a call to the United States.³⁰ The 4th edition of the EU report failed to record international tariffs for alternative operators in Poland as at June 2003. The only two other countries not reporting alternative operator tariffs both had legal monopolies. While liberalization in Belgium reduced the cost of a call to Warsaw by six times, the situation in Poland remains unchanged. Clearly the expected benefits of competition have not materialized in Poland after 10 years of liberalization.

In other countries, competition brought down tariffs, as illustrated below. It should be noted that Poland liberalized its market well *before* some EU countries.

Interfax reported TPSA's predictions that the last 1.2 million subscribers using analogue exchanges for international long-distance calls will remain under the monopoly until the end of 2005, which is supposedly the date by which these exchanges will have been replaced by digital ones. The date is three years after the EU's deadline for a fully liberalized telecommunications market. URTiP, the independent regulatory body, has stated³¹ that 70 percent of TPSA's customers cannot access the international services of alternative operators because it is not "technically feasible" for TPSA to allow them to do so, hence the difficulty in obtaining alternative international tariffs. Providing customers with a choice of operators for international and other

²⁹ For example, in Sweden, Telia held 76 percent of the market for international calls three years after liberalization, 55 percent five years after liberalization, and 43 percent 10 years after liberalization. See Rossotto (2003).

³⁰ IBM for the European Commission, "Second Report On Monitoring EU Candidate Countries (Telecommunications Services Sector)," December 16, 2002.

³¹ Reported by PMR IT and Telecoms Monitor

services will require investments by TPSA—and it is unclear where the incentives are for these investments³² (if it sees liberalization as a zero sum gain) since doing so will allow alternative operators to supply customers. In EU member states, National Regulatory Authorities (NRAs) have directed incumbents to ensure “technical feasibility.”

There is some uncertainty regarding the functioning of the interconnection framework, without which the linkage of communications networks—that is, the core characteristic and requirement of the ICT environment—cannot flourish. As of end 2003, Poland does not seem to have an adequate regulatory and business environment in place to support the diffusion of ICT and thereby the development of the knowledge economy.

Best international practice regarding the regulatory environment (and a requirement of Poland’s EU membership) is the EU *acquis communautaire* for electronic communications. The current regulatory and legal framework does not appear to conform to the 1998 *acquis* and is in the process of being updated to take account of the new EU regulatory package of 2002.³³ Regarding developments the sector the OECD observed “The reform process has lacked a coherent, consistent, and determined approach to regulatory frameworks and full competition.”³⁴ To the OECD, it appears that URTiP has not become an effective regulator and that the government has some responsibility for this state of affairs.

The Access Gap

Two forms of “access gap” can be identified³⁵ as illustrated in Figure 7.6: “market gap” and “pure access gap”. The first of these is the gap that results because a monopoly is in place and the forces of competition are not allowed to make their full contribution to close it (see “previous level of access” in Figure 7.6). The second kind of gap exists because some customers cannot afford the access provided by market forces owing to low income or location (e.g., the rural poor). In response to this kind of gap, public intervention may be justified (see section on the rationale for government action and public support spurred by market and coordination failures in Chapter 3).

When the telecommunications market is effectively and fully liberalized, it will start to make its full contribution to the provision of access to commercial customers, particularly when the required regulatory environment is in place. However, the “pure access gap” will persist as a function of income distribution and demand, which raises the question: should the state intervene?

Frequently a Universal Service Obligation (USO) is imposed on an operator with Significant Market Power (SMP) in order to ensure that the access gap is closed. It is normal practice to undertake an exercise to determine the net cost (taking account of the benefits and cost) to the operator designated as SMP and then to design a system to share these costs among appropriate market players.

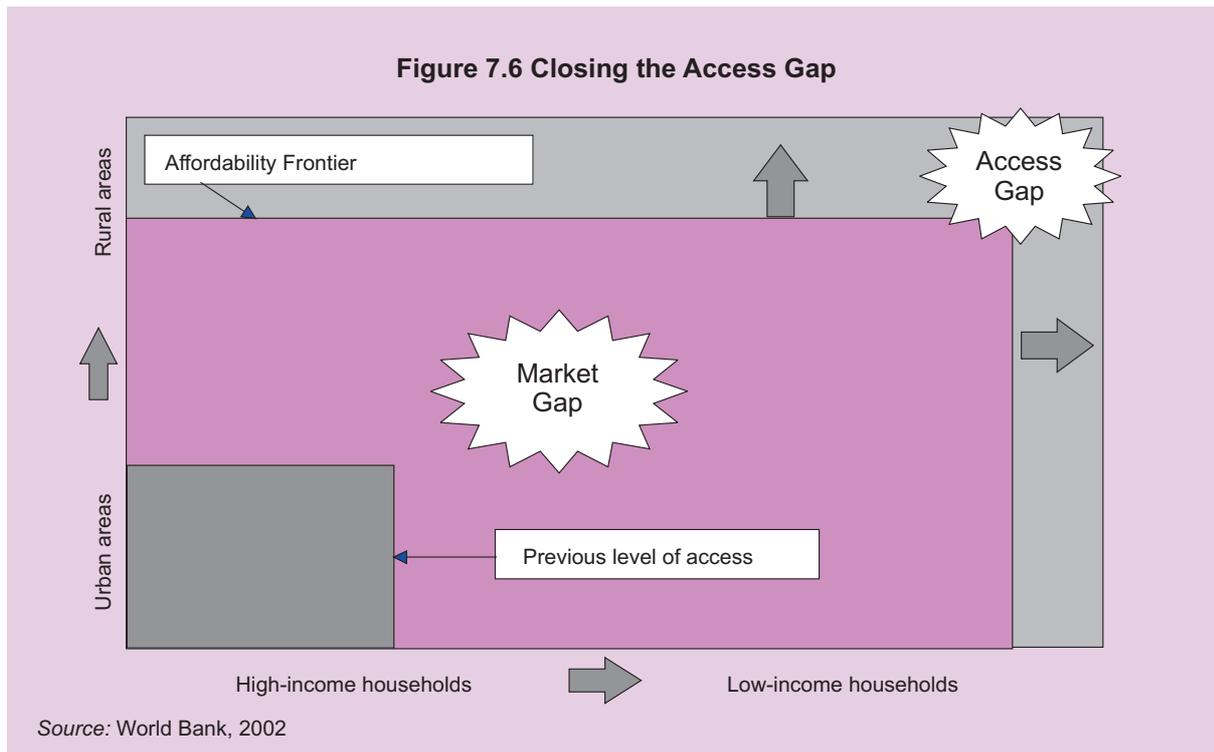
Alternatively, as proposed here, policy can be directed at an interim solution of “Universal Access” to facilitate the availability of a wide range of ICT services, including the Internet, at public access points or tele-centers in targeted communities where there is a pure access gap. This approach can be refined to include “smart subsidies” and to allow for local private or municipal participation in the operation of public tele-centers. The “smart subsidy” approach is described in Annex 1. It is worth emphasizing that the European Commission has issued draft “Guidelines on Criteria and Modalities of Implementation of Structural Funds in Support of

³² TPSA cut its capital expenditure forecasts for 2003 by 6 percent.

³³ http://europa.eu.int/eur-lex/en/archive/2002/L_10820020424en.html.

³⁴ OECD “Regulatory Reforms in the Telecommunications Industry” 2002.

³⁵ Navas-Sabater, Dymond, and Juntenen (2002).



Electronic Communications.” These draft guidelines explain in which ways EU structural funds could be used to close the pure access gap in, for example, Świętokrzyskie.

To sum up, EU accession brings with it opportunities and challenges. The EU market is open to Poland and the Polish market is open to the EU, including the other new members. Existing EU members are accelerating the rate of take-up of ICT, while Poland lags behind EU members and also some of its Accession peers. The country needs to catch up on access, diffusion, and usage if it is to take maximum advantage of the opportunities of membership.

ICT POLICY PROPOSALS

We have identified the following broad priorities for ICT policy—independent of the *ePolska* action plan and the success of its implementation:

- Promote the widespread use and diffusion of ICT—which will improve productivity and micro-economic competitiveness and lead to growth.
- Enhance competitive pressures in the ICT sector by (a) facilitating the maximum contribution of Poland’s wealth of infrastructure (the terms and conditions of interconnection among networks are central to realizing this potential) and (b) ensuring that ICT hardware and software is available in Poland at the best prices by removing any barriers (technical or physical) to trade for these products.
- Ensuring the utmost confidence of businesses, households, and civil society in ICT and their usage.
- Assuming a leadership role for government in the adoption of ICT.

7. Building the ICT Infrastructure

The World Bank has found³⁶ that the key to success for ICT strategies are:

- Expressing strong leadership, which builds political consensus;
- Developing and establishing best international practice for the ICT regulatory framework;
- Developing advanced information infrastructure (e.g., including “Wi-Fi”) through private sector investment; and
- Ensuring appropriate high levels of human capital to use the ICT products and services.

The following are our specific proposals for the immediate future:

- The regulatory framework should be updated to the level of the EU 2002 regulatory package on electronic communications, taking account of the particular circumstances of Poland.
- This (technology neutral) package should be implemented effectively to ensure that the market contributes to the maximum in the provision of access and services.
- Initiatives should be launched to strengthen the capacity and market credibility of the URTiP (the regulatory authority) and by these means promote private investment.
- Universal access should be established as an interim goal for sector policy.
- “Smart Subsidies”—at least at the pilot stage—could be used to promote universal access and provision for this approach should be made in any law on electronic communications, following the Guidelines of the European Commission if structural funds are to be used.

³⁶ See, for example, Nomba et al. (2003).

8. POLICY PROPOSALS

In this chapter we provide the Government of Poland with proposals about the policy actions required to prepare the country more successfully for becoming a knowledge-based economy with a sustainable rise in productivity. The key proposals of this KEA are:

- As regards R&D and innovation, efforts need to be made to build institutions and provide financial incentives aiming to increase Polish R&D from its current level of 0.7 percent of GDP. Following the experience of other countries and the literature reviewed in the KEA, which suggests that increased R&D and innovation is associated with faster growth, a system of grants and a pilot seed capital fund is proposed. These two are complementary because the grants are needed to fund R&D, which will hopefully yield the ideas (deals) for the seed capital fund. Although several of other measures are being used in OECD countries, we consider these two most appropriate given Poland's fiscal situation and the problems of bureaucracy and corruption discussed below.
- As regards the business environment, it should be stressed that an improvement in the business environment in Poland is a necessary condition for raising firms' R&D. Grants and VC alone cannot succeed in raising private R&D, if entrepreneurs continue to operate in the current business environment. Therefore, the measures regarding entry, social costs and IPRs, should be implemented as soon as possible.
- As regards learning systems, efforts need to be made to increase the quality and relevance of the formal education system, ensure the provision of life long learning systems to the entire population and improve the linkages between academia and the scientific and business communities that assist the transfer of technology in other countries..
- As regards ICT, since the liberalization process to date has been incomplete, efforts should be made to significantly increase competition in communications and reduce the cost long distance calls. It is proposed that the regulatory framework be updated to the level of the EU 2002 regulatory standards and that the capacity and market credibility of URTiP, the regulatory authority, be strengthened in order to sustain competition.

As we argued in Chapter 2, Poland needs to develop its absorptive capacity by increasing indigenous R&D in order to benefit from FDI and from the technology embedded in high-technology intermediate inputs imported by the Polish industry. Absorptive capacity could be developed by increased R&D spending and by improved learning systems and increased market competition stimulated by liberalization of the product markets; hence, the rationale for the focus of Chapters 4 and—5 on R&D and Chapter 6 on learning.

In Chapter 3 we argued that the experience of countries that took off to become knowledge-based economies during the 1990s points to the importance of taking the policy measures proposed in this report in concert, probably coordinated at the highest level of government. The argument for a proactive government policy in the knowledge economy area has been made by academics and policymakers alike—knowledge is distinguished by a number of market failures that inhibit the optimal level of private investment in R&D and argues for government intervention to address those failures. Moreover, virtually all developed countries have support programs for innovation and R&D. Even though the programs differ in their design, they share the practically universal realization that due to the market failures mentioned here, the government's role is an essential ingredient of the NIS, in conjunction with business and the research and academic communities.

The discussion of the business environment in Chapter 3 indicates that there are many administrative barriers to the development of innovation and knowledge-based entrepreneurship in Poland. The most important are the unfavorable legal environment (especially tax and labor regulations); the low efficiency of judicial infrastructure (courts, police); and the high level of labor costs due to the social contributions and overgrown bureaucracy corruption. In view of the analysis in Chapter 3, we believe the following measures to be particularly worthy of consideration by the government:

International property rights protection legislation and the effectiveness of the Polish Patent Office, UPRP, need to be improved and a national campaign in the SME sector promoting IPRs should be undertaken. The business registration process should be simplified to allow for the completion of all necessary registration activity in one visit, as proposed on in a new law on “Freedom for Entrepreneurship” to be adopted in 2004.

In Chapter 4 we outlined a continuum of indirect and direct measures that a government can implement to influence R&D investment. Our basic proposal to the Polish government is that it should consider a mix of funding measures. The specific proposals outlined in each of the six options listed in Chapter 4 lead to the following conclusions: the Government needs to consider the advantages of tax benefits vis-à-vis the added complexity into an already complicated tax system.

Loans are better provided by the private sector, such as banks and VC that are familiar with the commercial operations of the business, rather than in state hands. Government-run VC institutions have not proven successful. Risk-guarantees could be a useful tool, provided the private sector commits its own capital to the project at significant risk. However, since the fiscal contingent liability of such guarantees is difficult to evaluate at the initial stage of an R&D or project cycle, we find it difficult to propose this option given the fiscal situation of Poland.

Matching grants have been proven beneficial in certain countries (e.g., Finland and Israel) and are best used to provide incentives for developing new networks and collaborative linkages. The administration of matching grants requires an independent selection process, which runs the risk of undue pressures. To mitigate this risk, many countries look to outside evaluation of their clusters and programs and there are many international experts, particularly in Europe and the United States, that could be involved with the evaluation of projects.

Another preferable role is for governments to seed the VC industry by investing in privately-managed funds. In these public-private partnerships, governments mitigate some of the risk inherent in technology-oriented start-ups while the venture capitalist provides commercial and managerial expertise. It should be stressed that VC is not a substitute for grants. The proposed system has grants and VC interwoven: these two are completely complementary because the grants are needed to fund R&D, which will hopefully yield the ideas (deals) for VCs.

This approach is exemplified in the Pilot Trust Fund proposed in Chapter 4. If this option is selected, it is critical that it be linked to funding for technical assistance to train the VC industry in technology investments so that it can devote sufficient energy and expertise to this pilot. Moreover, while considering this proposal, an assessment of the potential “pipeline” or “deal flow” needs to be conducted. It is very difficult to identify or estimate in advance a flow of potential ideas or deals for VC. One source of information could be the pipeline of projects solicited by MNiI when the Lockheed Martin offsets were negotiated. The discussion in Chapter 4 focuses on how the capital markets can provide capital for early-stage companies. The key to creating an environment in which VC is ready to invest in early-stage companies is creating the cycle whereby money that is invested is returned to investors at a later stage. In developed economies, a well-functioning stock exchange, which can provide an exit route for early investors

as well as new capital for burgeoning businesses, is essential for the health of the VC market. We believe that the improved functioning of the WSE is essential to encouraging early-stage capital.

As mentioned in Chapter 4, to make the Polish capital markets more accessible to smaller companies we propose simplifying the listing procedure for smaller companies on the WSE so that it is not so costly and time-consuming. We also propose that pension funds and insurance companies be allowed to invest a small proportion of their funds, say 2 percent, in the pre-IPO stage alongside VC money and in smaller cap companies once they are on the capital market

As mentioned in Chapter 5, in autumn 2003 an inter-ministerial team for ownership transformation developed a structural transformation program for all the JBRs. The annual budgetary expenditure on the JBRs is 1,341 million zloty. We believe that the time is now to take the opportunity to effect urgent changes along the lines described in Chapter 5 and encourage action, as the better institutions among these have the potential to play a valuable role in the regeneration of industrially focused research and the fostering of networks. This is entirely in line with the strategies followed by the other members of the EU; the equivalent institutions across Europe have been encouraged to become relevant to the business sector to the point that they get their main funding from businesses—through joint projects, service provision, or core membership fees.

Naturally the fiscal cost of these proposals is an important consideration in the government's decision whether or not to accept all or some of these proposals. If some of the funding options mentioned above are selected, a more precise estimate of the cost would be prepared. However, if one studies the entire NIS, the restructuring, merging, and even liquidation of some of the JBRs will save an amount that would presumably (depending on the scope of the program to be undertaken) cover a significant part the cost of a grants program or seeding the VC industry.

The discussion of learning systems in Chapter 6 shows that Poland needs improved education and training policies to build a knowledge society. We point out below *only* those topics that are directly related to the knowledge economy and to innovation.

In the short run, we suggest that governance structures be broadened to involve external stakeholders; in particular the Law on Higher Education should require Higher Education Institutions (HEIs) to appoint business representatives to sit on university boards and on academic committees. We propose that IPR-related questions between researchers and their employers, universities, or institutes be resolved as soon as possible. Finally we propose that the draft Law on Higher Education *explicitly* allow employment of academic staff in business.

In the longer term, we propose the creation of competitive funds for HEIs as a tool for promoting quality improvement, innovation in the educational process, and enhanced linkages to the scientific/research community as well as the business world. As noted earlier, there are many international examples of how public and private universities compete for these funds (for instance, France, Chile, and Argentina). We propose as well that new strategies be introduced to attract additional private financing into the system. This should include, but not be confined to the mobilization of additional money from students and their families through tuition fees (but only when combined with targeted scholarships and effective student loan schemes to ensure equity); and the encouragement of private endowments and donations from the business community.

The Polish electronic communications market has been progressively liberalized since 1992. Significantly, despite this process, TPSA still retains over 90 percent of fixed line customers. A recent EU report on telecommunications in Accession countries noted that international long-distance calls in Poland were three times as expensive as in member states, and eight times as expensive when making a call to the United States. There is some uncertainty regarding the functioning of the interconnection framework, without which the linkage of communications

networks—that is, the core characteristic and requirement of the ICT environment—cannot flourish. As of 2003, Poland does not seem to have an adequate regulatory and business environment in place to support the diffusion of ICT and this represents a significant obstacle to the development of the knowledge economy and the overall competitiveness of the economy. ICT is the toolkit of the knowledge economy and electronic communications are the engine of the toolkit. Effective competition drives down prices, widens choice and brings forth new services, but competition can only be sustained in an appropriate regulatory environment. Best international practice regarding the regulatory environment (and a requirement of Poland’s EU membership) is the EU *acquis communautaire* for electronic communications. The current regulatory and legal framework does not appear to conform to the 1998 *acquis* and will now have to be updated to take account of the new EU regulatory package of 2002.

A more competitive market will and ensure that ICT hardware and software are available in Poland at the best prices by removing any barriers (technical or physical) to trade for these products. Lower prices will allow better for cost effective linkages between businesses and greater diffusion of ICT in the business sector, which in turn will improve productivity and microeconomic competitiveness. The diffusion of ICT will help to build confidence of businesses, households, and civil society in ICT and its usage. Universal access is an interim goal for sector policy. “Smart Subsidies”—at least at their pilot stage—could be used to promote universal access and provision for this approach should be made in any law on electronic communications, following the Guidelines of the European Commission, if Structural Funds are to be used.

ANNEX 1: THE “SMART SUBSIDY” APPROACH TO UNIVERSAL ACCESS

THE CONCEPT

The smart subsidy concept can be outlined as follows:

- Aims to mobilize private entrepreneurship and investment to supply services;
- Focuses on providing public access to voice services, computers, the Internet, and other ICT services through tele-centers (or cyber cafés) in rural and low-income urban areas on a commercial basis by charging fees for services;
- The range of services and ICT available on a shared basis is wider than available on an individual, “at home” basis;
- Allows public or quasi-public agencies to become important commercial clients or partners in the tele-center;
- Encourages local entrepreneurs to manage and have a stake in the tele-center as well as forming partnerships with bigger industry players; and
- Recognizes that in certain circumstances a tele-center providing universal access may not be commercially viable and that a subsidy may be required for a portion of the start-up and investment costs.

The subsidies are allocated in the following manner:

- The licensing authority defines a level of service for a particular geographic territory for a set period (say, 10 years) and issues an invitation to bid for a one-time subsidy;
- Bidders are allowed to make their own technological choices;
- Bidders calculate their required subsidy on the basis of expected income streams from fees, capital, and operational expenditure;
- Bidders may find additional individual, commercially attractive customers in the territory who may be reached for a small incremental cost once the public access points are in place. Bidders will take account of these extra commercial opportunities when calculating the required subsidy;
- The required subsidy is an amount that is just sufficient to make the tele-center commercially viable—it is not a full subsidy;
- The bidder requiring the lowest subsidy is declared the winner and is obliged to provide the defined level of service over a specified period of time on a commercial basis;
- The disbursement of the one-off subsidy is linked to operational performance indicators regarding the establishment of the public access points; and
- The bidding ensures that the subsidy is minimized and generates substantial private investment.

SMART SUBSIDIES FOR RURAL ACCESS IN LATIN AMERICA

Smart subsidies have been used to stimulate private investment in Latin America. It should be noted that the level service and access in these initiatives is less sophisticated than is proposed for Poland.

Table A.1.1 illustrates the size of subsidies involved, the number of localities covered, and the subsidy per locality. The “maximum subsidy available” indicates the sums set aside for the purpose, based on the estimated subsidy amount before the competitive bidding process. In the majority of cases the subsidy allocated after the bidding process was less than the sum available. Financing was through the government budget, levies on the revenues of operators, or funds generated by auctioning off the radio spectrum. (Financing from EU Structural Funds or similar mechanisms is not available in Latin America.)

Country	Source of finance	Period	Localities served	Maximum subsidy available (US\$M)	Subsidy given (US\$M)	Subsidy per locality
Chile	Government budget	1995–97	4,504	24.2	10.2	2,256
		1998–99	1,412	14.4	9.8	6,919
		2000	142	1.9	1.8	12,727
Peru	1 percent operator levy	1998	213	4	1.7	18,800
		1999	1,937	50	11	5,700
		2000	2,290	59.5	27.8	12,100
Colombia	Operator levy and government contribution	1999	6,865	70.6	31.8	4,600
Guatemala	Spectrum auctions	1998	202	NA	1.5	7,587
		1999	1,051	NA	4.5	4,282
Dominican Republic	2% operator levy	2001	500	3.8	3.4	6,800

NA. Not available.
Source: World Bank, 2002

The lessons learned in Latin America are that success is highly dependent on:

- Well-designed bidding mechanisms that are easily understood, transparent, and accessible to all potential bidders with a clear statement of minimum service requirements;
- Careful and full preparation by the licensing authority of data on potential market demand, both to establish the maximum available and for inclusion in a “data room”;
- A one-stop shop for licenses and radio frequencies (where required) and for multiple license applications, thereby providing new entrants with a clear path into the market;
- Regulatory support for the process, in particular in allowing tariff flexibility (better to have access at a cost than no service at all) and in ensuring adequate and timely interconnection;
- Providing a choice in technology solutions, for example allowing for fixed and wireless technologies;
- Offering training and support services to operators;
- Generating supplier interest (many new entrants in Latin America associated themselves with suppliers of telecommunications equipment; in the case of Poland this would include ICT suppliers);

- Promoting local stakeholders—usually in conjunction with a bigger player to achieve economies of scale; and
- Monitoring and evaluating results and disseminating best practice.

The lessons from Latin America regarding major risks and challenges are as follows:

- The bidding process must be sustained through more than one round of bidding. In Chile, the first round for 4,500 localities was the most competitive as bidders sought strategic positions;
- Bidders may have operational inexperience—especially with marketing, customer service, and investment optimization;
- Under-bidding may occur because of inexperience and poor business planning;
- Financial markets may deteriorate, resulting in the need for “senior institution” commitment; and
- The solicitation of bids must be ensured for the more marginal and least viable localities.

If adopted in Poland, it would be prudent to commence smart subsidies with a limited number of carefully considered pilot projects across a range of circumstances both to refine the smart subsidy approach to Polish circumstances and to benchmark the likely subsidies required.

ANNEX 2: QUALITY ASSURANCE IN TERTIARY EDUCATION

Internationally, accreditation is regarded as a major instrument serving two functions: *accountability* and *improvement*.¹ To address the growing disquiet about quality, two separate accreditation initiatives have emerged in Poland in the space of three years that are broadly in line with European initiatives. By late 1997, a formal consortium of Polish universities (comprehensive, classical higher schools encompassing natural, exact social, and human sciences including law and management) took steps to address the issue of quality assurance through the creation of an independent University Accreditation Commission (UKA). As of 2003, there are independent accreditation commissions for all types of schools: technical universities; medical, agricultural, and pedagogical academies; schools of management and economics; art schools; and others. A coordinating body, the Accreditation Commission of the Conference of Rectors of Polish Academic Schools (KRASP) has been established to ensure coordination of procedures and processes. Some programs have been evaluated jointly, for example information technology by UKA and the Accreditation Commission for Technical Universities (KAUT).

Meanwhile, like many other transition countries confronted with the challenges of rapid expansion of mass tertiary education, the Polish Government established the State Accreditation Commission (PKA) a fully independent body which took over responsibility from the General Council for Higher Education in 2002 and which has a statutory responsibility to ensure the quality of teaching in Polish HEIs. Since then, all applications for the establishment of new institutions and courses have been required to be submitted to the PKA. Thus, it is fair to conclude that Poland has already taken some important steps toward a comprehensive quality assurance system. The two accreditation bodies, PKA and UKA complement each other as the former is responsible for establishing and controlling minimal requirements while the latter is already focused on the possibilities of improvement.

Ideally, quality assurance in tertiary education should be based on mechanisms that are transparent and capable of reassuring users and the government of the quality of the course offerings and the value for money. This report argues that quality assurance in Poland needs to go beyond what has been achieved to date and to develop accreditation further from being a tool for evaluation to a means of general improvement. As a tool for comparison and to enhance mobility, quality assurance is also important within the international context.

Other countries have adopted a variety of measures to provide quality assurance, ranging from procedures for monitoring teaching effectiveness (Scotland and England); high quality management processes (Hong Kong (China)); systems for licensing new institutions and certifying educational credentials (Chile); and rewarding research productivity, either of individual schools (as in Mexico) or of entire academic departments (as in the United Kingdom).² Other quality assurance approaches include accreditation councils, national examinations, rankings, and publication of information. Netherlands and Germany have introduced accreditation by law.

One of the objectives of the Bologna Declaration (see Box A.2.1) is the promotion of European cooperation in quality assurance to develop comparable criteria and methodologies. The signatories also intend to introduce a more convergent degree system, which underlines the need for comparable quality standards.

¹ The European Training Foundation defines accreditation as “the award of a status. Accreditation as a process is generally based on the application of predefined standards. It is primarily an outcome of evaluation.” However, the U.S. definition goes further: “Accreditation is a process of external quality review used by higher education to scrutinize colleges, universities and higher education programs for quality assurance and quality improvement.”

² “Constructing Knowledge Societies: New Challenges for Tertiary Education.” World Bank (2002).

Box A.2.1. Accreditation in the EU Context

As a result of the Bologna Declaration, a working group headed by the European University Association (EUA) prepared a report on accreditation which started out with the following working definition:

“Accreditation is a formal, published statement regarding the quality of an institution or a program, following a cyclical evaluation based on agreed standards”.

In this context, the EUA group distinguished between two main possible functions of accreditation:

- Minimal quality control ensuring that a university fulfils minimal quality requirements and has appropriate quality-monitoring procedures in place.
- Quality assurance leading to an analysis and to proposals regarding the institution’s quality, including its specific quality assurance strategy.

As we have seen, in most respects Poland is beginning to develop its tertiary education quality assurance system along the same lines as most Western European countries. There is increasing autonomy in HEIs to decide for themselves what they are going to teach and research within budgets—over which they have, for the most part, complete control. In effect, the market will influence the qualifications sought by the users of the system and HEIs will respond to the market. Quality assurance will be provided by the Polish accreditation system, which has the potential to evolve further in the direction of greater autonomy and transparency. We are aware that this desire for autonomy has to be balanced by government’s need to know that it is getting value for its money. This does not necessarily lead to more regulations; incentives can also be developed to ensure that a university will voluntarily be accountable to the government for funding while screening itself to improve quality.

As Poland continues to develop its state accreditation committee, it will be essential that the process of accrediting institutions place greater emphasis on the importance of the initial internal self-assessment by the faculty and institution concerned to complement the external review conducted by visiting peers. This would contribute further to a climate that would encourage the best quality in tertiary education in Poland, including measures to promote a culture of quality through public debate, agreement on explicit standards and expectations, transparent rules, and enhanced information systems.

Box A.2.2. Scottish Qualifications Authority (SQA)

The SQA is the national body in Scotland for the development, accreditation, assessment, and certification of qualifications other than degrees. Its functions are as follows:

- Devise and develop qualifications, and keep them under review;
- Accredite and validate qualifications (other than degrees) as meeting the requirements the SQA specifies and publishes;
- Approve education and training establishments as being suitable for preparing people for these qualifications;
- Make arrangements for, assist in, and carry out the assessment of people undertaking education and training;
- Carry out quality assurance focusing on education and training establishments that offer people the opportunity to obtain the qualifications these institutions devise or award, and certify people’s achievement.

Working in partnership with people in education, industry, commerce, and government, the SQA develops qualifications that are relevant to the needs of individuals, society, and the economy. The qualifications are designed to be flexible—they can be taken in colleges, schools, workplaces, and training centers.

ANNEX 3: PROSPECTS FOR EXPORT-LED GROWTH AND DATA SOURCES

In view of its productivity-increasing foreign technology inflows, Poland can benefit from further productivity improvements by the development of its “medium-tech” sectors, such as consumer electronics or automobiles. The production of medium-tech goods is relatively labor intensive, and Poland still has a comparative advantage in manufacturing of labor-intensive commodities within Europe in comparison to Western Europe. Poland cannot compete with China but the extent that location does lower cost and provides confidence, Poland’s proximity is still an advantage.

The hypothesis of high-tech imports supporting the development of medium-tech sectors has been studied by Chong and Zanforlin (2000), among others. These authors present an endogenous growth model where innovations created in a high-tech sector may be assimilated or adapted by a lower-tech sector. This lower-tech sector expands and allows an economy to achieve long-run non-decreasing growth rates. This was actually the situation of the “Asian tigers,” which expanded rapidly owing to booming exports. Chong and Zanforlin test their hypothesis on a sample of 79 countries for the period of 1960–95, using a dynamic panel data approach, and confirm their hypothesis.

More narrative accounts of how these processes work can be found in Borrus (1996), Ernst (2000), and Radosevic and Yoruk (2001). Borrus and Ernst discuss the “high-tech” example of East Asian electronics. We find the possible beginnings of a similar success story in a transition-country environment—Hungary—in the case of the company Videoton (Radosevic and Yoruk).

Borrus (1996) shows how the East Asian electronics industry provides an example of how companies, by involvement in international production networks and with appropriate government policies, were able to move up the value chain from activities of a very low level of sophistication to leadership in electronic hardware. Beginning in the late 1960s, U.S. electronics leaders moved various production activities to affiliates (low-cost producers) in the Pacific Rim, starting with assembly and gradually moving more and more component manufacturing and testing and design functions to their affiliates. The trend was for U.S. producers to increasingly specialize in design and related tasks, while assigning more and more manufacturing tasks to their Pacific Rim affiliates. The movement to greater autonomy of the latter gained momentum especially in the first half of the 1980s. By the early 1990s, the affiliates had made a great deal of progress in the development of their own Asian networks. As their own activities became more sophisticated, with the accompanying rise in costs, they began outsourcing to indigenous lower-cost producers (e.g., Malaysia, Thailand, China) themselves.

There is a very instructive discussion of the government policies that helped to make these developments possible in Ernst (2000). Focusing on the Taiwanese case, he argues that the following aspects of government policy were particularly important:

- There were tax incentives for investment, as well as other investment incentives, such as facilitation of access to land for investors. However, rent-seeking activity was minimized by the absence of any attempt to limit these incentives to any privileged group: every domestic firm was eligible for the privileges if it complied with certain regulations.
- Moreover, foreign firms could also compete with domestic firms on very similar (although not quite equal) terms. This presents a stark contrast to the case of the Republic of Korea, which

virtually excluded foreign investment, and Singapore, which is dominated by foreign-owned firms to the virtual exclusion of domestic ones.

- The SME sector, which is dominant in Taiwanese electronics (another point of contrast to Korea), was actively supported. This support included labor training, loans, facilitation of technology upgrading, market promotion, and facilitation of inter-firm networking (for instance, strategic alliances, the “Center-Satellite Program,” and the like; linkages with large “core” firms played important role in the development of the SME sector). However, there was no discrimination with respect to size within the SME category (e.g., no special privileges for micro-enterprises).

The Hungarian electronics producer Videoton had an experience that was very similar to those discussed by Ernst and Borrus. Finding itself in a difficult position in the early 1990s, it integrated into international production networks by becoming a subcontractor (but remaining domestically owned, in contrast to most Hungarian exporters). This actually involved a move down the value chain in comparison to its product assortment in the days when it was an exporter to the CMEA. But what is interesting about Videoton is that it has positioned itself as the leader of a network with other domestic firms. However, it remains to be seen whether the company will rise to the challenge of becoming an own-brand manufacturer (Radosevic and Yoruk 2001).

Data Sources

Data that are used in this research come from four different databases. The OECD database on research and development was combined with two Polish databases on industry and one on international trade.

The R&D expenditures of the leading OECD economies come from the ANBERD (Analytical Business Enterprise Research and Development) OECD database. The series that are used are business enterprise expenditures on R&D expressed in PPP adjusted constant US dollars¹. The economies that are considered as sources of high-technology imports were chosen from among the group of countries that generate the vast majority of world R&D².

The flows of business R&D spending for industrial sectors in Germany, Italy, France, the Netherlands, Sweden, the UK, Japan, and in the US were used to calculate technology stocks for these countries. Following Keller (1997), R&D flows (φ_t 's) were cumulated using the perpetual inventory method, where the technology stock for each industry at time t equals:

$$n_t = (1 - \delta)n_{t-1} + \varphi_{t-1} \quad \text{for } t = 2, \dots, 12$$

$$\text{and } n_1 = \varphi_1 / (\lambda + \delta + 0.1).$$

The rate of depreciation of the knowledge stock— δ —is set at 0.1. This is a commonly used assumption in the literature on the subject. It is possible that the rate of depreciation of the knowledge stock is higher, thus reducing its rate of growth. Keller (1997) refers to two empirical papers, where the estimated value of δ is of the magnitude 0.12 and 0.25. Nevertheless, the author of this paper decided to adopt the assumption of 0.1 depreciation of the knowledge stock. The initial magnitude of the knowledge stock depends also on λ . This is the average annual growth rate of φ over the whole considered period. The denominator is increased by 0.1 in order to get rid of negative numbers of n_1 .

¹ PPP USD series were converted to constant 1996 US dollars using US GDP deflator.

² Further explanations about the choice of high-tech import sources are given in the Appendix.

The start year for the calculations of the technology stocks was set to 1987 and the end-year to 2000, primarily because of data constraints³. The OECD ANBERD data already consists of estimates as well as reported figures. In addition to this, some other missing data had to be interpolated by the author.

Technology stocks for Polish manufacturing industries were calculated with the use of the similar method as above. Flows of R&D business enterprise expenditures obtained from the Polish Central Statistical Office (GUS) were used to calculate stocks using the perpetual inventory method. The difference was in the knowledge depreciation rates and in the period over which the calculations were done. The parameter δ was set at 0.05 that is half the value used for the calculations of knowledge stocks for leading economies. The underlying assumption is that knowledge depreciates substantially slower in CEEs than in rich, Western economies. The starting year for Polish data had to be 1995 (earlier data are not obtainable⁴), and the end year 2000. The R&D expenditures were converted from the local currency to constant PPP adjusted US dollars with the use of the OECD GDP conversion rates and IFS US GDP deflators. They were also regrouped according to the ISIC Rev.3 classification, from the initial NACE Rev.1.

Foreign technology effect $b_{i,t}^f$ was obtained by multiplying technology stock indicator $n_{i,t}$ by the respective country's imports share in a given industry's imports. Polish trade statistics with detailed data on imports and exports of individual trading partners⁵ are classified according to the *Combined Nomenclature* products database. In order to get the respective trade shares, trade nomenclature was correlated with the STIC Rev. 3 classification of economic activity. This operation required disaggregating trade data to a very low 8-digit level—*i.e.* to the level of individual products—in order to group them into the STIC 3-digit level of economic activity.

³ The ANBERD data on R&D for the majority of the countries of interest are given from 1987 onwards in ISIC Rev.3 classification. The oldest data are in the ISIC Rev.2 classification which is not easily comparable with the current one.

⁴ There was a change in the statistical industrial classification in 1994, so earlier data are not comparable. Besides, there is only few data on business expenditures on R&D in 1994, since only few enterprises were reporting it, so the year 1994 had to be excluded from the analysis as well.

⁵ The countries analyzed are the following: Germany, Italy, France, the Netherlands, Sweden, the UK, Japan, and the US.

ANNEX 4: MATCHING GRANTS IN ISRAEL

In 1985, Israel passed the “Law for the Encouragement of Industrial R&D.” This legislation has defined the parameters of government policy toward industrial R&D ever since. The stated goals of the legislation, to be implemented by the Office of the Chief Scientist (OCS), are to develop science-based, export-oriented industries, which will promote employment and improve the balance of payments.

At the heart of the law is a program of financial incentives. Companies—whether they are big corporations or small start-ups—that meet certain eligibility criteria, are entitled to receive matching funds for the development of innovative, export-targeted products. The OCS funds up to 50 percent of R&D expenses in established companies, and up to 66 percent for start-ups.

The OCS supports and administers a wide range of additional programs, the main ones being (i) “Magnet,” a program to encourage pre-competitive generic research conducted by consortia; (ii) a program of technological incubators; and (iii) various programs involving bilateral and multilateral international R&D collaboration.

Administering support for standard R&D programs is by far the main activity of the OCS. The program works as follows:

As noted in Chapter 4, qualifying firms submit grant applications for specific R&D projects to a research committee, and if approved (about 70 percent are) they receive a grant of up to 50 percent of the stated R&D budget for the project. Successful projects (i.e., those leading to sales) are required to repay the grant. To be eligible for the grant, the R&D project must be executed by the applicant firm itself; the project’s product(s) must be manufactured in Israel; and know-how acquired may not be transferred to third parties.¹

The Research Committee, chaired by the Chief Scientist, is responsible for defining the conditions for granting aid (within the confines of the 1985 law), and for reviewing the applications and selecting the recipients. The committee is staffed both by qualified government officials and by public representatives, but it relies on (outside) professional referees and advisers to review the applications. The decisions of the Research Committee can be appealed before an Appeals Committee.

Grants of (up to) 50 percent of the total R&D costs are given to projects that “lead to know-how, processes or systems for manufacturing a new product/process or substantially improving existing ones.” Five grants covering 30 percent of R&D costs are available for projects leading to **improvements** in existing civilian products, and 20 percent for improvements of **military** products. Start-up companies qualify for grants of up to two-thirds of their R&D costs, with a ceiling of \$250,000 a year for two years. Products aimed at the military (export) market qualify for grants of up to 30 percent. If one could assume that OCS grants brought about higher **total** R&D outlays (this is commonly referred to as “additionality”), the findings of high returns to R&D would imply positive returns to government support as well. Capital markets were extremely limited in Israel during the early developmental stages of the country’s high-tech sector (in other words, in the 1970s and 1980s), and hence it is highly unlikely that R&D grants supplied by the OCS would have crowded out private R&D funds back then. Later on, however, internal reform as well as international openness greatly increased the availability of funds to industry, bringing back to the forefront the additionality issue, certainly during the 1990s.

¹ Trajtenberg (2000).

According to Trajtenberg (2000) the basic conundrum posed by additionality is the obvious lack of counterfactuals (i.e., “what would the recipient firm have done if it had not received an R&D subsidy?”), which effectively means the lack of appropriate controls (i.e., data on non-recipients that are otherwise similar to the recipients). Several recent papers have tried a variety of approaches to deal with this problem (see for example Busom [2000] and Wallsten [2000]), but the jury is still out both on method and on “stylized facts.” Feldman and Kelley (2000) come closest to having an appropriate control group: they followed both winners of ATP grants and applicants that failed to receive grants. Surveying both types of firms, they find prima facie evidence of additionality—e.g., non-awardees tend **not** to pursue the proposed projects by themselves, and awardees are more successful in seeking additional funding for the projects.

The evidence thus far available from these studies provide econometric support, albeit limited, to the presumption that OCS grants in Israel have had a positive and significant impact on productivity in R&D-intensive sectors, and through them on the economy as a whole. Still, there is a long way to go in that respect, if only because a major ingredient of the rationale for government support to R&D, namely spillovers, has not been investigated at all.

The R&D Law in Israel does not address the thorny issue of how to allocate a (rigid) budget for R&D support if the demand for such support exceeds the budget provision. That is, the OCS support program was not meant to be competitive, and in principle it should provide R&D subsidies to **all** projects that pass the eligibility criteria.

These criteria are based on technological and commercial feasibility, and other procedural considerations. Projects are judged one by one, and there is no attempt to rank them or otherwise establish a funding priority. The paramount principle of “neutrality” that has been a cornerstone of R&D Policy in Israel since the late 1960s also precludes choosing projects based on their fields—or any other such consideration. Until now the system has worked such that all eligible projects are supposed to be supported, and in principle the support should be equal across projects (in percentage terms). The eligibility criteria entail checks of technological and commercial feasibility (or “viability”), the good standing of the applicants, and other administrative criteria.

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