POLAND
ENTERPRISE INNOVATION SUPPORT REVIEW

Natasha Kapil
Marcin Piatkowski
Ismail Radwan
Juan Julio Gutierrez

THE WORLD BANK

POLAND ENTERPRISE INNOVATION SUPPORT REVIEW: FROM CATCHING UP TO MOVING AHEAD

Natasha Kapil
Marcin Piatkowski
Ismail Radwan
Juan Julio Gutierrez

Private and Financial Sector Development
Europe and Central Asia Region

This is an evaluation of the Enterprise Development Program of the Government of Poland.

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Acronyms and Abbreviations

BGK	National Economy Bank
CEE	Central and Eastern Europe
CIS	Community Innovation Survey
EPD	Eastern Poland Development Operational Program
ESTD	Early Stage Technology Development
GUS	Central Statistical Office
HC	Human Capital Operational Program
ICT	Information and Communications Technology
IE	Innovative Economy Operational Program
KFK	National Capital Fund
MNCs	Multi-national Companies
MoSHE	Ministry of Science and Higher Education
MoE	Ministry of Economy
MoRD	Ministry of Regional Development
MoLSP	Ministry of Labor and Social Policy
MoIA	Ministry of Interior and Administration
NACE	Classification of Economic Activities in the European Community
NCBiR	National Center for Research and Development
NOT	Polish Federation of Engineering Associations
OECD	Organization for Economic Cooperation and Development
OP	Operational Program
PARP	Polish Agency for Enterprise Development
R&D	Research and Development
RDI	Research and Development Institute
REGON	National Official Business Register
SMEs	Small and Medium Enterprises
TFP	Total Factor Productivity
VA	Value Added
VC	Venture Capital

Introduction

This report reviews and evaluates the current state and future prospects of enterprise innovation in Poland. Inspired by the section on innovation in the 2011 report "Europe 2020 Poland: Fueling Growth and Competitiveness in Poland Through Employment, Skills and Innovation", which highlighted the pressing need to reform the approach to research and development (R&D) financing in the public sector, this report provides a sequel focused on publicly funded innovation and R&D in the private sector.

The analysis captures existing developmental dynamics and projects long-term trends in innovation and R&D spending in Polish enterprises. It engages the Europe 2020 Report by exploring the public-private sector nexus in an attempt to shed more light on the role that public financing may be playing in innovation efforts pursued by Polish companies.

The ultimate goal of the report is to produce a grid of policy recommendations that could serve as guideposts for the Polish Government as it proceeds to formulate its long-term strategy for innovation and R&D in the enterprise sector. The report reviews existing approaches, methods and policy tools used by the Government, and it evaluates an advanced draft of Poland's Enterprise Development Program (PRP) for the upcoming EU financial perspective.

The breakdown of the six chapters of the report is as follows:

- **Chapter One** presents a brief overview of existing innovation- and R&D-related efforts in Polish enterprises with a special focus on the structure of expenditures and sources of funding.
- **Chapter Two** maps the institutional and financial support system for innovation and R&D in Poland. First, it lists the institutions and programs designed to boost innovation efforts in Polish enterprises according to target activities and sources of funding. Next, it discusses the impact of the support system on private sector innovation, R&D spending and industry-level productivity. Finally, it identifies the challenges that the system needs to overcome to operate optimally.
- **Chapter Three** evaluates the activities of the leading agencies implementing innovation programs in Poland in greater detail. It examines the division of responsibilities within the institutional architecture and then analyzes the agendas of relevant implementation bodies, focusing on objectives, programs, funding and patterns of interaction with beneficiaries. The chapter also offers an assessment of the implementation bodies' capacity to perform their stated goals and designated tasks.

- **Chapter Four** summarizes the lessons learned about Poland's existing innovation system and provides general pointers for the reform process. Capitalizing on the review of programs, instruments and institutions presented in the previous chapters, it identifies the main substantive areas with notable room for improvement.
- **Chapter Five** offers an ex-ante evaluation of the proposed PRP. It first spells out the principles of international good practice. Then it highlights the strengths and the weaknesses of the institutional reshuffling, policy realignment and instrument design outlined in PRP. Finally, it proposes ways in which the World Bank could assist the Government of Poland with the reform process.

Methodology and sources

This report is an in-depth study of ongoing innovation and R&D activities in Poland from a regional perspective. The statistical analysis relies on publicly accessible datasets, including Eurostat, Community Innovation Surveys (CIS) and the Science and Technology indicators of the Organization for Economic Cooperation and Development (OECD), among others.

The analysis of the role of public support in private sector innovation applies the theoretical model of the innovation process developed by Auerswald and Branscomb (2003). The model breaks the innovation process into five notional phases: research, concept/invention, early-stage technology development, product development and commercialization. Accordingly, this review classifies public funding for innovation (See Table 3) by the stage that it targets. Public support for innovation is also categorized by the financing instrument (e.g. matching grants, tax credits, vouchers) and the inherent risk that it addresses. To this end, the study has reviewed the operational manuals of Operational Program Innovative Economy (OP IE) and Operational Program Human Capital (OP HC) as well as databases monitoring program implementation at the Ministry of Economy, Central Statistical Office (GUS) and the Polish Agency for Enterprise Development (PARP). This data has also been used to analyze the group of hitherto OP IE beneficiaries, with a focus on firm size, technology intensity and sector.

The institutional review of the stakeholder agencies in Poland's innovation system (e.g. PARP, National Capital Fund [KFK], etc.) and the ex-ante evaluation of PRP draw on operational manuals and available mid-term evaluations, interviews with beneficiary firms as well as roundtables and meetings between the World Bank team and relevant public officials. When it comes to PRP, the World Bank has cooperated closely with the Polish Ministry of Economy since the early drafting stages, employing an interactive approach to assessment and providing expert advice throughout.

The study of productivity, included in the Appendix, capitalizes on the notion of sectoral technological frontiers, defined as highest total factor productivity (TFP) in industry *i* at time *t* by Griffith, Redding and Van Reenen (2004).[1] The methodology used to calculate TFP is based on the Levinsohn – Petrin (LP) method (Levinsohn & Petrin [2003]), (Levinsohn, Petrin & Poi [2003]) and a NACE 31 sectoral classification on the 2-digit level. This part of the analysis utilizes the Amadeus dataset as well as the EU KLEMS dataset for firm level information on the sectoral level.

1. See Appendix for details.

Executive Summary

Sustaining Growth and Convergence Through Innovation and R&D

Poland: strong growth through the crisis

Poland has been a showcase of solid economic performance since it joined the European Union in 2004. It has been catching up with the EU-15 at an impressive pace. Incomes have more than doubled in real terms since 1990. EU accession has prompted further growth acceleration. Until recently, the economic crisis in Europe did not dampen the ongoing convergence. Poland has weathered the crisis better than any other country in Europe. It remains the only EU economy that avoided a recession in 2008-2010. It is also one of the few countries that continued to expand at a relatively rapid pace, even though growth prospects for 2013 and 2014 are more subdued. While many other EU members continue to struggle just to reach pre-crisis levels, Poland's output has increased by over 15 percent compared to 2007. As a result, Poland's income levels are rapidly converging with the EU-15 income levels, reaching historically unprecedented highs.

Poland's strong economic performance can be explained by a fortunate combination of structural advantages and astute economic policies. First, the country's industrial structure, dominated by low- and medium-tech manufacturing, as well as its geographical proximity to Germany, has helped support exports throughout the global economic downturn. Next, Poland's flexible exchange rate eased adjustment to external shocks and boosted competitiveness on key export markets. Third, the Government's counter-cyclical fiscal policies that allowed budget deficit to swell to nearly 8 percent in 2009 and 2010 helped cushion the blow in the short-term. The overall deficit dwindled in 2011 and 2012, while public debt stayed below legal limits set by the Polish Constitution and the European Commission.

From catching up to moving ahead: why is innovation important?

Poland had successfully completed its transition to a well-functioning European market economy even before the crisis struck the EU. In other words, it had largely "caught up" with the EU-15 in terms of institutional infrastructure, although not yet in terms of income. The country upgraded its large and diversified manufacturing base by successfully adopting some international good practice, acquiring and applying cutting-edge machinery and attracting foreign direct investment (FDI).

While the catching up approach has helped increase productivity on the factory floor, it could have done more to facilitate growth of smaller enterprises and spur job creation. Despite recent progress, employment levels linger below the EU average, largely because of low employment rates among older workers, aged 50 and above, and women. Unemployment also remains relatively high, approaching 10 percent of the labor force, partly due to supply-demand mismatches in certain geographical areas and specific skillsets. Nonetheless, thanks to positive GDP growth rates, Poland's unemployment is still lower than in the euro zone (10.2%).

For Poland to sustain its impressive growth, the country has to replace the catching up strategy with a moving ahead one, aimed at enhancing competitiveness, productivity and job creation. The fulfillment of this goal will require further sophistication of the economy: an increased emphasis on innovation and higher VA manufacturing and services. The new strategy must support the development of Poland's own intellectual property. It ought to encourage entrepreneurship and back small businesses and start-ups — especially in the tech area — through a mixture of grants, loans and venture capital as well as technical advice, mentoring, networking and incubation. It is also crucial to promote greater internationalization of domestic firms and intensify the effort to attract R&D-intensive FDI.

Poland's Existing Enterprise Innovation System

Institutions and programs: the opportunity for a strategic revamp

The institutional infrastructure supporting Poland's enterprise innovation system suffers from fragmentation, and it requires greater inter-agency coordination. On the national level, responsibilities for strategy, financial planning and implementation are unevenly distributed between five different agencies and/or ministries, which manage 22 innovation support programs. Unsurprisingly, most of the programs package innovation with other relatively diverse objectives related to regional development, human development or SMEs. On the regional level, each of Poland's sixteen regions, or *voivodships*, also has its own innovation support initiatives. This high level of fragmentation poses several obstacles to a comprehensive, integrated and affordable Polish strategy for innovation and R&D. It duplicates objectives, discourages information sharing, disperses responsibility and accumulates administrative costs for the public sector as well as the grant applicants and beneficiaries.

This report recommends streamlining the system of public support around the five notional stages of the innovation process and placing a heavier emphasis on the early ones. To maximize output, innovative enterprises should receive sustained support starting from research, concept/invention and early-stage technology development to product development and commercialization.

Sources of funding: a €10 billion EU-driven boom has yet to unleash innovation

Since EU accession, Poland has experienced an impressive surge in funding for innovation activities from the EU structural funds. The budget for public support programs for innovation funded by the EU was three times larger in 2010 than it was in 2007. Spending is forecast to increase further in 2013. However, the ratio of public R&D expenditure to GDP has continued to stagnate at 0.45 percent of GDP in 2010 as funding appears to have financed non-R&D innovation activities.

This report argues that the surge in EU funding has created a momentum that Polish policy-makers should harness by taking steps to create a powerful innovation engine. At present, EU sources account for more than 85 percent of Poland's EUR 9.8 billion budget for innovation in the 2007-2013 programming period. The government should focus on building home-grown capacity based on sustainable market-based solutions and increased risk-taking by supporting early stage innovation projects. This way, Poland can maximize the chances of making a mark on the global innovation map and transitioning smoothly to a post-structural funds era.

The government also ought to focus on closing the gap vis-à-vis regional peers in private innovation expenditures and attract R&D-intensive FDI. Public programs have played a significant role in establishing venture capital and public R&D infrastructure, but they have wielded limited impact on private R&D investment. Moreover, at this point, R&D-intensive FDI in Poland accounts for only 4.5 percent of total business R&D spending as compared to 13 percent in Hungary and an impressive 21 percent in the Slovak Republic. This report recommends that the Polish Government focuses on attracting R&D-intensive FDI, which tends to be long-term and less prone to flight.

Public spending allocation: risk-averse selection favoring large and mature firms and low- and medium-low technology industries

The risk-averse selection process steers large proportions of public funding to big companies in the form of grants for absorption-oriented activities and neglects innovative SMEs. Government agencies have assorted more than 40 percent of OP IE funds to large companies for technology upgrading through capital investment. This report recommends that more grant funding is channeled into big firms and SMEs interested in breakthrough innovation and R&D. Technology absorption, which remains necessary and desirable, should be financed via revolving instruments rather than grants.

Public funding for innovation also tends to finance projects at the later stages of the innovation process, where market failure is smaller. A large proportion (56 percent) of public funding is channeled into companies focused on later stages of technological development, approximately 30 percent supports research and invention and only 7 percent ends up with firms at earlier stages of the innovation process, where public support is most sorely missed. Most start-ups struggle to get beyond the stage at which research has been concluded and to actually develop the innovative product.

The selection process ends up channeling the bulk of R&D support into low- and medium-low tech manufacturing, presumably also due to risk aversion. There is a clear preference for firms in low- and medium-low tech manufacturing in the disbursement of funding for R&D. OP IE actions 1.4. and 4.1., which are supposed to support research and its implementation, have mostly funded enterprises operating in low- and medium-tech manufacturing, such as retail, wholesale trade, construction and transport, where the technological risk tends to be lower than in high-tech manufacturing and knowledge-intensive services. In absolute terms, public support contributes a greater share to overall enterprise expenditures on R&D in low- and medium-tech manufacturing than it does in high- and medium-high tech. This pattern of funding allocation may be one of the reasons why Poland is catching up but not yet moving ahead of its regional peers and the EU-15.

Enterprise innovation: the dominance of absorption over breakthrough innovation

Defying EU-15 and regional trends, the majority of enterprise spending has thus far gushed into technology absorption. Firms have used an overwhelming 87 percent of their resources

on innovation to finance technology absorption in the form of fixed capital investments into plant machinery and only 13 percent to support R&D, which indicates that technology absorption remains relevant for Polish enterprises.

Public funding contributes marginally to enterprise R&D. The majority of R&D, 88 percent, is financed by the firms themselves. Moreover, contrary to the Polish Government's official objectives, most of the public funding for private R&D ends up sponsoring low-tech, not high-tech industries.

Financing instruments have been dominated by capital investment grants for the absorption of new technologies. Those have accounted for nearly 40 percent of all available funding. Few, if any, absorption-related innovation activities are funded via revolving instruments, e.g. loans, even though capital investments have stable and predictable cash flows that would facilitate loan repayment.

The focus on absorption has thus far been largely appropriate given the current level of Polish economic development and enterprise needs. Moreover, it is possible that it has helped the Polish economy withstand the global financial and economic crisis in better shape than its regional peers.

However, Poland will need to divert innovation spending from absorption to innovation to maintain or accelerate the current pace of convergence. Though modern machines, better management practices, strong inward FDI flows and improved human capital in a good macroeconomic environment have so far proven sufficient in driving economic growth, the experience of highly developed economies suggests that to sustain the current rate of economic expansion, the country will have to generate productivity growth based on innovation and R&D.

Looking ahead, Polish innovation policy needs to adopt more market-based instruments and adjust the toolkit of financing instruments in line with trends in advanced economies. The report recommends channeling more resources into private R&D and high-tech industries, as well as gradually switching from grants to revolving instruments to fund technology absorption.

Legalistic application procedures and risk-averse selection processes: bypassing creative entrepreneurship

While innovative enterprises do apply for public funds, the application and selection procedures are designed in a way that scarcely engages them. A closer look at the beneficiaries reveals that the system tends to reward larger companies and favor projects focused on absorption and later stages of the innovation process, e.g. commercialization. Several features of the overly legalistic process might be to blame. First, it appears that the selection criteria established by the implementation bodies weed out variation. As such, they may be interfering with the market-based self-selection that reflects the real needs of the Polish enterprise sector. Second, the application process uses a disproportionate number of non-substantive criteria and assessment mechanisms that do not sufficiently focus on the inherent qualities of the proposed projects. Third, the selection process is largely paper-based, which suggests that applications prepared by professional intermediaries have a greater chance of succeeding. It is thus possible that form is overshadowing substance. Overall, evidence suggests that Poland's private sector does not suffer from a lack of creative entrepreneurs or breakthrough innovators seeking public funds. But the legalistic application process and risk-averse selection procedure may not necessarily be rewarding the best projects.

Government agencies are legally obliged to eschew personal interaction with applicants, which severely limits their ability to conduct proper due diligence or deliver meaningful mentoring. Innovative start-ups and SMEs often require hands-on mentoring from seasoned business professionals, who help them hone their business plans, integrate tested

ideas and approaches and potentially reduce the risk of failure. The argument commonly used by the defenders of the current approach is that the system has been specifically designed to diminish the potential for charges of favoritism and corruption.

The highly regulated and technocratic process of funding allocation fosters risk-aversion, which may be contributing to Poland's overall underperformance in innovation. The staff of several implementation agencies — while clearly committed and dedicated —are constrained by legal requirements and the strict anonymity of the selection process. They also seem to lack the knowledge and the skills relevant to industry, which limits their ability to redesign effective selection procedures and discern promising projects. As a result, many government employees are reluctant to use public resources to fund innovative and risky projects that, by definition, may not result in commercially viable products and services.

Impact evaluation system: putting policy-makers into the feedback loop

Polish authorities have not yet upgraded the impact evaluation mechanisms used in the innovation system from monitoring inputs and outputs to assessing outcomes. Hence, it is an impending task that lies ahead. Without a methodologically rigorous evaluation system, it is difficult to say with at least some degree of confidence what has worked in the innovation system and what has not. At present, the design of the innovation system itself poses obstacles to meaningful evaluation, as program objectives often make it impossible to establish baselines. Moreover, while some evaluations have been conducted, most of them have not met the standards of methodological precision or included control groups, which means that they were unable to assess the actual additionality of each public zloty spent. Most importantly, even the conclusions of otherwise useful evaluation studies have not received sufficient attention from policy makers, making the whole exercise largely futile.

This report argues that Poland should establish a robust ex-ante and ex-post evaluation system. In so doing, the Government would create strong feedback loops ensuring that future support for the enterprise innovation system is constantly tailored and refined, based on Poland's own experience.

Towards a Future Enterprise Innovation System

The raison d'etre of public support for enterprise innovation is to encourage firms to generate and commercialize homegrown intellectual property. During the 2014-2020 funding cycle, enterprise support programs in Poland should encourage innovative R&D on all levels: universities, research labs and especially high-tech start-ups. The innovation system must create market-based processes, including robust revolving instruments, that can be scaled in a post-structural funds environment. Importantly, public aid should not crowd out private expenditure but leverage it. In the future, the quality of the innovation results will be more important than the quantity of innovation inputs. With this objective in mind, this report proposes to strengthen the public support system for enterprise innovation in the following ways:

- ***From catching up to moving ahead:*** in terms of objectives, Poland will need to move towards innovation, i.e. creation of products and services that are new to the world, to continue converging at a rapid pace.
  a. The public sector will have to boost support for smaller firms in high-tech industries.
  b. Public spending should continue to support capital investment but reprioritize R&D.
  c. The innovation system must integrate market-based approaches to financing.

- ***Strategic revamp of institutions and programs:*** redefining responsibilities of the stakeholder agencies is key to create a viable institutional umbrella for the national innovation system. Existing programs need to be consolidated and their features modernized.
  a. It is recommended that the authorities reshuffle project portfolios among the leading agencies (e.g. PARP and NCBiR) according to their mandate, risk appetite and institutional capabilities to assess the general needs of entrepreneurs, decide between R&D proposals and technology absorption requests, and match selected projects with appropriate funding instruments.
  b. Market-based institutions, such as BGK and KFK, could manage revolving instruments, e.g. loan guarantees and/or matching angel funds. PARP could specialize in support services to entrepreneurs and SMEs.

- ***Creating a risk-tolerant environment:*** transitioning to a less risk-averse culture in the reshuffled institutional system will be a longer, more incremental process wherein the Polish Government will require the full support of the European Commission. Key implementation agencies are currently biased in favor of financing low-risk capital expenditures in larger firms, often sidestepping SMEs and projects at the earlier and riskier stages of the innovation process.
  a. The Government can foster a more risk-tolerant environment by assuming a portfolio management approach. In the case of start-ups, only a small percentage of them would need to be commercially successful for the whole portfolio to be profitable.
  b. The Government should also strengthen the participation of the private sector in the decision-making on public funding by integrating entrepreneurs in investment committees.

- ***Overhauling the selection process:*** public support should reward projects that complement the objectives of the overarching programs and reflect the demands of the Polish market. The legalistic application process currently favors form over substance, and the risk-averse selection process channels most public funding for R&D into low- and medium-low tech manufacturing. In sum, the system does not seem to be giving a shot to the worthiest applicants.
  a. The selection criteria should be redefined and simplified.
  b. The selection procedure ought to include face-to-face meetings, at which entrepreneurs would be able to present their projects.
  c. The implementation agencies must bring in international technical experts for peer review and engage private sector investment professionals as well as industry experts in investment committees, especially when larger amounts of public funds are involved.

- ***Tailoring programs and financing instruments to future growth objectives:*** public support instruments should be tailored to the challenges typical for each of the notional stages of the innovation process — research, concept creation, early-stage technology development, product development and commercialization.
  a. Research and concept creation could be backed by matching grants, access to networks, linkages to academia and engagement with innovative enterprises abroad.
  b. ESTD could be supported with a mixture of grants and venture capital.
  c. Less risky ventures at the later stages of the innovation process could be assisted by equity and commercial debt instruments.

- ***Prioritizing early-stage technology development:*** expanding existing incubators and their services and focusing on relevant companies that are scaling-up their operations is crucial if Poland wants to establish itself on the global innovation market. At present, incubators seem somewhat limited in their activities, e.g. renting real estate and providing basic support services. Leading venture capitalists will start considering them as investment opportunities when they prove themselves as viable sources of deal flow.
  a. Differentiation between two types of incubators is recommended: technological incubators focused on high technology start-ups and business incubators specializing in services for companies in low-tech and mature sectors.
  b. Both could garnish their menu of services with some form of venture capital and links to academia and prototyping facilities.

- ***Establishing a rigorous impact evaluation system:*** an overhaul of monitoring mechanisms would enable policy-makers to tailor programs and instruments of innovation policy based on implementation feedback, i.e. the assessment of the difference made by public funding in the group of beneficiaries in comparison to similar non-beneficiary firms. Impact evaluation is necessary to assess the additionality of the public zloty.
  a. The system should employ rigorous impact assessment methodologies and rely less heavily on qualitative assessments.
  b. Future quantitative studies capitalizing on GUS innovation statistics ought to ensure that there is a unified way of accounting for innovation and R&D spending among Polish enterprises. This report detected some misconceptions and/or under-reporting of expenditures and thus recommends to run an educational campaign.
  c. The output of impact evaluation must be sure to reach relevant policy-makers and, if necessary, translate into policy realignment.

CHAPTER 1

Enterprise Innovation in Poland: an Overview

The objective of this chapter is to present a brief survey of Poland's innovation policy and its impact in the enterprise sector. The chapter focuses on the sources and targets of public expenditures, evaluating the effect that they have had on enterprise R&D and innovation thus far.

Innovation expenditures in Poland: absorption-dominated and regionally stagnant

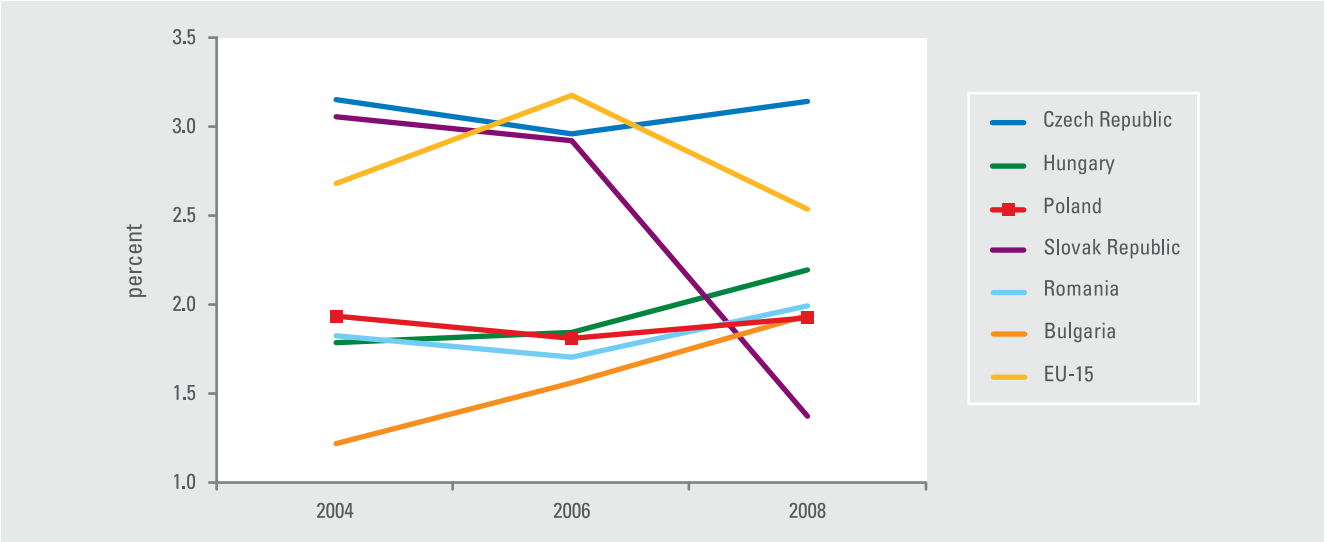
Poland is a regional laggard in terms of overall spending on innovation and R&D. Poland's level of development is roughly similar to that of the Czech Republic and Hungary, as reflected in GDP per capita (with the Hungarian level of income slightly lower and the Czech level of income slightly higher). But since transition, the country has been devoting comparatively fewer resources to innovation and R&D than its two closest regional peers.

Poland's current levels of innovation expenditures are on par with those common in less developed parts of Central and Eastern Europe (CEE). The spending on innovation activities, as defined in the EU's Community Innovation Survey (CIS), amounted to just 1.9 percent of GDP in 2008. This is much lower than in the EU-15 or among Poland's regional peers, in line only with the less developed CEE countries, such as Romania and Bulgaria (Figure 1.1).

In relative terms, Poland's R&D expenditures remain modest. In 2009, they amounted to only 0.68 percent of GDP. The Czech Republic and Hungary spent about twice as much (1.48 percent and 1.17 percent) in the same year. Poland's 2010 expenditures, at 0.74 percent of GDP, are still very far from the target 3 percent of GDP that the Europe 2020 Strategy has set for R&D spending. They are only slightly closer to Poland's own target of 1.7 percent of GDP, which it hopes to hit by 2020. Private sector expenditures on R&D, which in developed economies tend to have much higher returns than public R&D spending, are particularly low in Poland, amounting to a mere 0.2 percent of GDP. In comparison, Hungarian and Czech enterprises spent 0.7 percent and 0.9 percent of GDP, respectively, on R&D in 2009 (Figure 1.2). Based on research conducted for this report, there is a strong suspicion that Polish enterprises under-report volumes of innovation and R&D spending as they likely classify certain activities as regular engineering and not innovation or R&D. Hence, official statistics do not necessarily reflect reality. The World Bank recommends that GUS tests the hypothesis.

Poland's R&D expenditures have been largely stagnant in the last 15 years, unlike in other CEE countries. While R&D expenditures (in proportion to GDP) in the Czech Republic and Hungary increased by 60 percent and 70 percent, respectively, growth in R&D spending in Poland was negligible in the same period. Total R&D spending has oscillated around 0.7 percent of GDP throughout much of the transition (Figure 1.3).

FIGURE 1.1 Poland Lags Behind Regional Peers in Innovation Expenditures



Notes: the vertical axis depicts innovation spending as a percentage of GDP, while the horizontal axis shows values for selected CEE countries and the EU-15 in 2004-2008. EU-15 denotes different groups of countries in different years, depending on the CIS coverage (2004: Belgium, Denmark, Germany, Greece, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden; 2006: Belgium, Denmark, Germany, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden; 2008: Austria, Belgium, Germany, Finland, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden).
Source: CIS, Eurostat.

FIGURE 1.2 Poland Trails Behind CEE and EU-15 in R&D Expenditures

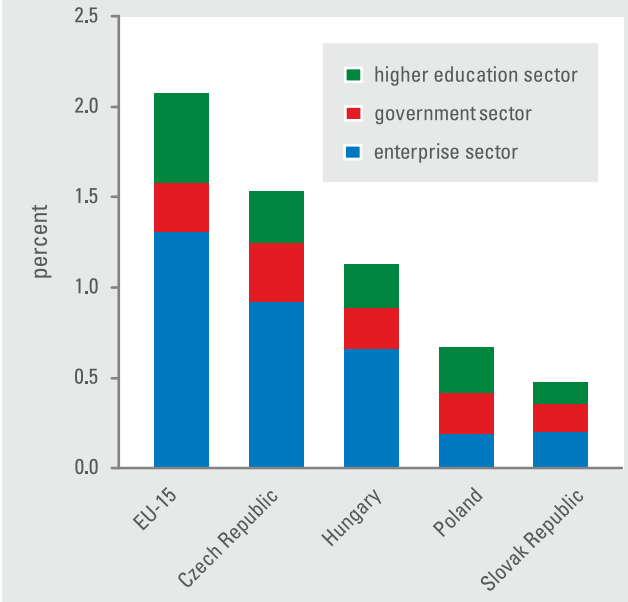
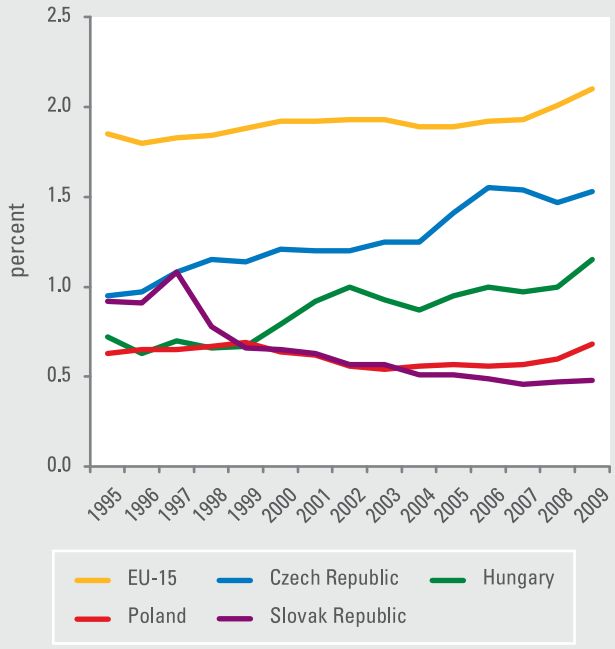


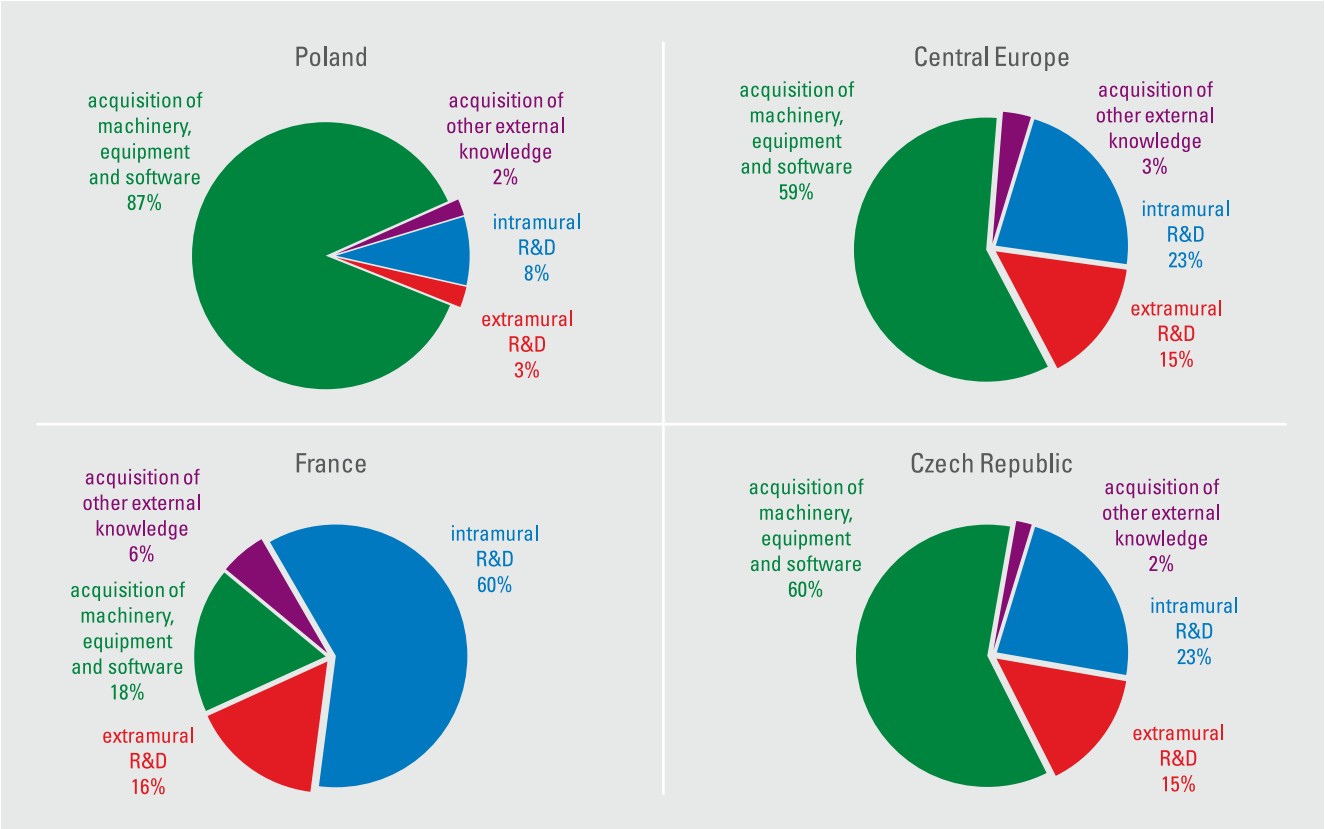
FIGURE 1.3 Poland's Stagnating R&D Expenditures



Notes: in both figures, the vertical axis depicts R&D expenditures as a percentage of GDP. In Figure 1.2, the horizontal axis includes values for CEE countries and the EU-15 in 2009. In Figure 1.3, it illustrates trends in spending in the EU-15 and selected CEE states in 1995-2009.
Source: IBS based on Eurostat.

The composition of enterprise spending on innovation is also different from the country's regional peers and the EU-15, as technology absorption tends to crowd out innovative R&D. At present, technology absorption through fixed capital investment represents the dominant part of innovation spending in Polish enterprises (87 percent). R&D-related expenditures, including extra- and intra-mural R&D, as well as acquisition of external knowledge, amount to only 13 percent of the total innovation spending in the private sector. In a regional comparison, total R&D expenditures, coupled with spending on acquisition of external knowledge, absorb about 41 percent of all innovation funding in enterprises across CEE (see Figure 1.4). For the conceptual distinction between technology absorption and innovation, see Box 1.1.

FIGURE 1.4 Absorption Dominates Enterprise Innovation Spending in Poland Compared to CEE and EU-15



Notes: innovation activities are classified by type of expenditure. Central Europe denotes the Czech Republic, Hungary, the Slovak Republic and Slovenia. The data is from 2008.
Source: IBS based on Eurostat (CIS).

Enterprise expenditures on R&D are also markedly lower in Poland than in the CEE neighborhood. Relative to GDP, spending on business R&D — both intra-mural and extra-mural — is much more modest than in the Czech Republic and Hungary. Within CEE, it is only comparable to the two least developed EU-10 countries, Bulgaria and Romania (Figure 1.5).

The puzzle of generous public spending on innovation on the one hand and the surprisingly low number of genuinely innovative enterprises on the other hand could be explained by a number of factors:

- *Funding gap:* although the availability of public resources has increased in the past couple of years, mainly owing to the surge in EU funding, private spending on innovation has stagnated. First, suboptimal selection procedures tend to discriminate against riskier innovative projects. Moreover, the financing instruments are not used at the appropriate stages of the innovation process, e.g. absorption is funded via grants, not revolving instruments, etc. Finally, public support may be replacing, rather than complementing, private expenditures on innovation and R&D.

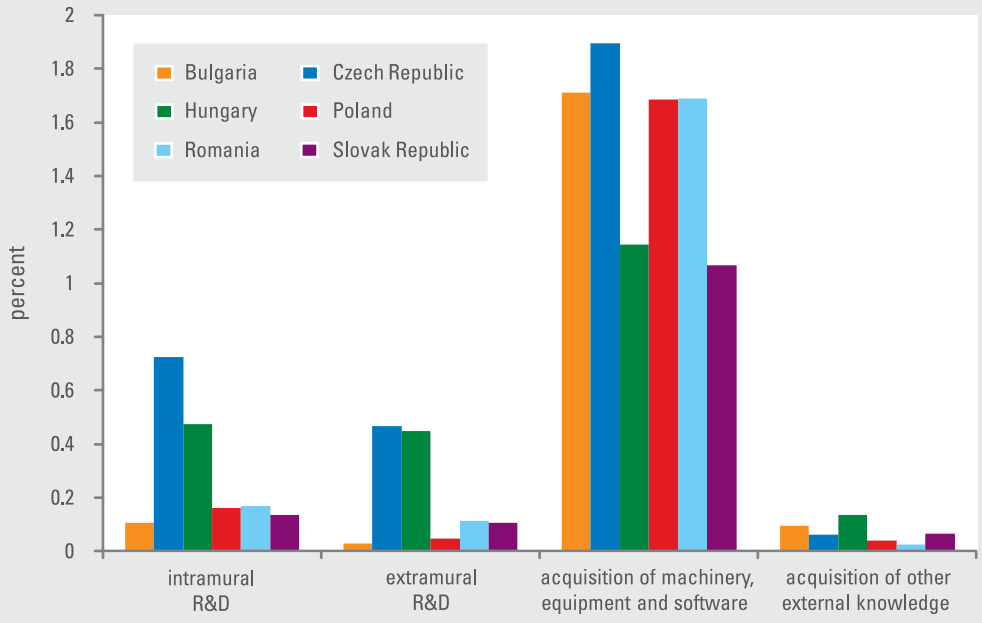
BOX 1.1 Definition of innovation and technology absorption

Based on Goldberg et al. [2011], we define innovation and technology absorption in the following way:

- Innovation is the development and commercialization of products, processes and services that are new to the firm, new to the market or new to the world. Activities range from identifying problems and generating new ideas to implementing new solutions and diffusing new technologies. It often requires significant investment in research and development.
- Absorption, a subset of innovation, is the application of existing technologies, processes and products in a new environment where they have not yet been tested and where their market and commercial implications are not fully known—that is, they are "new to the firm".
- When referring to "innovation activities" more broadly, this report relies on a composite set of indicators used by CIS, which include intramural and extramural R&D, as well as acquisition of machinery, equipment and software and acquisition of other external knowledge.
- Innovation and absorption can work together to create a virtuous circle. Innovation promotes absorptive capacity — a firm's capacity to assess the value of external knowledge and technology and make necessary investments and organizational changes to absorb and apply them. In turn, the economy's ability to research and develop new technologies boosts the enterprises' ability to understand and apply existing technologies. Furthermore, the absorption of cutting-edge technology inspires new ideas and innovations.

Source: Goldberg et al. (2011).

FIGURE 1.5 Poland Mirrors Bulgaria and Romania in Enterprise Innovation Spending



Notes: the vertical axis depicts CEE enterprise spending on innovation activities as a percentage of GDP in 2008. The horizontal axis shows different types of innovation spending, including intramural and extramural R&D, as well as acquisition of machinery, equipment, software and other external knowledge.
Source: IBS based on Eurostat data (CIS).

- *Underdeveloped innovation ecosystem:* as documented by the World Bank (2011), the existing legal framework, skillsets, the quality of research and development facilities, infrastructure and public support policies in Poland may not be efficient enough to support private investment in R&D and innovation.

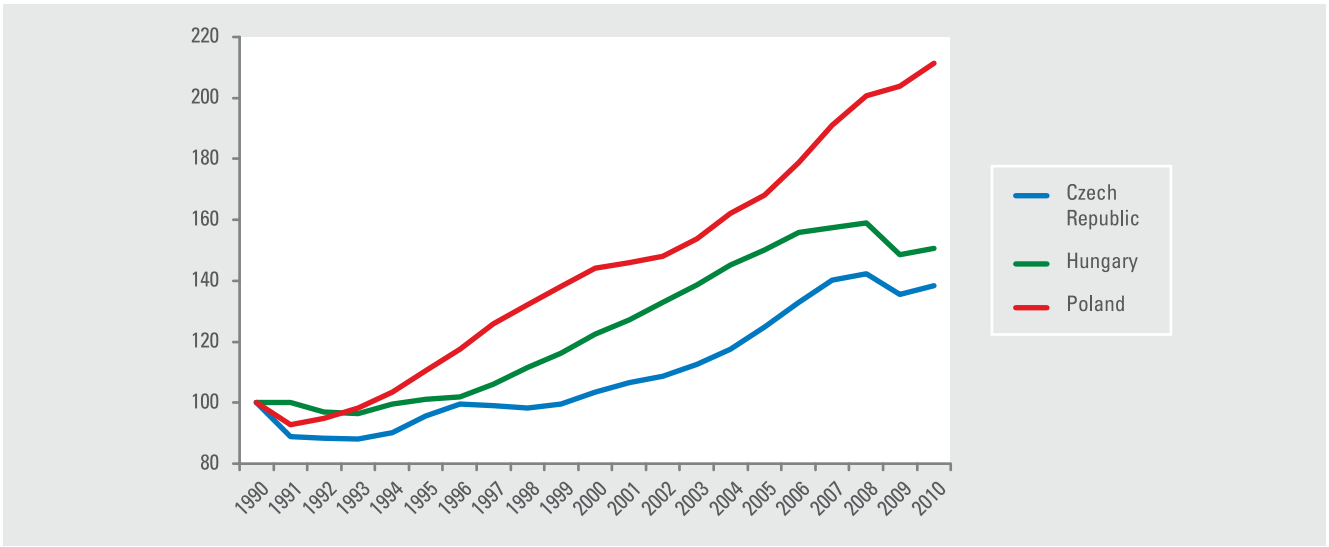
- *Nascent innovation culture:* Poland does not have a strong track record of innovation, and the private sector does not currently perceive innovation as critical to long-term competitiveness. Moreover, Polish enterprises seem comfortable with being the champions

on the domestic market only, rarely aspiring to regional and global leadership according to Rybinski et al. (2011).

- *Microeconomic disincentives:* the structure of the economy and the level of development allow most enterprises to boost productivity by simply importing technology. Hence, for the moment, technology absorption through capital investment remains more attractive and economically viable for Polish firms than investment in riskier R&D and innovation.
- *Insufficient competition:* the large size of the Polish market, coupled with a low level of trade openness, insulates domestic enterprises from international competition. The country's product and service markets are among the least liberalized in the EU and OECD. Since Polish firms can be sufficiently profitable on the home market, the pressure to compete with counterparts abroad by investing in innovation and R&D may be less compelling than elsewhere.

Insufficient emphasis on innovation and R&D has not prevented the Polish economy from growing faster than the rest of CEE. In the past two decades, the economy has expanded at a rapid pace both in terms of GDP per capita (Figure 1.6) and TFP growth (Figure 1.7). The low volume and suboptimal composition of enterprise spending on innovation and R&D suggest that productivity growth in Poland in that period must have been driven by improvements unrelated to innovation and R&D, e.g. technology absorption, better management practices, enhanced human capital, reorganized business processes and improved macroeconomic environment. Throughout the global financial crisis, Poland has shown surprising resilience to the turmoil affecting its main trading partner, the euro zone. But the economy may not be bucking European trends for much longer.

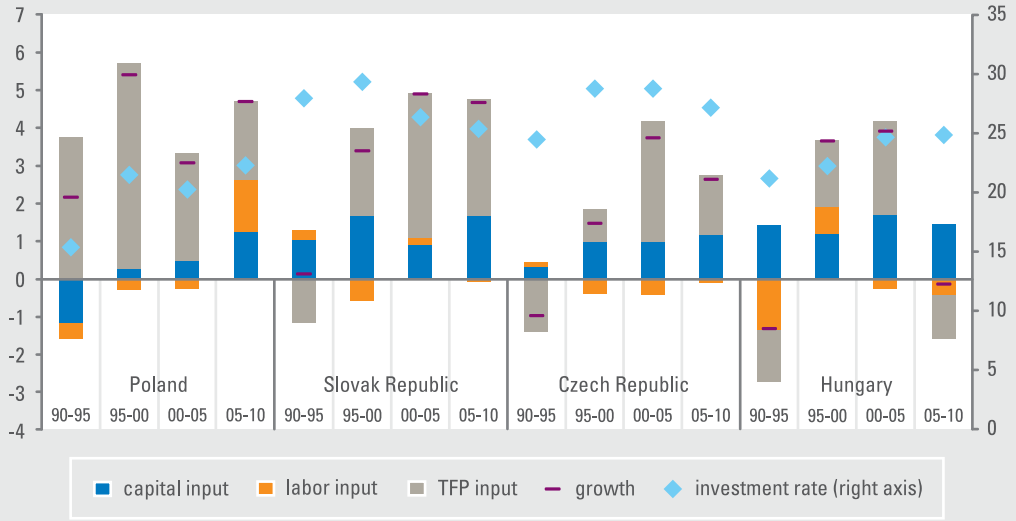
FIGURE 1.6 Poland is the Frontrunner in GDP per Capita Growth in CEE



Notes: the vertical axis depicts real GDP per capita growth (1990 = 100), and the horizontal axis plots it over time (1990-2010).
Source: OECD.

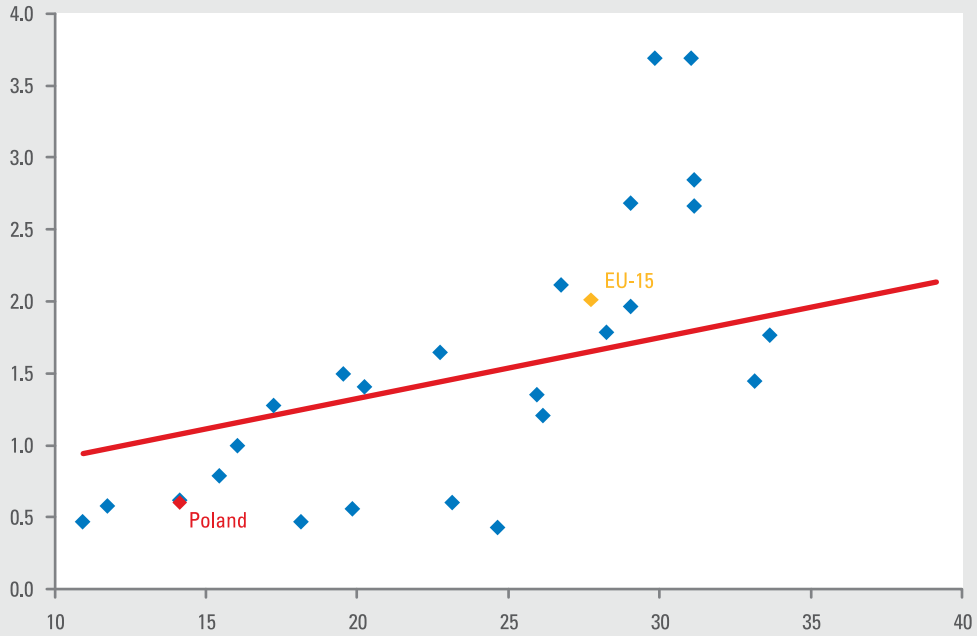
As forecasts indicate that the solid economic performance may soon falter, Poland needs to adjust its current pattern of economic development to sustain the impressive growth rates. The International Monetary Fund (IMF) predicts comparatively weaker GDP growth of 2.4 percent for 2012. Further slowdown is supposed to follow in 2013 and 2014: GDP growth may fall to about 2 percent, below the country's growth potential. This fast deceleration is a far cry from the 4.3 percent growth that Poland reported in 2011. Evidence from advanced economies suggests that higher levels of national income coincide with higher R&D spending (Figure 1.8). As Poland's relative income levels continue to rise

FIGURE 1.7 TFP Has Been a Major Driving Force of Poland's Growth



Notes: the figure evaluates the input of capital, labor and TFP (expressed as yearly averages in percent) into GDP growth in the Czech Republic, Hungary, Poland and the Slovak Republic. The left vertical axis represents the input into GDP growth in percentage points. The right vertical axis depicts the investment rate to GDP. The horizontal axis differentiates between four periods in the four countries: 1990-1995, 1995-2000, 2000-2005 and 2005-2010. Calculations are based on 1990-1995 estimates.
Source: IBS 2011 based on EUROSTAT data.

FIGURE 1.8 Poland Needs to Catch Up with EU-15 in R&D Expenditures



Notes: the horizontal axis shows GDP per capita in thousands of Purchasing Power Standard in 2008 in a sample of 35 countries (EU-27, EFTA, the US, Japan and Korea). The vertical axis depicts total expenditure on R&D as percentage of GDP in 2008.
Source: IBS based on Eurostat.

and productivity levels approach the global technological frontier, simple growth reserves will become depleted. This report argues that further convergence with income levels common in the EU-15 requires a gradual shift from technology absorption, based on capital investment, to R&D, human capital and invention-based innovation. Polish experts, including Hausner et al. (2012), Bukowski, Szpor & Sniegocki (2012) and Rybinski et al. (2011) share this view. Given Poland's current minimal spending on R&D, the transition towards a more innovation- and R&D-oriented economy is likely to be slower. Additional integrated reforms will be required in the education system, labor market and the public research sector (see Box 1.2 for details).

BOX 1.2 The reform path: policy adjustments enhancing Poland's R&D and innovation capacity

In line with Kapil et al. [2011] in the Europe 2020 Report, the following reforms are recommended to boost innovativeness in Poland:

Closing the skills gap by revamping the education system:

- Focus on lifelong learning in all subsectors, equity of access and access to early-childhood education in any overall reform of the education system.
- Develop an outcome-oriented learning approach for all levels of learning, with more emphasis placed on generic skills as a basis for labor mobility.
- Broaden the mission of tertiary education institutions and make them more efficient through performance-based financing.
- Make the Bachelor's degree an important part of the future lifelong learning system.
- Place more emphasis on data collection and monitoring and evaluation of the system, including tracer studies for graduates.
- Strengthen the ties between the education system and the economy through, for example, sector councils with employers defining learning outcomes for certain professions, employers' involvement in university governance, etc.

Complementing technology absorption with innovation:

- Improve the investment climate by upgrading the business environment to stimulate firm investments in R&D.
- Channel public funding into supporting co-inventions in addition to domestic inventions, promote international collaboration and knowledge spillovers.
- Establish a system of employee-led privatization, i.e. a transfer of ownership to RDI managers and researchers (excluding real estate), to complete the restructuring of commercialized RDIs and RDIs volunteering for privatization.
- Reform the RDI financing system to intensify applied research and address the needs of Polish SMEs and industry.
- Support international interdisciplinary research and foster links with relevant institutions and organizations, in the Polish diaspora and beyond.
- Continue to improve the quality of human capital and increase the availability of specialized skillsets, which have to go hand-in-hand with innovation and technology absorption to bring the largest benefits.

Source: World Bank (2011). "Europe 2020 Poland. Fueling Growth and Competitiveness in Poland through Employment, Skills, and Innovation".

Innovation expenditures on the industry level: rerouting to a path of sustainable growth?

Industry-level analysis of interactions between productivity and innovation reveals that Poland's productivity growth is not yet driven by innovation and R&D spending. Polish firms can be categorized into four groups: stars, promises, problems and laggards. The taxonomy can be used to contrast Poland's current levels of innovation expenditures — as they relate to productivity across sectors — to comparator countries: the Czech Republic, Hungary, the Slovak Republic and Slovenia (see Table 1.1 on the next page and refer to the Appendix for more detail). Productivity levels are estimated at a distance from France, used as an approximation for the EU-15. Tellingly, Poland does not match or trump its neighbors in R&D and innovation investments in any of the industry categories.

Enterprise innovation in perspective: the need for a major make-over

Polish enterprises are spending significantly less on R&D and innovation than their regional peers, but so far, the country's economic performance has not suffered. On the contrary, Poland's income and productivity growth in the past 20 years has been much faster than that of its neighbors. This suggests that factors unrelated to R&D and technological progress must have accounted for the boom. Looking ahead, however, Poland needs to transition to innovation- and R&D-driven growth to meet targets defined by the Europe 2020 Strategy and sustain the fast pace of convergence with the EU-15.

TABLE 1.1 Productivity, Economic Performance and Innovativeness in CEE by Sector: Polish Enterprises Under-emphasize R&D

Code	Sector	TFP	Labor productivity	VA share	Export share	Innovation expenditure	Innovative companies	Reduce labor cost	Improve quality of goods
C10-C12	Manufacturing of food, beverages and tobacco	+	+	+	+	=	–	+	=
C13	Manufacturing of textiles	–	–	+	+	–	–	=	+
C16	Manufacturing of wood products	=	–	=	+	+	–	–	–
C17	Manufacturing of paper products	–	=	=	+	+	–	+	=
C20	Manufacturing of chemical products	–	–	–	=	–	–	+	=
C22	Manufacturing of plastic products	–	=	–	+	–	–	+	=
C23	Manufacturing of nonmetallic mineral products	+	+	=	=	–	–	+	=
C24	Manufacturing of basic metals	=	+	–	=	=	–	=	–
C27	Manufacturing of electrical equipment	=	=	–	–	–	–	+	=
C28	Manufacturing of machinery n.e.c.	+	+	–	–	–	–	=	–
C30	Manufacturing of transport equipment	–	–	–	=	–	–	+	–
C32	Manufacturing n.e.c.	+	=	+	+	–	–	–	–
F	Construction	+	=	+	n/a	n/a	n/a	n/a	n/a
G	Trade & repair of vehicles	=	–	+	n/a	+	–	–	=
G46	Wholesale trade	–	–	+	n/a	+	–	–	=
G47	Retail trade	=	–	+	n/a	n/a	n/a	n/a	n/a
H	Transport	+	=	–	n/a	n/a	n/a	n/a	n/a
I	Hotels and restaurants	=	–	–	n/a	–	–	=	–
J&H53	Post and communication	+	+	=	n/a	+	=	–	–
J62	Computer services	–	–	=	n/a	n/a	n/a	n/a	n/a
M w/o M72	Other professional activities	–	–	–	n/a	–	–	+	–
M72	R&D	–	–	–	n/a	n/a	n/a	n/a	n/a
N	Other business activities	+	=	–	n/a	–	–	+	–

Notes: "+" means that Poland has a competitive advantage over neighboring countries in this area, "–" means that comparator countries have a competitive advantage over Poland, "=" means that there is no significant difference between Poland and comparator countries, "n/a" means that no data exist, or they not applicable to that sector. For the three last variables, Poland is compared with the Czech Republic.
Source: IBS based on AMADEUS data and Eurostat (CIS, EU KLEMS).

Poland bucks regional trends inasmuch as enterprise spending on innovation targets capital investment, which overwhelmingly dominates over R&D. Enterprise expenditure on R&D, both intra-mural and extra-mural, is negligible. Importantly, Poland's industrial structure consists of fewer R&D-intensive sectors. But the under-investment in R&D and the low overall number of innovative enterprises can also be attributed to a funding gap, an underdeveloped innovation ecosystem, weak innovation culture, macroeconomic disincentives and insufficient competition, all of which incentivize companies to focus on technology absorption rather than innovation.

Stagnation in private R&D and innovation expenditures raises the concern that the EU-driven boom in public support has been substituting enterprise spending on R&D and innovation. While more time may be needed for the public spending surge to visibly enhance the innovativeness of Polish enterprises, current evidence suggests that, at least so far, public support for innovation in Poland has not been encouraging private investment in R&D.

CHAPTER 2

Public Support Programs for Enterprise Innovation: a Mapping Exercise

This chapter provides a more detailed overview of the public support system for innovation in Poland. In the first, descriptive, part, it breaks down the basic pillars of the strategy for innovation and R&D in the country: the scale and distribution of funding, the number and focus of programs and the responsibilities of the institutions and agencies involved. In the second, analytical part, it attempts to assess the impact of public sector support on enterprise spending on innovation and R&D and industry-level productivity. Finally, the chapter highlights the main hurdles that the Government will have to remove for the nascent innovation system to function optimally and provides recommendations to that end.

Policy mix, spending structure and output: a misfit?

Since EU accession, public support for innovation and R&D has seen some dramatic improvements: both in terms of financing, owing largely to the inflow of EU structural funds, a revamped institutional infrastructure and activeness on the part of Polish officials. The ratio of public innovation expenditures to GDP has increased more than four times in the last six years, from below 0.10 percent in 2004 to 0.45 percent in 2010, although the comparison between 2009 and 2010 figures already reveals a slight setback. It is key to note that the upturn of recent years has largely relied on the massive inflow of EU structural funds, not so much a boost in national spending, which has remained steady. Overall, intensified spending has been complemented with an increasingly sophisticated public support system. A range of tailored programs has begun to address diverse challenges related to innovation, including human capital. The implementation agencies have also started to offer specialized services to enterprises investing in innovation projects, e.g. technology parks and consultancy, through grants for technology absorption and R&D in public and private facilities.

The current set of policies reinforces a general systemic tendency to favor technology absorption through capital investment over innovation. Of the available financing instruments, grants are the ones that are used most frequently, regardless of the risk associated with the type of innovation activity supported. Hence, technology absorption tends to prevail to a degree unmatched in neighboring countries. More than 50 percent of all funds allocated to enterprises for innovation purposes target absorption.

Due to this reason, and others, it appears that the accelerated "cash" flow in the innovation system has not been a sufficient stimulant of genuine innovation among Polish enterprises. Innovation output indicators, such as the number of patents or firms introducing new products, have remained stagnant. Moreover, despite the surge in public support, private spending on innovation has only seen marginal improvements, suggesting that either the effect needs more time to manifest itself in the statistics on innovation outcomes, or that public expenditures may have crowded out private spending.

Public support programs: aspirations, responsibilities and funding

This section offers a comprehensive summary of publicly supported innovation and R&D programs, financed from both EU and domestic sources. For the sake of clarity, the programs are divided into nationally and regionally operated schemes, and within those two categories, they are distinguished by the main source of funding: either the EU or the Polish Government. The following subsections describe each program's design and objectives, and they estimate the value and the composition of the financial resources available to it.

National Programs

Support programs funded by the European Union

Poland's EUR 67.3 billion budget for operational programs from the EU's Structural and Cohesion Funds in the 2007-2013 financial perspective has thus far assigned EUR 8.3 billion to innovation. From the variety of operational programs (Table 2.1), three instruments, in particular, have addressed challenges related to innovation: Innovative Economy, Human Capital and Development of Eastern Poland. This sub-group's combined budget for 2007-2013 amounts to EUR 20.3 billion, of which more than two fifths, EUR 8.3 billion, have been allocated to public support for innovation activities. Poland has contributed an additional EUR 1.5 billion, elevating the total budget for innovation and R&D in this period to EUR 9.8 billion.

TABLE 2.1 EU-funded Operational Programs in Poland (2007-2013)

Operational Programs	EUR billion
Regional Operational Programs	16.6
OP Infrastructure and Environment	27.9
OP Human Capital	9.7
OP Innovative Economy	8.3
OP Development of Eastern Poland	2.3
OP of European Territorial Co-operation	0.7
OP Technical Assistance	0.5
Reserves	1.3
TOTAL	**67.3**

Source: Ministry of Regional Development of Poland.

The most extensive national scheme tailored to support innovation is the Innovative Economy Operational Program (OP IE). The program capitalizes on Polish officials' experience with the Sectoral Operational Program "Improving the Competitiveness of Enterprises", which was implemented in the previous 2004-2006 EU funding cycle. OP IE was designed in recognition of the under-emphasis on innovation in the Polish economy, the overall lack of willingness on the part of Polish firms to innovate and the complex challenges of reforming the innovation system. It focuses on facilitating technology transfer; stimulating the business environment; revamping the ICT infrastructure; fostering cooperation between state-run research and development institutes (RDIs), academia and the private sector; and increasing the public sector's capacity for advanced research.

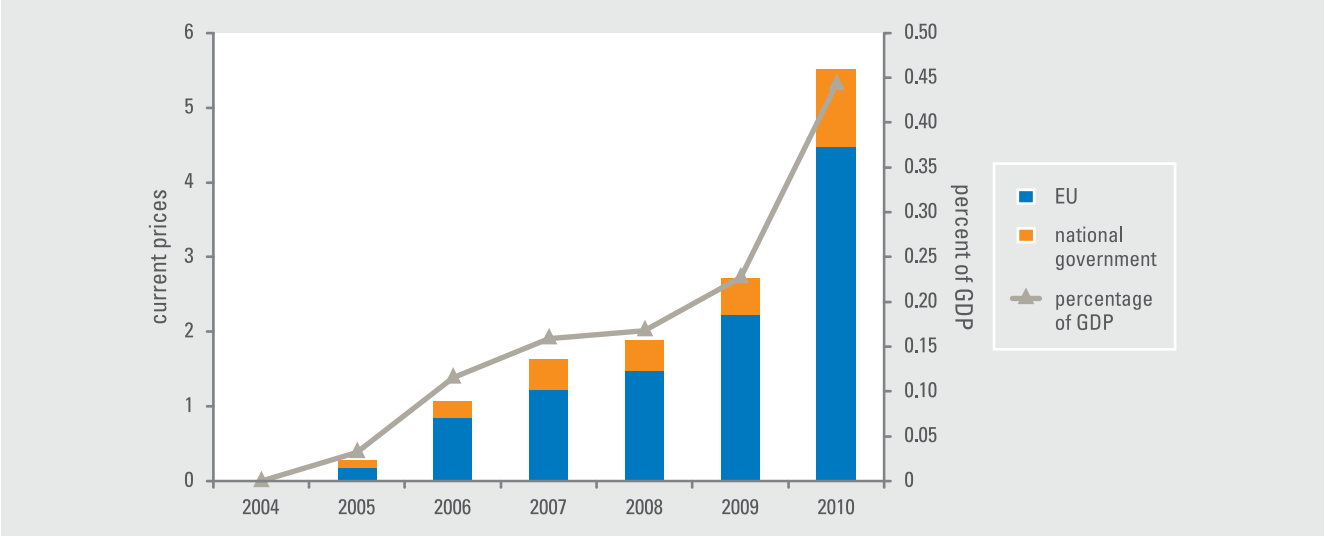
Second in size, the Human Capital Operational Program (OP HC) is another national framework that partially addresses challenges related to innovation. The primary focus of OP HC is to increase Poland's competitiveness via development of human capital. OP HC is authorized to execute interventions in the realm of human capital, pursue active labor market policies and enact changes in the primary, secondary and tertiary education system. Enterprise innovation is also part of the package. OP HC's efforts to improve the skills of entrepreneurs and academics involved in innovation activities, support enterprise expansion and fortify the business environment have made a significant contribution to the development of the innovation system in Poland.

Lastly, the Eastern Poland Development Operational Program (OP EPD), focused on leveling lingering regional disparities, is also invested in innovation efforts. OP EPD is essentially a vehicle for development in the more rural and poorer regions of Eastern Poland. It is a broad program addressing a plethora of issues ranging from infrastructure development and tourism through education to the development of human capital. Innovation falls into the category of enterprise development, which encompasses several schemes focused on modernizing the research base and strengthening the regional business environment. Most relevant to private sector innovation is the provision of absorption-centered advisory services to local enterprises.

The implementation of these three OPs is handled by several institutions and agencies of the central government on the level of priority axes, actions and sub-actions. The Polish Agency for Enterprise Development (PARP) focuses on OP IE and OP EPD, the Ministry of Science and Higher Education deals with the science- and R&D- oriented interventions carried out under OP IE, the Ministry of Labor and Social Policy is in charge of OP HC, and the Ministry of Economy focuses on some of the enterprise-oriented actions under OP IE.

All three main OPs have benefitted from the recent influx of Structural and Cohesion Funds. In 2005-2010, 85 percent of all public transfers made to beneficiaries upfront by the Government was refunded by the European Commission. Since Poland's accession to the Union, EU funding has been on a steady upswing, which steepened in 2010 when inflows nearly doubled year-on-year. In 2010, EU-funded government support for innovation was three times larger than in 2007 (Figure 2.1). It is expected to rise further, peaking in 2013, according to the Ministry of Regional Development. Under the 2014-2020 EU financial framework, Poland can anticipate to receive at least as much funding for innovation support as it has been rewarded in the current programming period.

FIGURE 2.1 EU-driven Surge in Public Support for Innovation



Notes: the two vertical axes depict payments to beneficiaries in PLN billion (current prices, left axis) as a percentage of GDP (right axis). "National Government" includes Poland's public input into EU programs, as well as support schemes funded by the national Government alone. The horizontal axis depicts changes over time in the 2004-2010 period.
Source: IBS.

Support programs sponsored by the Polish Government

Despite the predominance of EU-funded programs, the Polish innovation system also implements instruments financed from the national budget. They are typically narrower in scope than their EU-sponsored counterparts and work with more modest budgets. Examples include the Technology Initiative and IniTech (grants for applied science projects), the Tax Deduction for Innovation and KFK (initially funded by the Polish Government, in part financed by the EU and most recently, co-funded by Swiss donors). Responsibilities for implementation are divided between various government agencies, such as the National Center for Research and Development (NCBiR), the Ministry of Economy or the Patent Office.

National support programs at a closer glance: funding instruments at various stages of the innovation process

National programs can be categorized not only by the source of funding (EU or government) but also by the type of support (direct or indirect) that they render and the stages of the innovation process that they target. For a brief overview, see Table 2.2, and for a more detailed account, refer to Annex 2, which tables all national intervention schemes relevant to innovation according to programs, instruments, objectives, implementation agencies and allocated budget.

TABLE 2.2 Public Support Instruments for Ongoing EU-funded and Government-sponsored Programs

		University / RDIs			Firms
		Basic and scientific research	**Applied research and development**	**Company formation**	**Capital investment**
Direct support	Grant	OP IE 1.1 OP IE 1.3	OP IE 1.4 OP IE 4.1 OP IE 4.2 Key R&D projects Product of the future Technological Initiative I IniTech Regional programs Voucher for Innovation		Technology Credit (incl. OP IE 4.3) OP IE 4.4 OP IE 4.5 Regional programs
	Loan			OP EPD 1.2	OP EPD 1.2 Loan for innovation
	VC/PE			OP IE 3.2 National Capital Fund	
	Tax		Tax deduction for innovation (I)		Tax deduction for innovation (II)
		Human capital	**Research infrastructure**	**Incubators / tech offices / specialized services**	**Cooperation and organization**
Indirect support		OP IE 1.2 OP HC 2.1 OP HC 4.2	OP IE 2.1-2.3 OP EPD 1.1 OP EPD 1.3 Regional programs	OP HC 2.3 OP IE 3.1 OP IE 3.3 OP IE 5.2 – 5.3 OP EPD 1.3 Regional programs National Services System National Innovation Network	OP IE 5.1, 5.4 Patent PLUS OP EPD 1.4 Regional programs

Notes: Action 4.5 of Innovative Economy has been classified as a capital investment grant. In fact, roughly two thirds of the action's budget (i.e. the whole sub-action 4.5.2) is spent as capital investment grants aimed to stimulate the onset of R&D activity in enterprises. This creates potential ambiguity, as the instrument could technically also be treated as private R&D support, though no R&D or applied R&D projects are financed under OP IE 4.5.2. To some extent, such ambiguity has also been detected on the regional level.
Source: IBS based on official detailed descriptions of relevant programs and other documents.

Regional programs

Support programs funded by the EU

On top of the three large national OPs, the EU funds also sponsor sixteen regional schemes related to innovation. These regional support programs, one per each of Poland's sixteen *voivodships*, tend to swallow up to 20 percent of total public expenditures on innovation. The organization and implementation of innovation support schemes on the regional level follows the same logic as it does on the national level. The programs have a broad scope, and they address a number of issues ranging from business R&D and university infrastructure to tourism, transport infrastructure and urban development. Most of them are run and implemented by regional governments, typically the given *voivodship*'s Marshal Office.

The primary focus of regional programs is enterprise development, where innovation and R&D investment are championed alongside other modes of modernization, such as business climate improvement or skill building. Although innovation and R&D are generally regarded as important gateways to regional economic development, most of the funding on this level has been channeled into absorption-related activities (see Table 2.3). Chapter I has established that absorption introduces technologies that are new to the enterprise, but not necessarily to the whole region or the industry. Box 2.1 gives an example by describing one of the ongoing regional programs in more detail.

The public support system for innovation and R&D on the regional level consists of five basic instruments. They are financial, service-oriented and know-how-based. They include: (i) capital investment, which continues to dominate, accounting for more than a third of the budget, (ii) private R&D, (iii) cooperation and organization, (iv) specialized services and (v) development of research infrastructure. Table 2.3 provides a comprehensive overview.

TABLE 2.3 Public Support Instruments for Innovation

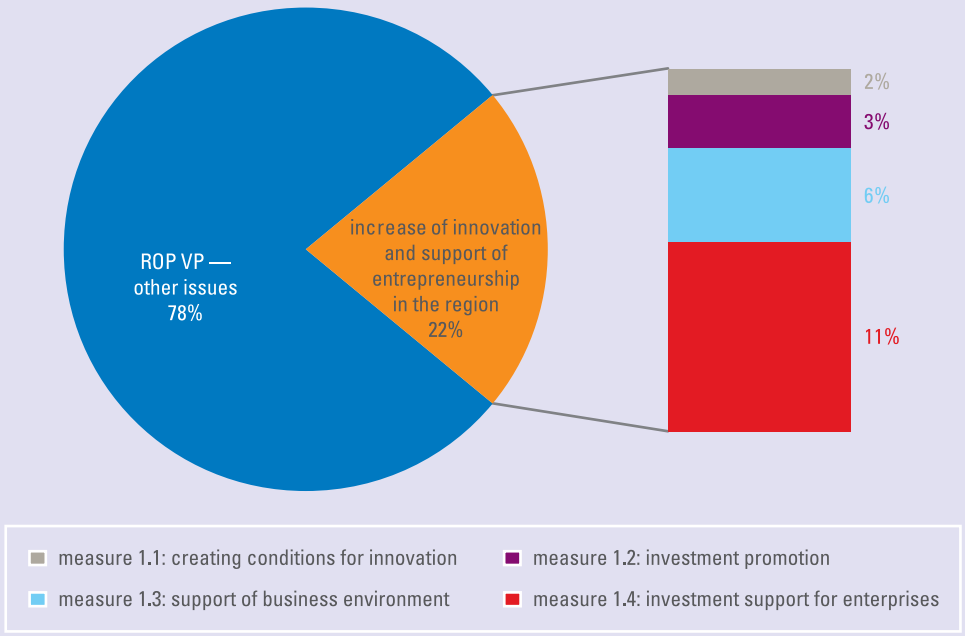
Instruments	Objectives and activities	Budget (PLN)	Budget (EUR)	Comments
Capital investment	Direct support in the form of matching grants for investments in SMEs and micro-enterprises to enhance enterprise competitiveness.	PLN 2.6 billion	EUR 650 million	The scheme supports technology absorption rather than innovation. Projects tend to focus on the purchase of machinery and equipment. Spreading or adopting new or innovative technology is not a declared objective of the measure.
Private R&D	Support for cooperation between private enterprises and R&D institutions.	PLN 1 billion	EUR 250 million	The program is similar to OP IE.
Cooperation and organization	Development of clusters, extension of networking initiatives and facilitation of information exchange.	PLN 0.8 billion	EUR 200 million	
Specialized services	Development of technological parks, incubators and technology transfer centers.	PLN 3.8 billion	EUR 950 million	
Development of research infrastructure	Developing infrastructure, including ICT infrastructure, research equipment, laboratories and other research premises.	PLN 0.9 billion	EUR 225 million	
Total		**PLN 9.1 billion**	**EUR 2.3 billion**	

Source: IBS based on official descriptions of relevant programs and other documents. Exchange rate: PLN 0.25 per EUR.

BOX 2.1 Innovation support within the framework of a regional development program — the Podlaskie *voivodship*

The Regional OP of the Podlaskie Voivodship (ROP VP) is a European Regional Development Fund infrastructure development program for the 2007-2013 funding cycle. The top priority axis of the program is enterprise support (22 percent of allocated funds — EUR 151 million). Measure 1.1 is concerned with creating conditions for innovation, (EUR 10 million), whereas Measure 1.4 is focused on investment support for enterprises (EUR 73 million).

FIGURE 2.2 Podlaskie *voivodship* OP Emphasizes Enterprise Support



Source: Documentation of ROP VP 2007-2013.

Measure 1.1: Creating conditions for innovation

The measure aims to create a stimulating environment for innovation among Polish enterprises. Its primary focus is infrastructure development, namely the construction of industrial, scientific and technological parks and technology and business incubators. Furthermore, the measure supports purchases of new technology for innovation facilities and to a lesser extent, R&D activities. Demand for funding from this scheme has so far been low due to a combination of factors, including an overlap with other support programs and the low innovation potential of the underdeveloped region.

Measure 1.4: Investment support for enterprises

Under this measure, enterprises compete for non-repayable grants covering up to 70 percent of the investment cost, depending on firm size. While the scheme does not openly seek to boost the innovative potential of Polish enterprises, most of the calls for proposals that it issues indirectly require the projects to be innovative. However, as the definition of innovation that the measure works with is rather broad, it often ends up funding projects predominantly focused on technology absorption rather than innovation, in line with broader Polish trends. When compared to Measure 1.1, Measure 1.4 has been more successful in attracting applications and disbursing funding.

Source: IBS 2010a.

Financing innovation from the "public pocket": resources, instruments and the focus on absorption

Funding distribution

The total budget for innovation public support measures in 2007-2013 amounts to EUR 9.8 billion. Table 2.4, below, breaks down the budget for each of the public intervention instruments.

The bulk, almost 60 percent, of the available budget for innovation supports enterprise development. The funding instruments range from non-reimbursable grants, loans and guarantees to equity-based instruments. Their purpose varies from capital investment (38 percent) to applied R&D (nearly 11 percent).

The remaining 40 percent of the overall budget for innovation is distributed among various business environment institutions. They include PARP's National Network of Innovation and Services and a range of public research institutions with agendas in science and R&D. As for the latter, almost half of the funding is allocated to universities and other organizations engaged in R&D specifically, with the aim of modernizing research infrastructure. Moreover, this slice of the funding pie finances incubators, technology hubs and other specialized innovation services and measures with the goal of deepening cooperation among enterprises and between the private sector and academia.

Financing instruments

The funding allocation system, which emphasizes capital investment grants, is dated and tends to reinforce the overall dominance of absorption in the innovation system. Capital

TABLE 2.4 Types of Instruments and Intervention in Public Support for Innovation: the Dominance of Grants

		University / RDIs			Firms	
		Basic and scientific research	**Applied research and development**	**Company formation**	**Capital investment**	
Direct support	Grant	3.209 7.8%	5.070 12.3%		12.6 30.7%	49.6%
	Loan				0.1 0.2%	0.2%
	VC/PE			0.97 2.4%		2.4%
	Tax		0.056 0.1%		0.011 0.02%	0.1%
	Total	7.8%	12.4%	2.4%	31.0%	53.4%
		Human capital	**Research infrastructure**	**Incubators / tech offices / specialized services**	**Cooperation and organization**	
Indirect support		2.647 5.5%	9.043 21.9%	5.914 12.4%	1.516 3.7%	46.4%

Notes: all figures are projections only. Regional programs were included in the summary with conservative assumptions about the relevance of regional capital investment to innovation-related activities. The total amount of public funds (regional, central government and EU) is divided between different types intervention in the period 2007-2013. Due to reallocations, differences in performance and changes in the macroeconomic environment (i.e. exchange rates, tax revenues), total public expenditure calculated ex-post may differ from the preliminary figures. Support for enterprises is highlighted in bold.
Source: IBS.

investment grants for technology absorption currently absorb as much as 40 percent of all available financial support. Funding for private R&D is more than three times lower, a mere 12.4 percent of the total budget. Here, however, grants are a good fit. There is only one tax-based innovation support instrument targeting enterprises, entitled the "Tax Deduction for Innovation". As it represents only 0.1 percent of public expenditures on innovation, its impact is insignificant. Overall, the range of funding instruments currently used by Polish officials to sponsor innovation activities in the private sector underlines the trend of continued dominance of technology absorption over innovation.

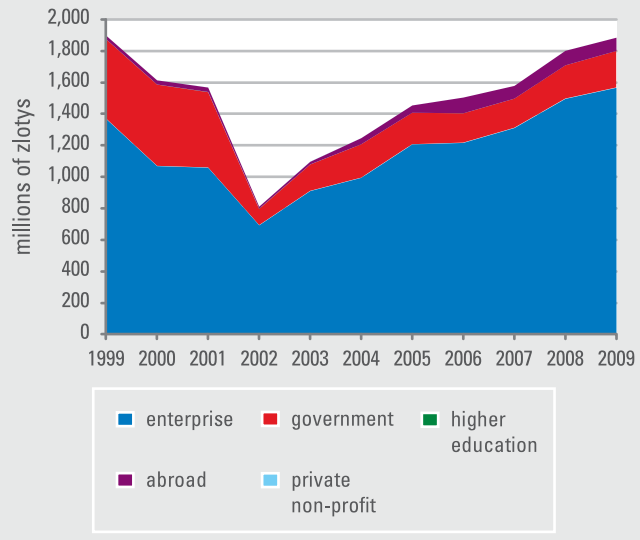
Public/private nexus: impact of public support on enterprise spending on innovation

The objective of this section is to establish whether public support encourages private spending on innovation and R&D. The section maps the patterns of R&D spending in Polish enterprises, focusing on the relationship between public support and private expenditures on innovation and R&D. Finally, it provides recommendations that could facilitate the much-needed increase in enterprise expenditures on innovation and R&D in the long run. The section is divided into the following substantive subsections: share of public support in innovation spending and share of public support at different stages of the innovation process.

Share of public support in innovation spending

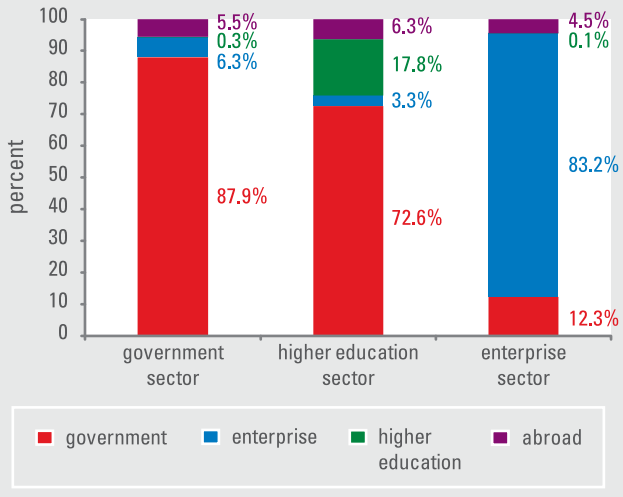
In the government sector, 80 percent of R&D expenditures is financed by the national budget and EU funding (see Figure 2.3). Small portions, 6 percent and 5.5 percent, are covered by the private sector and funding from abroad, respectively. Within the public realm, the higher education sector is marginally less reliant on government and EU funds when it comes to R&D than the government sector. While 70 percent of the sector's total budget is covered from public resources, the remaining 30 percent of the funds originate within the sector and abroad (see Figure 2.3).

FIGURE 2.3 **Public Support for R&D in the Enterprise Sector Has Been on a Steady Upsurge**



Notes: the vertical axis denotes contributions of the government, enterprise and foreign investment to R&D funding in PLN million (constant prices 1999). The horizontal axis plots them over time (1999-2009).
Source: IBS based on Eurostat.

FIGURE 2.4 **Public Support for R&D in the Enterprise Sector Remains Marginal**



Notes: the vertical axis depicts the contributions of the government, enterprise and foreign investment to R&D funding as a percentage. The horizontal axis distinguishes between the government, higher education and enterprise sectors in 2009.
Source: IBS based on Eurostat.

In the private sector, the trend is reversed, as spending on R&D is predominantly financed by the enterprises themselves (Figure 2.3). The share of public support in enterprise expenditures on R&D is a modest 12 percent, which is a figure common across the region. Poland appears to be lagging behind regional peers in attracting funds from abroad, which account for only 4.5 percent of total business R&D spending. It compares unfavorably to both the Czech Republic and Hungary, where it amounts to 13 percent, as well as the regional champion, the Slovak Republic, where funding from abroad constitutes almost 21 percent of overall private expenditures on R&D. As for trends over time, the public contribution to enterprise R&D has visibly increased, whereas the funding from abroad has only risen marginally in the 1999-2009 period (Figure 2.4).

Mirroring the over-arching trends in R&D spending in Poland, most industrial sectors also overwhelmingly rely on private funding. Industries finance nearly 80 percent of R&D expenditures out of their own budgets. The public sector and foreign investors only contribute modestly, a detailed survey of both manufacturing and services sectors reveals (Figure 2.5 and Figure 2.6). Funding tends to be allocated for technology absorption, e.g. acquisition of machinery, equipment and software, rather than innovation.

FIGURE 2.5 Private Funding Dominates Innovation Expenditures in the Manufacturing Sector

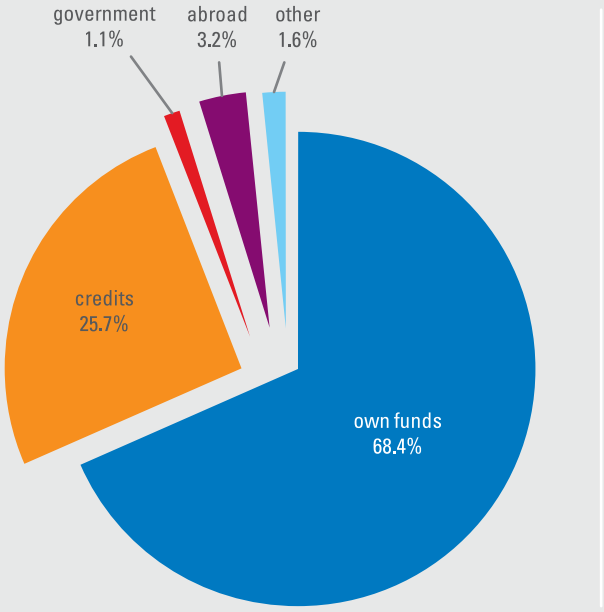
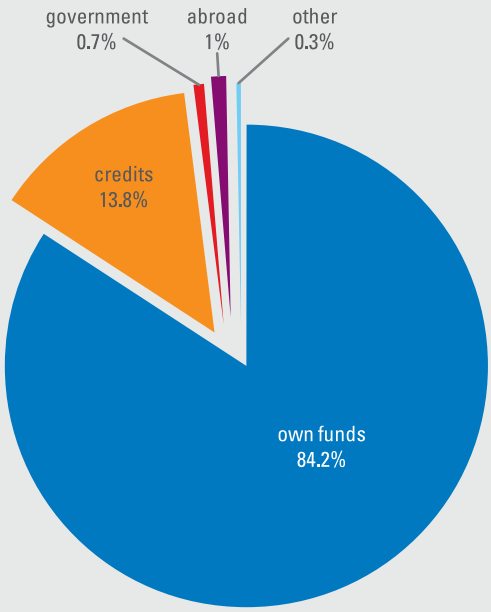


FIGURE 2.6 Private Funding Dominates Innovation Expenditures in the Services Sector



Notes: the data are from 2009.
Source: Central Statistical Office, Innovative activities of enterprises in 2006-2009.

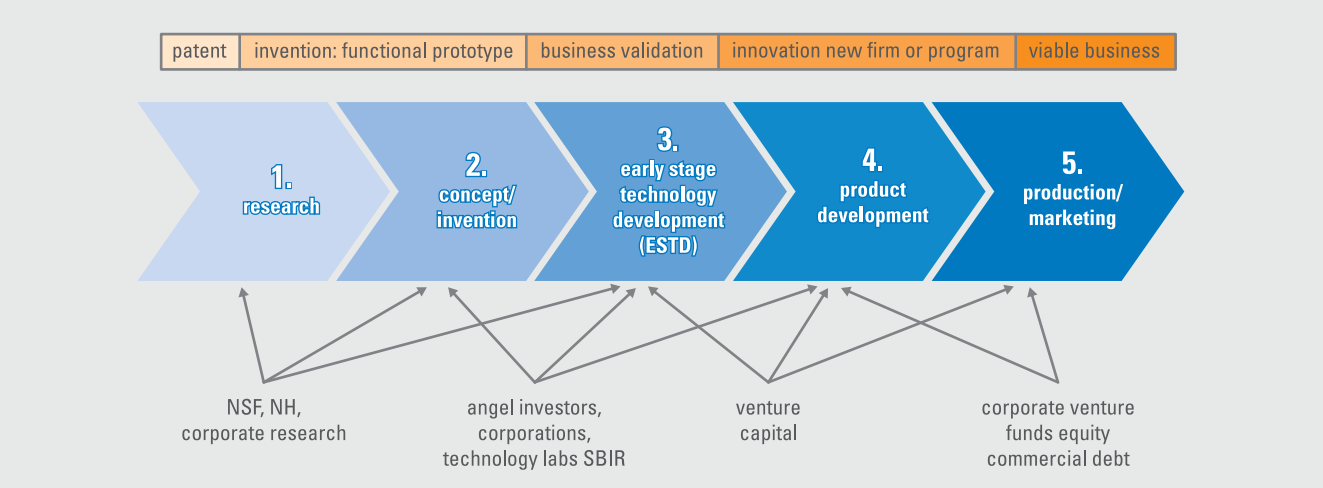
Consistent with the surge in EU funding for innovation, the previously low public share in private R&D expenditures has seen a formidable increase in the last two years. From an average of 6 percent in 2004-10, it rose to respectable 18 percent in 2010. The Government's contribution to innovative capital investments, in line with CIS, has also increased twofold, from 3 percent to 6 percent.

In the same vein, direct public support for private R&D has also hiked up, approximating the EU-15 standard. It went from 0.02 percent of GDP in 2007 to 0.06 percent of GDP in 2010, placing Poland on par with Finland and the UK in OECD rankings. While the upswing marks a positive development, increased public support for private R&D has not facilitated similar growth rates in enterprise spending on innovation. Private R&D spending has continued to stagnate at about 0.2 percent of GDP throughout the last decade. This suggests that either increased private spending needs more time to manifest itself in official statistics, or that intensified government support might have been replacing private investment. Meetings with selected beneficiaries of programs funded by the EU and consulting firms involved in the application process seem to uphold the latter assumption.

Share of public support at different stages of the innovation process

An additional lens for the analysis of public spending on innovation is the so-called "sequential model", which divides innovation development into several distinct stages. The sequential model (see, for instance, Auerswald and Branscomb [2003]), applied widely in the US, recognizes five notional stages of the innovation process: research, concept/invention, early-stage technology development (ESTD), product development and commercialization (Figure 2.7).

FIGURE 2.7 The Five-Stage Model of the Innovation Process

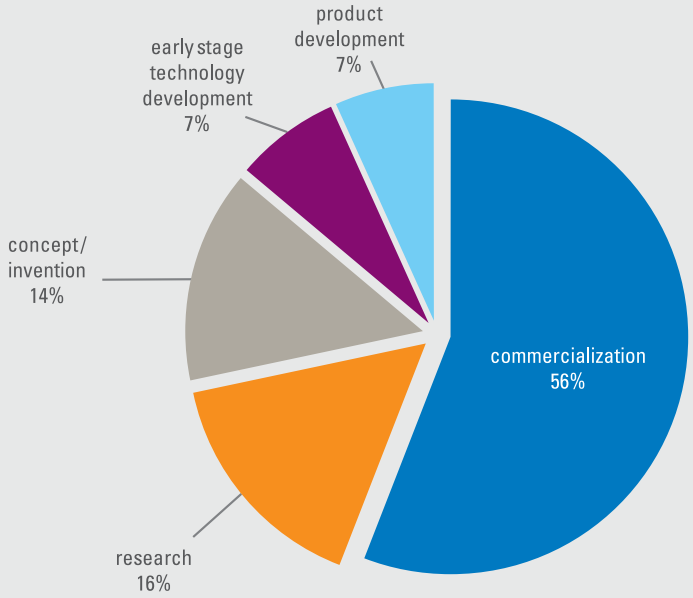


Source: Auerswald and Branscomb (2003)

Public intervention is most critical at the first three stages of the innovation process when market failure looms large. Spearheading a new idea, prototyping it and developing early commercial products carries a lot of risk, which can be partly offset by public support.

Yet in Poland, the vast majority of public funding has thus far supported projects at the final stages of the innovation process, where the risk of market failure tends to be the lowest. 56 percent of public expenditure on innovation has been channeled into the final, commercialization, phase of the innovation process, supporting technology absorption (Figure 2.8), while projects at the early stages of the innovation process— research and invention — have only benefitted from about 30 percent of total public funding. The intermediary phase of ESTD fared even worse with 7 percent.

FIGURE 2.8 Public Support Cumulates at the Commercialization Stage



Notes: regional programs were included in the overview based on conservative assumptions about the relevance of regional capital investment support to innovation. The absorption category includes: actions 4.3, 4.4 and 4.5 of OP IE, technology credit, selected measures from regional programs as well a few minor non-EU interventions (tax breaks for innovators, loans for innovators). The research category includes actions 1.1 and 1.3 of OP IE and – partly – IniTech and Technology Initiative I. Furthermore, actions 1.4 and 4.2 of OP IE were classified as support in the second phase of technology development, along with the remaining funds from IniTech and the Technology Initiative. Support for ESTD can in the Polish context be equated with government support for venture capital. Finally, parts (namely, action 4.1 of OP IE) of public funds have been allocated to product development.
Source: IBS.

Application and selection processes: two-level disqualification of innovators through legalism and risk aversion

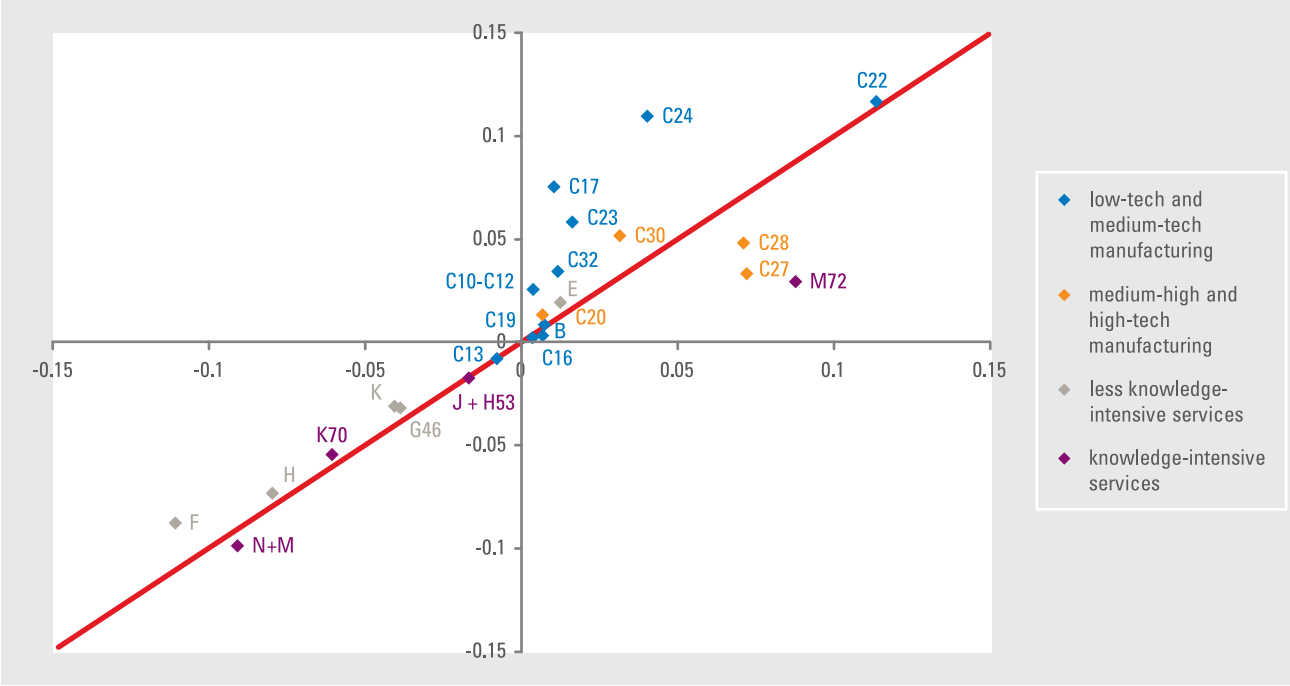
Application process

The applicant firms are different from the general firm population. The good news is that the self-selection of applicants seeking R&D support includes a plethora of enterprises in medium-high and high-tech manufacturing and knowledge-intensive services, as well as some low- and medium-low tech manufacturing firms, in line with the objectives of innovation policy (Figure 2.9). Companies in low- and medium-low tech manufacturing unsurprisingly tend to seek capital investment funding more frequently than their share in the economy would suggest.

In applications for R&D, medium-high and high tech manufacturing firms are over-represented, which is a positive phenomenon. Two sectors are particularly oversubscribed: 22 percent of the applications are in computer services and 9 percent in scientific research and development (Figure 2.10). Companies in low and medium-low tech manufacturing apply for R&D as well, but to a lesser extent. Finally, knowledge-intensive services also apply, but they are under-represented when compared to the general population.

Among applicants for capital investment, there is an oversubscription by firms in medium-low and low-tech manufacturing. The leading industries within this group are basic metals, rubber and plastics and pulp, paper and paper products (Figure 2.11). The assumption is that they choose to apply for capital investment more frequently than their counterparts in high tech manufacturing or knowledge-intensive services because the applicants tend to be mature enterprises in traditional sectors. Capital investment funding is also sought by firms from other sectors, particularly less knowledge-intensive services, but those are not over-represented in the pool of applications.

FIGURE 2.9 Applicants for OP IE Funding Mainly Hail from Low- and Medium-Low Tech Sectors Seeking Capital Investment Support



Notes: the deviations between the lineup of companies that applied for public support and the structure of the general population (i.e. absolute differences in industry shares) are plotted on two axes (horizontal axis – support for R&D, vertical axis – support for capital investment). The central black line depicts equal deviations for both types of innovation support. Therefore, enterprises from sectors below the line are attracted to R&D support more often, and firms from sectors above the line tend to gravitate towards capital investment. Computer services are an outlier that could not be included in the figure: they are grossly over-represented in applications for R&D. The industry classification is based on Eurostat.
Source: IBS based on Ministry of Economy data (the pool of applicants for OP IE measures) and GUS (the general population of enterprises from the REGON database).

FIGURE 2.10 Medium-high and High Tech Manufacturing Dominates Applications for R&D support

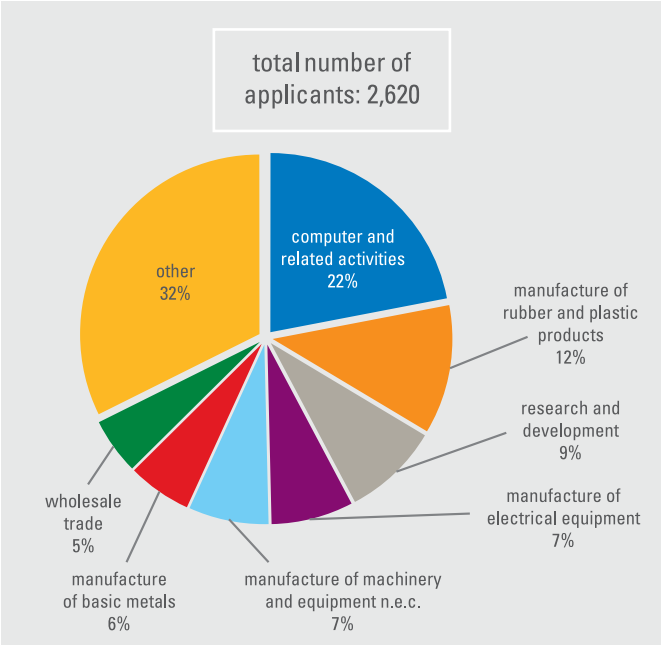
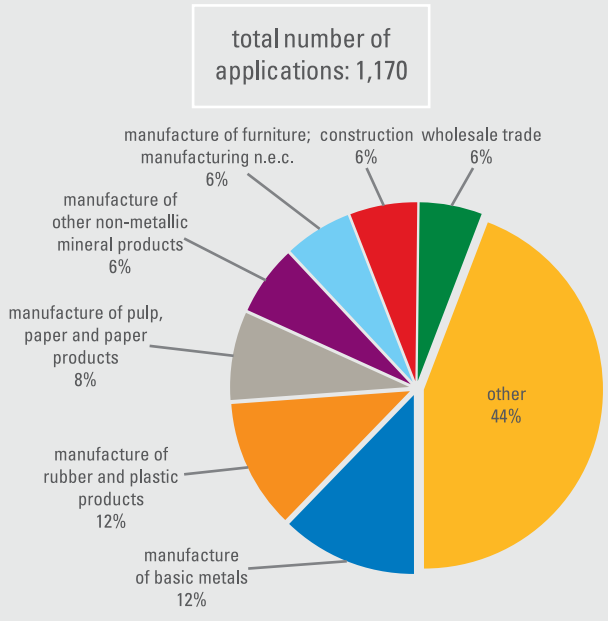


FIGURE 2.11 Capital Investment is Primarily Requested by Firms in Low- and Medium-Low Tech Manufacturing



Note: calculated by the number of enterprises, data as of March 2011.
Source: IBS based on Ministry of Economy data.

The applications for R&D and capital investments suggest that enterprises are sensitive to the knowledge and technological demands of their respective sectors. Enterprises from knowledge-intensive services and high-tech manufacturing sectors tend to seek government funds for R&D, rather than capital investment grants. Conversely, firms from low-tech manufacturing and traditional, less knowledge-centered services generally request capital investment grants for technology absorption.

Selection procedure

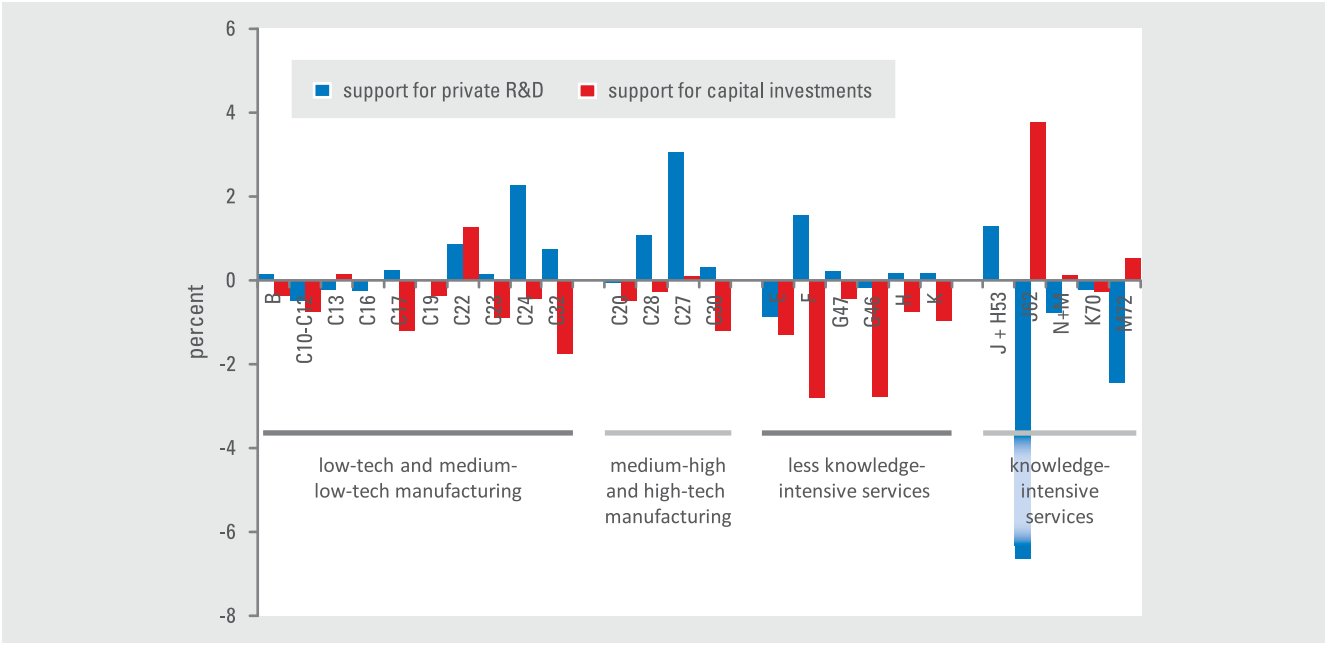
In theory, the implementation agencies would be expected to select a group of beneficiaries corresponding to the desirable composition of applicants. As of March 2011, nearly 2600 enterprises applied for funding under the R&D and capital investment OP IE measures 1.4 and 4.1, and more than 1100 of them have been approved. But these aid recipients do not match the original set of firms that applied. In other words, the decisions made by the implementation agencies are not in line with the self-selection that reflects actual enterprise demand. Some industries, especially in low and medium-low tech manufacturing, as well as large firms, appear to be favored, both by the overly technical criteria and the implementation bodies that review the applications, assumingly due to the previously discussed risk-aversion. The following sections will elaborate.

Considering the sectoral distribution of capital investment and R&D funding, the selection process discriminates against certain industries, more heavily in services than in manufacturing. In services, there is a moderate bias against less knowledge-intensive sectors applying for capital investment and a strong one against knowledge-intensive sectors seeking R&D. The latter, especially, is an obstacle that Poland's absorption-dominated innovation system needs to overcome because knowledge-intensive services tend to pursue innovative projects that deserve encouragement. As for manufacturing, the selection procedure discriminates slightly against low- and medium-low tech firms applying for capital investment grants for technology absorption. The good news in manufacturing is that when it comes to medium-high and high tech ambitiously seeking R&D, applicants from these sectors tend to be favored. Overall, the recipient configurations for both capital investment and R&D are more similar to each other than to the original applicant structure (Figure 2.12).

The latent favoritism towards certain industries in the selection process weeds out the original variation between applicants. The selection process essentially reduces differences between applicants for R&D support and capital investment, counter-streaming the self-selection of enterprises (Figure 2.12). Depending on the degree of industry disaggregation, the correlation between the makeup of the two types of government support is 40-60 percent stronger for beneficiaries than it is for applicants.

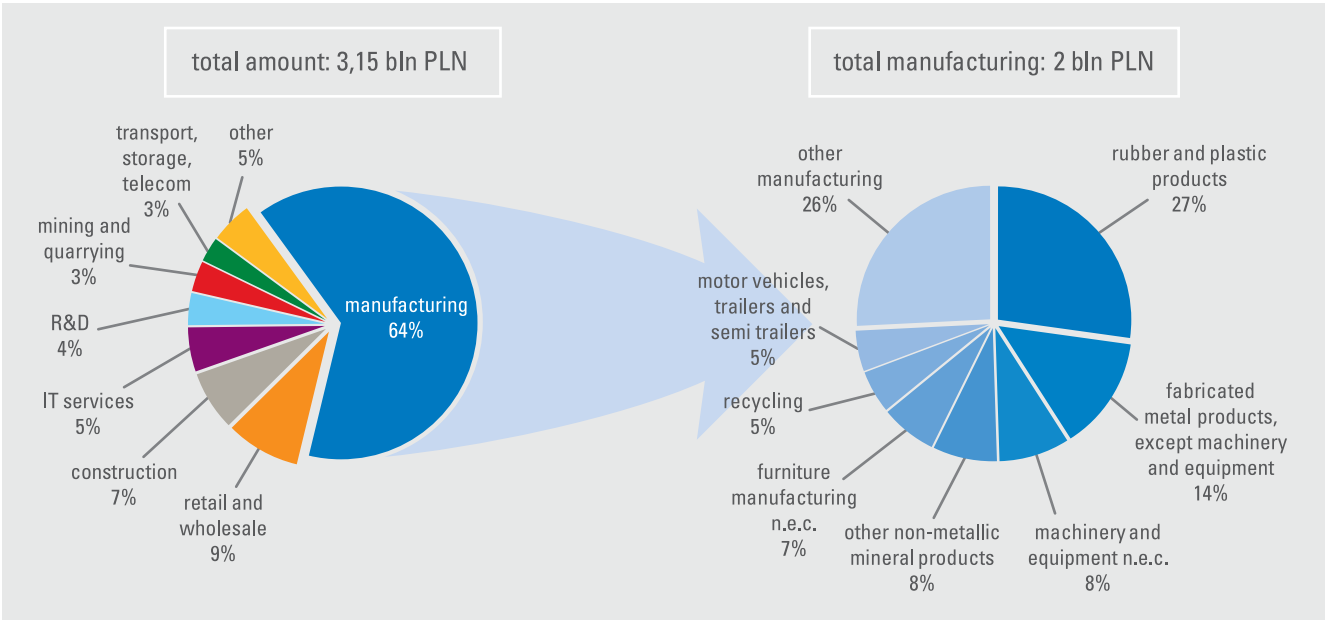
The preference for certain industries also testifies to risk aversion, as it ends up channeling the bulk of R&D support into low- and medium-low tech manufacturing. OP IE actions 1.4 and 4.1, which are supposed to support research and its implementation, have mostly funded enterprises operating in low- and medium-tech manufacturing, such as retail, wholesale trade, construction and transport, where the technological risk tends to be lower than in research and development or computer services (Figure 2.13).

FIGURE 2.12 OP IE Beneficiaries Vs. Applicants: "What You Seek Is Not What You Get"



Notes: the vertical axis depicts the deviations of the lineup of recipients from the original composition of applicants for OP IE funding, in percentage points. Positive values imply that a given sector is favored in the selection process; negative values suggest that there is a bias against the industry. The size of the bar equals the difference in the shares of recipients and applicants. The horizontal axis includes a variety of sectors. Industries are grouped together according to technological intensity, following the Eurostat (2010) classification (see Appendix).
Source: IBS based on Ministry of Economy data.

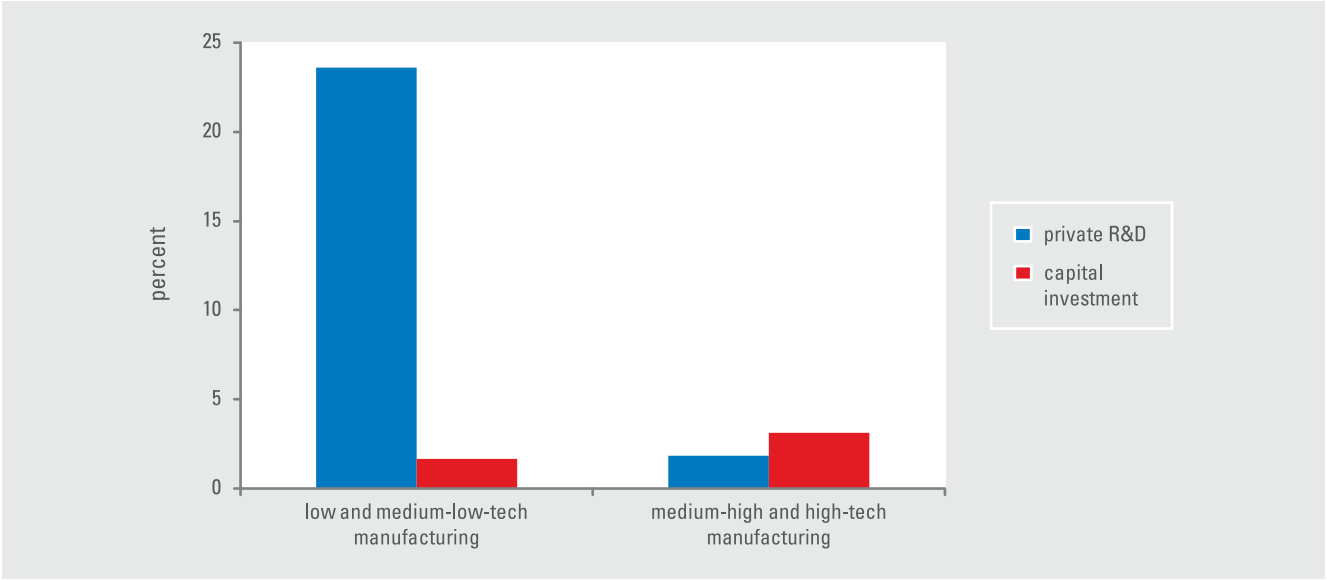
FIGURE 2.13 Public Support for R&D Snowballs in Low- and Medium-low Tech Manufacturing



Source: IBS based on Ministry of Economy data.

In absolute terms, public support contributes a much greater share to enterprise expenditures on R&D in low- and medium-tech than it does in high- and medium-high tech manufacturing, which is alarming. The trend is undesirable if Poland wishes to pursue the moving ahead growth strategy. Selection mechanisms for R&D funding should be redesigned to reward enterprises in medium-high and high-tech manufacturing with an intense focus on research. It turns out that these firms have received significantly less support for R&D than their counterparts in low-tech manufacturing. Instead, high-tech and medium-high tech industries have obtained more capital investment than their counterparts in medium-low and low-tech manufacturing. The assumption is that financing R&D in low- and medium-low tech more than in medium-high and high-tech manufacturing or knowledge-intensive services is perceived as less risky due to, in part, lack of industry knowledge in the selection committees (Figure 2.14).

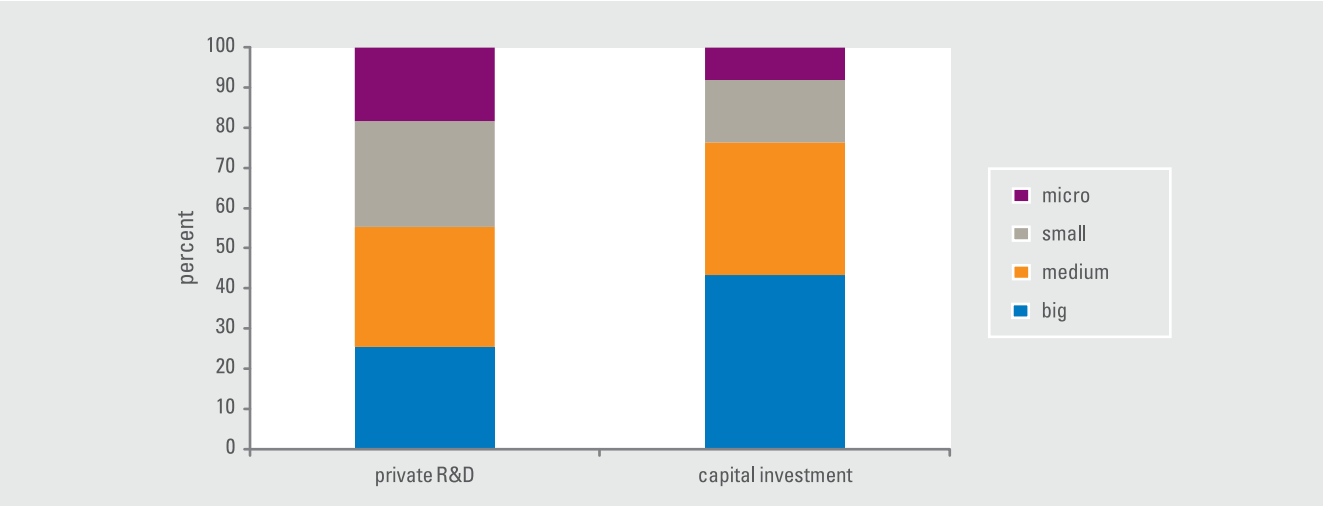
FIGURE 2.14 Public Support for Private R&D Flocks to Low-tech and Neglects High-tech Manufacturing



Notes: the vertical axis depicts the ratio of the value of public support for private R&D and capital investment under the OP IE framework disbursed in years 2008-2010 to beneficiaries from relevant sectors. The horizontal axis shows the distribution of private R&D and capital investment in low- and medium-low tech and medium-high and high-tech manufacturing sectors. Industry classification is based on Eurostat [2010].
Source: IBS based on Eurostat and the Ministry of Economy data.

Firm size is also an important factor in the selection process: overall, large enterprises tend to be favored over SMEs, especially when it comes to R&D. Funds from IniTech, one of the applied R&D instruments implemented by NCBiR, have been divided mainly between RDIs, science-business consortia and large enterprises. SMEs and micro enterprises received only 16 percent of the budget earmarked for IniTech. In line with the trend in distributing R&D support, a lot of capital investment, almost 40 percent of OP IE funds, has also ended up with larger firms (Figure 2.15). Less favoritism towards large companies has been observed on the regional level. *Voivodships* primarily target SMEs and micro-enterprises, although this does not mean that some of the regional programs do not dispense funds to

FIGURE 2.15 Significant Public Support for Big Firms in Both Capital Investment and R&D



Notes: both figures include public support for enterprise innovation under OP IE Action 1.4. and 4.1., 4.2. (R&D) and 4.4. and 4.5. (capital investment).
Source: IBS based on Ministry of Economy data.

large enterprises, especially for R&D projects and innovative investments. Even so, much of the public funding via regional programs has been disbursed as grants for projects with limited innovation potential.

The preference for big firms underlines the pervasive risk-averse culture that reigns in Poland's innovation system and adversely affects the selection. For large enterprises, the risk of market failure is traditionally less significant than for SMEs, particularly when it comes to capital investment, because they have better access to external financing. Going back to the abovementioned data, in Poland, a significant proportion of public funding is allocated to large enterprises for capital investment. While this in itself is not a problem, it is the use of the non-reimbursable grant instrument for capital investment that ought to be reconsidered. The introduction of revolving instruments as a means to support capital investment would enable more large enterprises to utilize the funding for more extensive periods of time.

Ultimately, the selection criteria are responsible for the dominance of low- and medium-low tech and large enterprises. The beneficiaries might be compatible with the standards set up by the implementation bodies, but they may not necessarily be the worthiest or even the best possible candidates for public support. This observation is confirmed by the results of the evaluation studies carried out by CASE (2008 and 2010). Those criticize the selection process under the OP IE framework for its choice of criteria and the point system used to grade projects. The disproportionate focus on non-substantive, technical criteria unrelated to the project (e.g. convergence with the general goals of EU policy) and overabundance of criteria assessing the applicant rather than the proposed project make it difficult for a budding entrepreneur to qualify in the first place. Coupled with the culture of risk aversion, the criteria compel the implementation agencies in charge of the selection to bypass desirable candidates who do apply for public support but do not necessarily get selected.

Impact evaluation: the incomplete feedback loop

Evaluations of innovation programs in Poland are scarce and lack rigor. Sporadic impact assessment studies of interventions in the 2004-2007 funding cycle provide limited useful feedback. Small samples, lack of control groups and overwhelming reliance on telephone and e-mail surveys without sound quality controls, which have characterized many of the studies, pose serious limitations on the analysis and run the risk of producing inaccurate results and drawing incorrect policy conclusions.

Weak impact evaluation studies prevent policy-makers from ascribing causality to public intervention, despite favorable recipient perceptions of its efficacy. Beneficiaries highlight the positive effects that both direct enterprise support measures and indirect interventions have had on their economic situation. However, it remains uncertain to what extent the cited improvements can be attributed to government support, as its effects are difficult to separate from those of the strong economic upturn under which the previous programs were implemented.

The studies that contained positive recipient feedback also uncovered flaws in both the innovation instrument design and the implementation methods. Only the disbursement of support to enterprises through loans, guarantees and equity-based instruments was classified as relatively effective (Gajewski & Szczucki [2009], PARP [2008d]). On the other hand, the selection process preceding direct enterprise support was found to be overly complicated, with unnecessary additional costs for applicants and beneficiaries (SMG KRC [2007], PARP [2006]). Moreover, the evaluation reports have criticized the largely failed effort to create technology transfer offices, incubators and other institutions providing specialized services (see PAG Uniconsult [2008a]).

Policy-makers need to spearhead efforts to establish methodological rigor as the norm in impact evaluation if they hope to obtain any meaningful feedback on program design. Impact evaluation is becoming increasingly critical to decision-making on public financing of innovation globally. Experience with government innovation support in two countries with high R&D to GDP ratios, the US. and Israel, highlight the necessity of impact evaluation thats enables officials to adjust the objectives and instruments of innovation policy in a flexible and more targeted manner. Experience with government innovation support in two countries with high R&D to GDP ratios, the US and Israel, highlights the necessity of impact evaluation enabling officials to adjust the objectives and instruments of innovation policy in a flexible and more targeted manner.

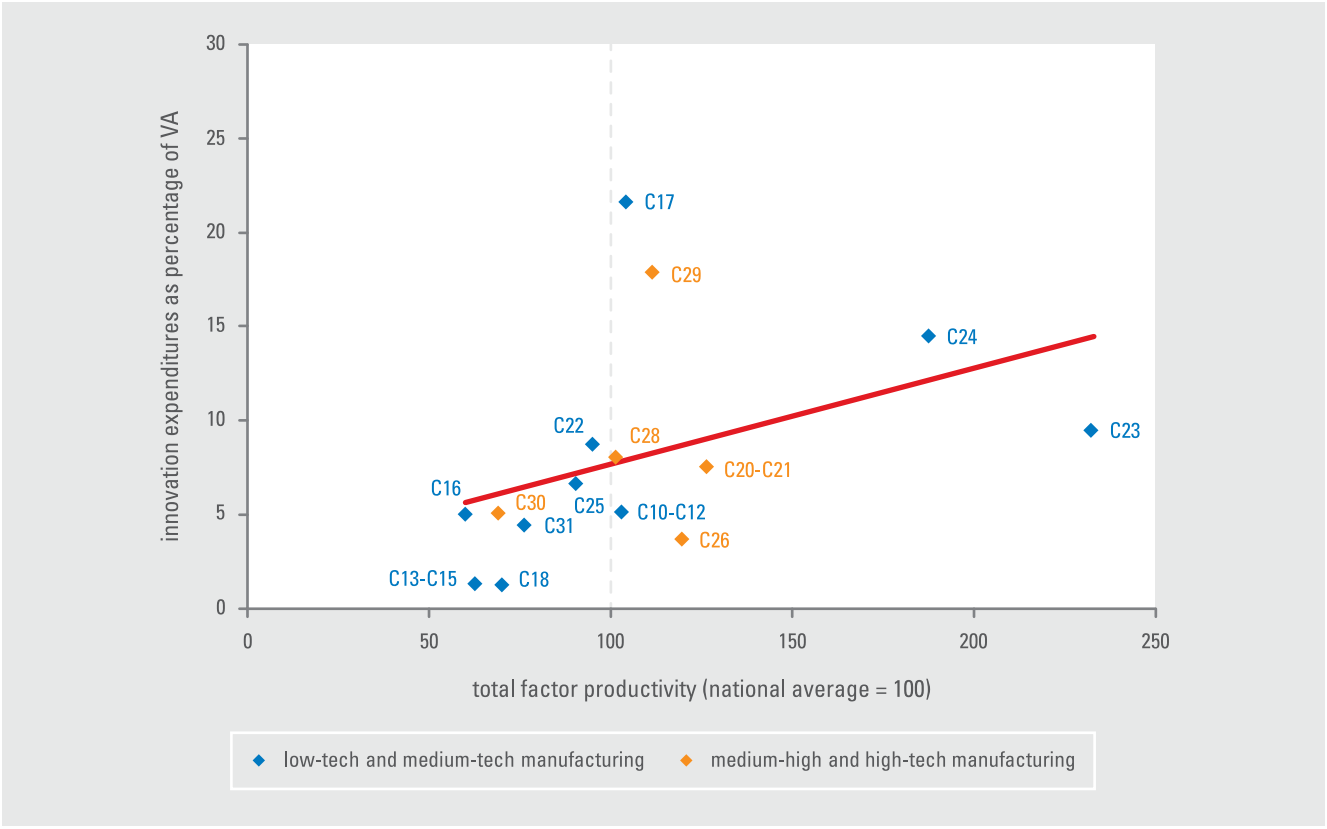
Innovation and R&D spending and productivity: a disconnect

Literature and experience of developed countries underscores the importance of absorption, innovation and R&D for growth and productivity. The latter's positive effect on growth, Griffith, Redding & Van Reenen (2004) argue, is especially strong. Empirical evidence suggests that higher levels of support for R&D have been facilitating TFP convergence in a range of industries across 13 OECD countries since 1970. Both R&D and human capital appear statistically and economically important in this TFP catching-up process and in directly stimulating innovation.

The influence of business R&D on productivity growth has also proven substantial in several leading empirical studies published in the recent years. Analyses conducted on multiple levels — business unit, firm and industry — in numerous countries — especially the US — conclude that R&D matters. Guellec & van Pottelsberghe de la Potterie (2004) claim that the estimated output elasticity with respect to business R&D varies from 10 to 30 percent. They have also found that an increase of 1 percent in business R&D can generate 0.13 percent in productivity growth. The effect is amplified in countries with an intense focus on business R&D. The authors also assert that a 1 percent increase in foreign R&D generates 0.44 percent in productivity growth. Once again, the results are even better in countries that emphasize business R&D.

In Poland, however, there is little evidence thus far suggesting that increased public support for innovation and R&D has accelerated industry-level productivity growth. Several factors can help explain this finding. First, business investment in innovation and R&D remains relatively small, which means that innovation activities are simply too limited to translate into effects on TFP growth, despite the potentially high rates of return. Based on the results of an extensive industry-level analysis of productivity (refer to the Appendix), Figure 2.16 shows that the positive correlation between innovation spending and TFP growth remains weak.

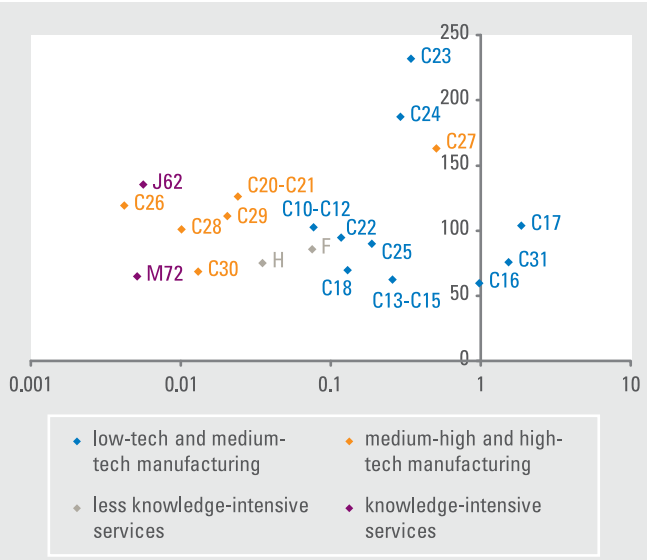
FIGURE 2.16 The Weak Positive Correlation between Innovation Spending and TFP Growth



Notes: the vertical axis depicts innovation expenditures in 2004-2008 as percentages of value added (VA). The horizontal axis shows TFP (national average = 100). See the Appendix for details on data and methodology.
Source: IBS.

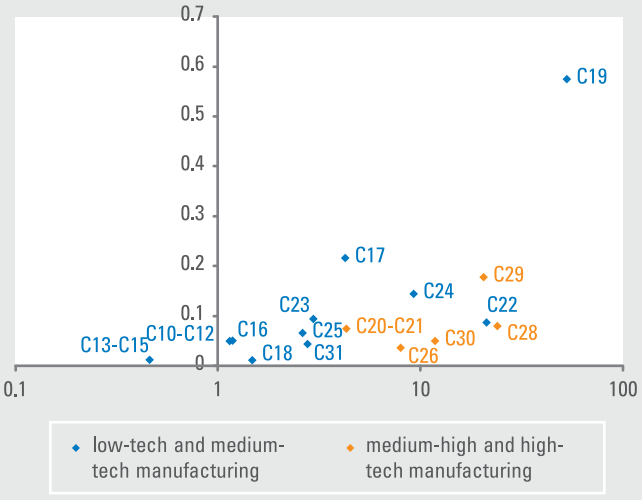
Similarly, the analysis of OP IE disbursements reveals that increased public spending on innovation has not yet translated into TFP growth. Figure 2.17 and Figure 2.18 suggest that neither R&D nor capital investment expenditures have stimulated productivity to a statistically significant degree. Once again, the overall low amounts of funding for R&D and innovation might be to blame. Even if the spending enjoys high private and social returns, its impact on TFP remains limited, in line with endogenous growth theory.

FIGURE 2.17 Public Support for Innovation Has Not Yet Stimulated TFP Growth Across Sectors



Notes: the horizontal axis shows total innovation support in manufacturing and services as percentage of industry gross VA, on a logarithmic scale (for clarity). The vertical axis depicts total factor productivity (national average = 100). See the Appendix for details on data and methodology.
Source: IBS based on OECD, Ministry of Economy and the AMADEUS database.

FIGURE 2.18 Public Support for Innovation Slightly Contributed to TFP Growth in Manufacturing



Notes: the horizontal axis shows capital investment support in manufacturing as a percentage of industry gross VA, on a logarithmic scale (for clarity). The vertical axis depicts total factor productivity (national average = 100). See the Appendix for details on data and methodology.
Source: IBS based on OECD, Ministry of Economy and the AMADEUS database.

CHAPTER 3

Enterprise Innovation Support Management: a Critical Institutional Review

This chapter offers a comprehensive assessment of Poland's institutional capacity to fulfill objectives and implement programs focused on innovation. First, it introduces the main institutions and agencies in charge of absorption, innovation and R&D that are powered through the pipeline of EU funding. It unpacks their behavioral patterns and analyzes the division of responsibilities as well as the modes of interaction between them. Next, it evaluates their competence to act in a goal-oriented and feedback-centered way. Finally, the chapter concludes with recommendations for policy realignment.

Diagnosis of the innovation system: institutional fragmentation, low capacity and risk-aversion

The innovation support system suffers from diminished capacity instigated, in part, by excessive fragmentation. Responsibilities and tasks are unevenly divided between 5 different agencies and/or ministries, which altogether manage 22 support programs of a stunning variety. For instance, PARP, a public agency, is in charge of 16 innovation programs worth approximately EUR 5 billion, which represents about 61 percent of the total EUR 8.3 billion of EU funding earmarked for enterprise innovation in the 2007-2013 budgetary cycle. In the meantime, the Ministry of Economy runs two programs with a total value of EUR 1.3 billion, or 15 percent of the structural funds (see Annex 2). The institutional disequilibrium has been incurring high administrative costs on both the public sector managers and the private sector applicants.

The system does not sufficiently integrate cutting-edge industrial expertise and know-how, and it has developed a culture of risk-aversion, biased against early-stage and high-risk innovation ventures, particularly in high-tech. Staff of implementation agencies cannot always possess sufficient knowledge of the industry, and they will remain limited in their capacity to fashion effective, output-oriented programs maximizing the impact of the funding distributed unless industry expertise is integrated in the instrument design and the selection phases. Moreover, the staff face another set of constraints stemming from the overly legalistic approach to program management. Emphasis on the EU's legal framework, the Polish administrative law and procurement regulations often makes them reluctant to allocate public resources to projects that may not immediately result in commercially viable products and services. In so doing, they are avoiding risk in an industry which by definition must be focused on stimulating risk-taking among innovative enterprises.

The efficacy of public support is also reduced by the formal, technical and "desk-top" selection procedure. Due to alleged concerns over potential corruption, officials from the implementation agencies are banned from face-to-face interaction with applicants throughout the selection process, which cripples their ability to conduct proper due diligence and diminishes their capacity to choose the most promising projects. The "paper-based" application procedure incents firms to hire consulting companies to draft grant applications that appeal to the reviewers but favor form over substance. In essence, this approach to candidate selection turns the decision-making process into a "beauty contest" judging the consultants' writing skills rather than a professional appraisal of the applicants' capabilities and the proposed projects.

The state of affairs under the micro-scope: the leading implementation bodies

This section examines implementation agencies managing programs that target enterprise innovation, financed from the basket of EU funds. It also draws attention to a relatively new agency, the National Center for Research and Development (NCBiR), founded in 2007, which has been stirring the waters of the innovation industry by quickly accumulating impressive experience in funding ESTD. During the short time of its existence, NCBiR has established a reputation for less risk-aversion towards financing genuinely innovative projects.

TABLE 3.1 Implementation Agencies in the Public Support System for Innovation

	EU-funded programs managed (number)	Budget 2007-2013 (in EUR million)
Polish Agency for Enterprise Development (PARP)	16	4,293
Ministry of Economy (MoE)	2	1,204 (including (KFK)
Ministry of Science and Higher Education (MoSHE)	2	405
National Economy Bank (BGK)	1	336
National Capital Fund (KFK)	1	180 (through the MoE)
Ministry of Labor and Social Policy (MoLSP)	1	168
Total:	**22**	**7005**

Polish Agency for Enterprise Development (PARP)

Introduction

PARP is a government agency that falls under the institutional umbrella of the Ministry of Economy. It was established in 2000. PARP's budget draws on government funding and the EU structural funds. In the 2007-2013 financial perspective, PARP has been responsible for implementing instruments under three main OPs: Innovative Economy, Human Capital and Development of Eastern Poland.

PARP's stated mission reveals a focus on the twin objectives of development and innovation. PARP seeks to: "act for the benefit of Polish economic and social development," with the purpose of "[supporting] entrepreneurship through implementation of actions aimed at using innovative solutions by entrepreneurs, development of human resources, expansion on international markets and regional development".

PARP's agenda mainly relates to government administration. It is in charge of the development of micro-enterprises and SMEs, exports, regional development, innovation activities, job creation, unemployment prevention and the development of human resources.

The general aim is to create and stimulate enterprising attitudes and approaches in the Polish business sector. Hence, the agency implements programs that facilitate enterprise competitiveness, encourage the development of human resources, support business environment institutions and channel resources and know-how into regions. On the margins, PARP is also involved in research and analysis in an attempt to identify and address the needs of entrepreneurs — particularly SMEs — in order to tailor existing programs as well as spearhead new ways of government involvement in supporting entrepreneurship, capacity for innovation and human resources development.

One of PARP's key goals is strengthening the competitiveness of Polish enterprises on foreign markets. The Enterprise Europe Network (EEN) operating under PARP provides information about investment opportunities and advisory services for Polish entrepreneurs seeking foreign partners. Through EEN, Polish firms can increase their visibility in the European arena by publishing their profiles in the Cooperation Offers Database, which can be accessed by approximately 600 network units in Europe and around the world.

At home, PARP uses a diverse toolkit of instruments to support Polish enterprises financially. The assistance can take the form of non-refundable investments, loans and full or partial cover of fees levied by service providers. PARP manages most of the EU-funded programs under the OP IE framework. It uses both direct instruments of financial support for innovation (1.4, 4.1) and absorption (4.4), as well as indirect instruments of financial support for incubators (3.1). As of December 2010, PARP made payments of about PLN 8.7 billion (EUR 2 billion) under OP IE. The total value of signed contracts amounted to approximately PLN 20.8 billion (EUR 4.8 billion).

PARP's management consists of two main bodies: the post of the Chief Executive Officer and the Supervisory Board. The Chief Executive Officer exercises control over the whole agency. Jointly with the Deputy to the Chief Executive Officer, he/she is authorized to make declarations of will and conclude agreements on behalf of the agency. PARP's activities are overseen by the Supervisory Board. The Board is composed of representatives hailing from governmental departments and business sectors playing a key role in economic development: the Ministry of Economy, the Ministry of Regional Development, the Ministry of Finance, entrepreneur organizations and employer associations.

PARP works with regional partners: most notably the Regional Financing Institutions (RIFs), which manage the implementation of EU-funded programs for micro-enterprises and SMEs. RIFs are nominated in a competitive selection procedure from among existing regional institutions with extensive and verifiable experience in implementing programs for SMEs. Reflecting Poland's regional structure, there are 16 RIFs, one per each *voivodship*, fulfilling various tasks, including promoting available programs and explaining conditions of participation, managing administration of implemented programs, cooperating with PARP in the field of technical and financial monitoring of implemented programs, preparing substantive and financial reports and maintaining a database of program participants.

Assessment

PARP's capacity to take risk and encourage enterprises to do the same to innovate is severely limited by the legal constraints that define its mission and mandate. Mounting pressure to disburse significant amounts of resources, combined with the dual mandate in managing both innovation and absorption programs, has encouraged "desk-top" and "paper-based" bureaucratic practices that channel public support into absorption and commercialization, e.g. the late stages of the innovation process. This trend seems steadfast. PARP's selection processes are currently ill suited for identifying risk-taking firms that strive to undertake the innovation projects that they need to be competitive in the future.

To amend the incentive structure for enterprise innovation, the Government should recognize that there is significant room for improvement in PARP's mandate, performance and practices. The standing risk aversion and biased selection procedures in the innovation system, which produce outcomes that are out of line with PARP's stated objectives, stem from an unfortunate mix of structural and agency-based factors: (i) the overwhelming amount of EU funding that PARP is required to disburse, (ii) the use of a single selection process for the allocation of high-risk R&D grants and low-risk capital investment grants, and (iii) the pre-occupation with potential misuse of public funds, which further reduces the appetite for risk. The problematic selection procedures, especially, cut right to the heart of the system's overall deficiency: heavily reliant on a paper trail and with little in the way of face-to-face interaction with applicants or visits to firms' research and production facilities, they point towards a largely outdated and overly bureaucratized approach to innovation that makes scarce use of market-based instruments.

To level the systemic imbalance between absorption and innovation, PARP's mandate ought to be redefined. With PARP at the helm, absorption has been the most common way of utilizing EU funds. Matching is not a problem, since the recipients are not cash-strapped early-stage firms but well-established enterprises with positive cash balances and sufficient funds to conduct lower-risk technology upgrading. If continued, this approach to funding distribution will foster redundant parallel financial systems that hinder, if not preclude, efficient allocation of resources. There is reasonable cause for concern that firms may become excessively reliant on absorption grants to fund capital equipment, and that they may find it difficult to adjust in a post-structural funds setting.

Cognizant of the institutional constraints that it faces in managing innovation programs, PARP staff have been relatively open to reshuffling responsibilities among the implementation bodies. The sentiment is that a different institution, potentially NCBiR, may be better positioned to manage funding distribution. PARP has itself already identified an "unmet enterprise need for technical assistance via non-financial programs". If PARP is relieved of some of the pressure to disburse massive amounts of financial support, it will be able to focus on accumulating the industry know-how that it needs to help firms hone skills and improve performance in areas where Poland holds a comparative advantage.

National Capital Fund (KFK)

Introduction

The National Capital Fund (KFK), the fund of funds, is the primary instrument focused on stimulating the development and capitalization of new Venture Capital (VC) funds in Poland. KFK was established by the Polish Government in 2005, with the aim of alleviating the equity gap in the financing of innovative Polish SMEs. The National Economy Bank (BGK) owns 100 percent of KFK's shares, and its senior managers serve on KFK's Supervisory Board alongside other appointees from Polish ministries. KFK's current capital base is approximately EUR 300 million in Polish government funds, EU structural funds and Swiss capital. KFK dispenses funding under OP IE 3.2.

The sole objective of KFK is to provide capital investment and technical assistance to VC funds investing in businesses established on Polish territory, particularly in innovative SMEs or enterprises conducting R&D. Since KFK can only invest 50 percent of any given VC fund's committed aggregate capital, it serves as a major catalyst for private sector investment in Poland's emergent VC industry. With the capital that is currently available, KFK aims to build a portfolio of more than 20 VC funds with total aggregate capitalization of

more than PLN 1.5 billion (EUR 349 million, and possibly higher, in the range of EUR 500 million). The types of support that KFK provides to VC funds operating in Poland include acquisition of shares; participation in venture capital funds; acquisition of investment certificates and/or participation units; acquisition of bonds, convertible bonds and bonds with warrants, and provision of non-reimbursable allowances covering the VC funds' costs of preparing and monitoring investment portfolios.

In terms of output, KFK has thus far invested in seven funds, and it plans to launch four more shortly. As for the latter projects in the making, KFK is covering up to 50 percent (effectively 60 percent including a 10 percent enticement grant) of the VC funds' anticipated aggregate capitalization, estimated to reach EUR 500 million. For further reference, see the list of KFK's funds in Table 3.2.

TABLE 3.2 VC Funds Supported by KFK

Fund	Capitalization (PLN/EUR million)	Target Sectors
BBI Seed Fund	60 / 14	ICT, life science, health protection, material technologies
Helix Ventures Partners FIZ	40 / 9	Internet technologies, mobile, software, electronics
Skyline Venture	30 / 7	Undefined
Venture Capital Status	50 / 12	Undefined
Internet Ventures	100 / 23	TMT
Assets Management Black Lion	100 / 23	Health protection, ICT, mobile marketing, innovative infrastructure
Opera Venture Capital FIZ	100 / 23	TMT, energy, commercialization of inventions,
Giza Polish Ventures I (GPV I)	84 / 20	New technologies

Note: data as of December 2011.

KFK's Innovation Programs

KFK implements measure 3.2 under the OP IE framework: "Support for venture capital funds". The overall budget for this instrument is about EUR 180 million, entirely devoted to the implementation of KFK's individual projects. As of August 2011, the Fund had committed to or invested in 10 VC funds with total capitalization worth more than PLN 700 million (EUR 162 million) utilizing funding from OP IE and the Ministry of Economy. In November 2011, it helped establish Poland's first Polish-Israeli Venture Capital Fund with a total capitalization of PLN 84 million (EUR 19 million), of which PLN 42 million PLN (EUR 10 million) was covered by KFK through OP IE.

KFK also handles the scheme "Improving the business environment and access to capital for small and medium enterprises" in the broader context of the Swiss-Polish Cooperation Program. The measure falls into the "private sector" category, one of the top items on the cooperation program's list of priorities. It assumes a regional focus, prioritizing the more depressed regions of eastern Poland. The Swiss Government has earmarked CHF 53 million (EUR 44 million).

Assessment

Given the developmental level of Poland's venture capital market, KFK's role as the public fund of funds has been crucial in filling the financing gap at the early stages of the innovation process. While early-stage VC is an important part of the innovation system, risk-adjusted financial returns on small-scale projects tend to be too low to encourage private

investors to supply sufficient capital. Investors also tend to be discouraged by the absolute administrative costs, which are on par with those of large-scale VC projects. Therefore government intervention is needed to catalyze investment of private capital into this high-risk, small-scale niche.

KFK is a good financial vehicle for early start-ups in terms of both the institutional framework and instrument design. The method of limiting investment to EUR 1.5 million per project meets the crucial objective of targeting SMEs. In exceptional cases, raising the limit, e.g. to EUR 2.5 million, might be worth considering to elicit better yields from investments in the best companies, provided that clear criteria for what constitutes an "exceptional case" can be established. Moreover, the selection process can be shortened in order to run more smoothly, based on the lessons learned from the hitherto operational experience of KFK.

KFK's current budget is appropriate as the restrictions imposed are discriminating against "money chasing deals". Premature augmentation of the funding for the VC instrument could lead to suboptimal investments, given the current limitations in the pipeline of investable projects. Privatizing KFK in the future is not advisable either, as it would likely shift the focus undesirably towards PE funds, where commercial returns are by definition higher than those of VC funds. Such a step would also limit the very space where public intervention remains critical even in mature economies, the early stages of R&D.

The outcomes of KFK's interventions need to be properly evaluated in the coming years in order to map performance, elicit feedback and make adjustments "on the go". Given the length of the venture capital funding cycle (five years after the initial investment by KFK, followed by new rounds of fundraising without KFK), there is not enough data today to ascertain whether the program has been successful or whether the VCs it has sponsored will expand their financing beyond the currently favored IT and Internet-based sectors. The list of KFK-supported VC funds in Table 3.2 indicates that the availability of capital through KFK has indeed stimulated the proliferation of VC funds that go beyond IT and the Internet, investing in innovative SMEs involved in health, life sciences and energy technologies.

National Economy Bank (BGK)

Introduction

BGK is Poland's only state-owned bank, and it's leading business objective it to render banking services to the public sector. It supports the government's economic measures on the national, regional and local level. Substantively, it tends to focus on the implementation of development programs sponsored by governmental and EU funds, which provide direct support to firms. BGK's projects revolve around the expansion of SMEs, export and infrastructure. In addition to its public sector mission, BGK also runs commercial operations on the corporate market.

BGK finances are sound, and the bank has maintained a good credit rating. BGK liabilities are guaranteed by the Ministry of Finance. As of September 2011 (3Q), total assets amounted to PLN 57.4 billion (EUR 13.3 billion). The 2011 cumulative net profit was PLN 428 million (EUR 99.5 million). This compared favorably to the previous cumulative net profit of PLN 198 million (EUR 46 million). BGK's capital adequacy ratio as of September 2011 was 14.4 percent. In 2011, BGK received an A- credit rating from the Fitch rating agency — the same as the Polish sovereign.

BGK assumed the sole responsibility for the disbursement of EU funds in January 2010. As of November 10, 2011, it released PLN 64.6 billion (EUR 15 billion) worth of EU funding to beneficiaries of EU-supported programs.

BKG's Innovation Programs

OP IE 4.3 – Technology Credit Fund

BGK is the implementing authority for the Technology Credit Fund sponsored by OP IE. The total budget for the 2007-2013 funding cycle is EUR 336 million. Between mid-2009 and mid-2011, BKG distributed nearly PLN 130 million (EUR 30.2 million) in contracted technology bonus payments between 130 relatively diverse SMEs. The total contracted amount under this program reached approximately PLN 130 million (EUR 30.2 million). Applications hail from diverse sectors, with no single sector holding an advantage over others in the decision-making process. In 2011, the application process was revamped. The call for proposals took place in June 2011, with a budget of PLN 278.2 million. Shortly after its announcement, BGK received 146 applications requesting an aggregate of PLN 420.7 million. Given the high demand, BGK asked the Ministry of Economy to allocate an additional PLN 200 million ahead of the next call for applications.

OP EPD 1.2 – Provision of Financial Engineering Instruments

The program "Provision of Financial Engineering Instruments" under OP EPD is also handled by BGK. The total available funding is PLN 98.3 million (EUR 23 million) for the 2007-2013 financial perspective. The program was launched in 2010, and the financial intermediaries were selected in the fourth quarter of that year in a competitive selection procedure. All resources have since been contracted.

JEREMIE Trust Funds

The BGK recently became the trust fund manager of the Joint European Resources for Micro-to-Medium Enterprises (JEREMIE). The JEREMIE program operates in five *voivodships*: Lower Silesia, Lodz, Pomerania, Greater Poland and West Pomerania. The program falls into the category of Regional OPs. BGK will distribute a total amount of PLN 1,663 million (EUR 372 million) in the 2007-2013 period. JEREMIE caters to micro-enterprises and SMEs in need of capital for developing innovative technologies. As of 2010, BGK signed agreements worth PLN 289 million (EUR 67 million) with 22 competitively selected financial intermediaries. Of the 22 contracts, 12 requested the Global Loan product valued at PLN 111.5 million (EUR 26 million) in total, and the remaining 10 sought the Re-guarantees product worth PLN 177.5 million (EUR 41 million). Micro-enterprises and SMEs started using the support of these financial intermediaries in the second half of August 2010. By the end of 2010, the JEREMIE program had benefited more than 450 entrepreneurs.

Assessment

The Technology Credit program, though conceptually sound, had not been put to sufficient use, mainly due to its inability to compete with OP IE grants and stringent operational procedures. Technology Credit is a subsidized loan instrument that is well-suited for certain niche projects, which entail lower risk than projects funded by grants or venture capital funds, but higher risk than those financed by commercial banks. At present, the use of Technology Credit to sponsor innovation activities is minimal. As of August 2011, only 12 percent of the EUR 336 million earmarked for the instrument has been committed. Polish firms tend to prefer competing sources of funding for similar purposes, such as grants under

the OP IE framework, because they do not require repayment. OP IE measure 4.4 has an extremely high utilization rate, of 87 percent (the budget is EUR 1,493 million). OP IE 4.5 also performs well with a medium-to-high utilization rate of 41 percent (the budget is EUR 1,024 million). The Technology Credit program was recently revamped, and its operational procedures were simplified. It would benefit from an in-depth analysis of its impact on innovation activities among its beneficiaries in the coming months.

BGK should establish and run a lending program targeted at modernization in innovative SMEs. As the Polish Government revises existing programs in 2007-2013 and/or incubates new programs for 2014-2020, it should consider transferring the responsibility for credit-based instruments of public support for innovative Polish firms to BGK. The innovation system would benefit from the consolidation of credit-based support schemes — like the proposed lending program that would address the capital equipment needs of Polish SMEs and larger firms — under BGK, which has a sound loan administration system and the banking skills that are required to manage credit evaluations, the lending process and the follow-up.

National Center for Research and Development (NCBiR)

Introduction

NCBiR manages and implements strategic scientific R&D programs and supports the transfer of scientific research results onto the market. Founded in July 2007, NCBiR operates with an annual financial plan approved by MoSHE. It is funded by both the Polish Government and the EU. MoSHE contributes no less that 10 percent of the annual budget for education. In the past three years, NCBiR's budget oscillated between PLN 400 million and 600 million (PLN 500 million in 2009, PLN 430 million in 2010, and PLN 640 million in 2011, which is EUR 116 million, 100 million and 149 million, respectively). The total amount of funding is expected to increase to PLN 1 billion in the near future. The Government's share should rise as well, as it is envisioned that NCBiR will receive about 50 percent of the annual education budget by 2020.

NCBiR is a dynamic institution whose mandate in the OPs is currently being extended. NCBiR's staff have increased from 79 full-time employees in December 2009 to a 179-member team in December 2011. The Center is currently the intermediary for three main OPs in the field of science and higher education: Human Capital (HC), Innovative Economy (IE) and Infrastructure and Environment (I&E), which have all been transferred to NCBiR from the Ministry of Science and Higher Education (MoSHE). The programs are three-fold: strategic, national and international.

NCBiR's Innovation Programs

NCBiR's Strategic and National Programs are designed to incorporate innovation activities, including scientific research and experimental development, into day-to-day operations of both the public and the private sector. The Strategic Programs section consists of projects aiming to address specific technical, scientific or social problems. NCBiR's proposals are subject to endorsement by the Minister of Science and Higher Education. As of December 2011, the Center devised five strategic programs that have received the stamp of approval (see Table 3.3). In the National Programs section, the Center has thus far operationalized seven projects: Technology Initiative I, INITECH, LIDER, Innotech, Innovation Creater, Patent Plus, BroTech and KadTech.

TABLE 3.3 NCBiR's Strategic Programs

Strategic Program	Budget PLN (EUR) million
Advanced technologies for energy generation	300 (70)
Interdisciplinary system for interactive scientific and scientific-technical information	60 (14)
Integrated system for reducing energy consumption in the maintenance of buildings	60 (14)
Improving safety in the mines	10 (2.3)
Technologies supporting the development of safe nuclear power	50 (11)

Note: data as of December 2011.

Technology Initiative I, INITECH and Innotech share a focus on developing and providing access to new technologies at different stages of the innovation process. *Technology Initiative I* funds projects attempting to commercialize Polish achievements in science and technology. In particular, it supports the development of new products and technologies by SMEs and research teams that are directly involved in target industries. The program's budget is PLN 230 million (EUR 53 million). NCBiR's contribution as of May 2011 amounted to about PLN 120 million (EUR 28 million). *INITECH* funds: a) scientific research or experimental development aimed at practical application within the Polish economy, b) projects designed to implement research results in the industry (the preparatory phase preceding practical application), and c) purchase of consulting services relevant to innovation. *Innotech* supports the absorption of modern technologies by Polish enterprises. This program targets micro-enterprises, SMEs, large enterprises and consortia, as well as centers of scientific and industrial application.

LIDER, *Innovation Creator* and *Patent Plus* strive to build capacity and fund activities at the early stages of innovation. *LIDER* supports the career development of researchers. It promotes and builds skills related to self-reliant planning and management of research teams working on application-oriented research projects. *Innovation Creator* supports innovative academic entrepreneurship. It facilitates student initiatives and encourages innovative endeavors of university staff. *Patent Plus* finances the patenting of inventions.

BroTech and *KadTech* seek to open up communication channels between science and the economy in order to increase enterprise access to innovative technologies, products and services. *BroTech* seeks to boost the efficiency of technology transfer between science and the economy. It finances services provided by technology brokers to scientific units, micro-enterprises or SMEs attempting to commercialize research results and transfer technology. *KadTech*'s primary objective is to strengthen cooperation between companies and highly qualified specialists from the sphere of research. The program is open to micro-enterprises and SMEs.

NCBiR also manages a range of international programs. NCBiR is in charge of activities related to Poland's participation in the ERA-NET and ERA-NET PLUS, EUREKA, Eurostars, AAL and ENIAC programs. It also supports bilateral projects such as the Polish-Israeli competition for R&D projects.

Assessment

NCBiR is playing an increasingly important role in the Polish innovation system. The Center is now managing OPs previously handled by MoSHE, and it is expected to take over more schemes in the near future. MoRD has already agreed to transfer an additional PLN 500 million of surplus money from PARP to NCBiR, to be spent under OP IE 1.4.

NCBiR's institutional design, pool of know-how and less risk-averse culture is better suited than PARP's to managing innovation programs. The Center applies parsimonious and flexible rules: the British-style main administrative ordinance serving as a framework

for NCBiR's operations is only two pages long. PARP works with an equivalent of more than 20 pages. Given their mandate, NCBiR staff possess deeper knowledge and understanding of the R&D process than PARP staff, which curbs risk aversion and facilitates financing of projects with greater innovation potential that entail more risk. NCBiR continues to accumulate expertise in financing R&D in the business sector. Moreover, it is adopting international good practice by piloting a selection process by an investment committee.

CHAPTER 4

Public Support System for Enterprise Innovation: Lessons and Pointers

This chapter summarizes the lessons learned about Poland's existing innovation system and provides general pointers for the reform process. Capitalizing on the review of programs, instruments and institutions presented in the previous chapters, it identifies the main substantive areas with notable room for improvement.

Two steps forward, one step back: strengths and weaknesses of the innovation system

While Poland's public support system has dramatically expanded the pool of resources available to enterprises for innovation, it has yet to tailor its activities to the future needs of the Polish economy. This report finds that large enterprises still receive 40 percent of public funds, that low-tech firms receive far more financial support than their medium- and high-tech counterparts and that most resources are allocated for capital investment via grants. These funding patterns may have been optimal in the early years of the OP IE when they helped large firms across Poland upgrade their technological tools and thus enhance overall productivity. But public funding has wielded limited leverage on facilitating innovative outcomes in the business sector, a goal that is currently the discussion topic "du jour" in national and the European policy circles, especially within the context of the Europe 2020 Strategy and the related plans for "smart specialization".

The institutional architecture is fragmented and gripped by risk aversion that steers funding toward low-risk capital expenditures and away from the critical high-risk early stages of the innovation process. The lack of inter-agency coordination raises administrative costs, duplicates objectives and undermines information sharing. There is no evidence indicating that the current system spurs the type of inter-institutional competition that would enhance the quality of the services or encourage the agencies to achieve program objectives. Moreover, employees of most implementation agencies in Poland are extremely reluctant to use public resources to finance high-risk innovation projects as it cannot be warranted that the R&D sponsored by the state will translate into commercially viable products. Therefore, there is a marked tendency in the system to finance low-risk technology projects, with tangible and guaranteed outcomes. The culture of risk aversion is an issue of great concern, and overcoming it will require an extensive national debate on the importance of public sector risk-taking at the early stages of the innovation process in particular.

The complex public support system and the long selection process are not particularly "enterprise-friendly". First, websites often don't provide sufficiently detailed information about the programs, making it difficult for enterprises to choose the ones that are best suited to their needs. Next, beneficiaries reported tedious deferrals between filing the application, receiving a decision and disbursement of the money granted. This spells bad news for cash-strapped early-stage entrepreneurs and SMEs in particular, as they face a tangible risk of running out of money while waiting for a funding decision and disbursement, a payment from customers or the enforcement of contracts.

The selection procedure is marked by risk aversion that unfavorably distorts the desirable self-selection of applicants. The good news is that the likelihood of applying for government funds correlates positively with the level of absolute productivity. Moreover, the applicant enterprises' choice of financing instrument shows sensitivity to the technology and knowledge needs of their respective sectors. But the selection process artificially reduces the natural differences between applicants for R&D support and capital investment. It also channels most of R&D support into low- and medium-tech manufacturing rather than high-tech manufacturing or knowledge-intensive services. These conclusions suggest that the selection process fails to fulfill the specific needs of different industries. Ideally, future innovation policy must stipulate selection criteria that actively encourage high-tech industries, which have the greatest potential for productivity growth in the long run even if they are not the most productive sector yet.

The use of financing instruments, emphasizing the non-reimbursable grant, encourages favoritism towards larger enterprises that focus on absorption rather than innovative SMEs. The demand for grants is high among SMEs, which often cannot undertake R&D projects unless they receive public support. But big firms and MNCs often succeed at securing funding at their expense. For MNCs, anecdotal evidence suggests that access to EU funding may have been one of the game-changing factors that contributed to their decision to locate production in Poland as opposed to other countries in the region, where EU funding may have been scarcer. But relatively generous allocations of grant funding for MNCs and their subsidiaries seem at odds with the officially stated objectives of the implementation agencies. This is not to suggest that Poland should not support large firms or MNCs. Implementation agencies ought to finance projects that pioneer innovative research with high commercialization potential that utilizes domestic human capital, regardless of firm size.

The proportion of resources allocated for technology absorption, as well as the structure of applications for grants, further underlines the pervasive avoidance of risk. Both the implementation agencies and the beneficiary firms focus on capital investments via non-reimbursable grants, creating a self-reinforcing cycle, which is unlikely to facilitate the much-needed gradual shift towards increased R&D spending. As of September 2011, 43 percent of funds and 39 percent of all EU-sponsored innovation programs were dispensed as grants to purchase equipment, which has little to do with innovation. Many of those grants ended up in large firms and multinationals that would have embarked on their investments even if public grants were not available. Several beneficiaries confirmed in interviews (see Annex 1) that for big enterprises public support is an additional perk, rather than a necessity, as they tend to have the capacity to finance their capital investments from their own pocket.

Poland's innovation system currently lacks a rigorous impact evaluation system. Under the current conditions, it is not possible to credibly gauge the effectiveness of public spending per each instrument and the efficacy of the innovation support system as a whole. Policy-makers lack valuable feedback that would enable them to see what has or has not been working and make adjustments to the innovation system on a running basis.

Insufficient use of public procurement is also a missed opportunity that is doing the innovation system dis-service. The overly restrictive interpretation of public procurement rules has been discriminating against demand-led innovation, especially among SMEs. Poland also lacks a developed administrative culture of organizing tenders around innovative ideas (for instance, technologies for the transformation of public administration buildings into zero emission establishments). As public procurement has proven itself as a viable tool for the public sector to create demand for innovation in advanced economies, the Government of Poland may want to start applying it more extensively in its own innovation policy.

The public support system is lopsided in its use of instruments, as it overwhelmingly favors the non-reimbursable matching grant, regardless of the type of intervention, target group and risk associated with the project in question. The utilization of loans, venture capital and private equity instruments, as well as tax incentives, is limited, though feedback from beneficiaries indicates that they perceive them as more efficient. Hence, this unbalanced toolkit should be diversified. In cases involving less risk — such as technology absorption — matching grants should be replaced by loans or other revolving instruments, since market failure related to credit constraints may not be as much of a threat. Such changes would reflect the recommendations of the European Commission, which has compiled a list of desirable support instruments for the upcoming 2014-2020 funding cycle.

A great leap forward: targeted reform of objectives, programs, institutions and instruments

In terms of policy objectives, while technology absorption by predominantly large firms is likely to continue spurring growth for some time, Poland will need to reprioritize innovation to continue its fast-paced convergence. The current patterns of innovation spending reflect Poland's existing competitive advantage, but given the higher productivity levels and growth rates typical of the high-tech sector, Poland should transition from buttressing low- and medium-tech to supporting high-tech, even if it is not the most productive sector yet.

As for program design, several schemes must be integrated and their features notably modernized. The plethora of programs has to be reshuffled and meaningfully merged in an integrated system. The current 22 programs can be streamlined around the five different stages of the innovation process.[2] Some positive features of the existing system are worth accentuating, such as the stated focus on smaller firms and enterprises located in less developed areas. While changes are enacted, the Polish Government has to prepare itself for a possible temporary fall in demand for funding or a slowdown in the disbursement of financial support.

On the institutional level, a revamped architecture must attempt to eradicate the culture of risk aversion. First, the management of early stage R&D-intensive innovation programs could be transferred to NCBiR, which has thus far exhibited a greater tendency towards risk-taking and demonstrated solid experience with financing high-tech and R&D in enterprises. Next, BGK could take over the management of revolving instruments for capital investment in enterprises. PARP should stay in charge of technical assistance to enterprises via non-financial programs.

The innovation system must also refine its use of financing instruments. Grant funding, which currently supports absorption-oriented activities in large firms and MNCs, must be diverted to innovation-related projects, be they proposed by big enterprises or SMEs. Capital investment, especially in large companies, should be financed through revolving instruments.

2. Five stages of the innovation process: 1) research, 2) concept/invention, 3) early-stage technology development, 4) product development and 5) production/ commercialization (see Figure 16).

To enhance the transparency of the selection procedure, this report recommends the introduction of international peer review. In line with global good practice, international peer review is meant to ensure that candidates applying for public funding are evaluated on merit. But in Poland, local experts have exclusive access to the selection committees. The pool of qualified technical experts is small, and the identities of the reviewers are informally known. In short, the design of the selection procedure encourages patronage, which incentivizes reviewers to choose applicants that are likely to be their own reviewers at a later date. This assumption has been confirmed in interviews. The modernized selection system ought to capitalize on international peer review based on extensive research, industry, business and investment expertise, which should play a key role in the candidate evaluation process.

CHAPTER 5

Enterprise Development Program until 2020: a Constructive Evaluation

In the era of European smart specialization, Poland will need to continue adjusting the institutions, programs and instruments constituting its innovation system on an ongoing basis to make them "smarter" in line with evolving international practice. This chapter serves as an external assessment of the Enterprise Development Program (PRP)[3] until 2020, which is currently being finalized by the Polish Government. The PRP will define the basis of the new OPs in the areas of innovation, entrepreneurship and human capital. The chapter provides constructive feedback and forward-looking recommendations for reform.

The chapter is organized as follows. Before it dives into the evaluation of PRP, it offers a refresher of innovation policy principles. Next, it summarizes PRP's key objectives and policy proposals, highlighting major modifications to the existing system of enterprise development via innovation. Lastly, it builds a case for further evidence-based adjustments to the framework proposed by PRP and outlines a set of actionable next steps that Polish authorities could take in the immediate future with the World Bank's assistance.

Principles of innovation policy: aligning with good practice

Horizontality

Horizontality, or sector neutrality, is a globally recognized good practice in innovation policy. In today's dynamic and interconnected world economy, no single public sector institution can possess sufficient expertise to correctly identify all future technological and market trends and update policies fast enough for resources to flow into those sectors where national firms are competitive and capable of innovating on the global technological frontier. As an additional principle, prioritization in innovation policy can lead firms to invest in sectors where a country's advantage may be declining and/or posing obstacles to the emergence of novel strengths in non-prioritized but globally relevant sectors.

Efforts to transform the public R&D sector to reflect the enterprises' needs have been hampered by the legacy of heavy industrial planning common to many transition economies. In an emerging economy context, in particular, it is important to ensure that selection mechanisms espouse the principles of neutrality, transparency, independence and

3. Ministry of Economy of Poland, 2012 (forthcoming). Enterprise Development Program. Government document. Obtained by authors. Soon to be accessed at www.mg.gov.pl

merit while awarding scarce public resources to firms pursuing innovation and R&D. Ideally, a country of Poland's size should attempt to incorporate international scientific and private sector peer review into its public selection procedures, to improve the odds of financing the most innovative and commercially viable projects on the global scale.

Careful observance of these principles of global good practice should, over time, lead to the emergence of a critical mass of Polish enterprises innovating in internationally relevant technological niches. Moreover, targeted allocation of additional incentives for smart specialization — substantively, to sectors with strong public good nature, e.g. environmental or renewable technologies, and geographically, to laggard regions — could be justified as long as stringent measures of project selection for financing based on professional excellence and market relevance are applied.

Targeting risk and market failure: the "when" and the "how"

In the realm of innovation, public intervention is warranted when enterprises are at risk of market failure, which is typically at the early stages of the R&D and innovation process. Reasons for potential market failure can include underinvestment in R&D by the private sector, owing to the non-appropriability of spillovers, coordination failure or information asymmetry. The amount of public support should commensurate with the level of risk undertaken by the enterprise or the entrepreneur. The highest levels of support tend to be afforded at the earliest stages of technology development, where the risk of market failure is greatest.

In turn, the type of public intervention, i.e. the financing instruments via which support is distributed, must vary depending on the type of risk being incurred by the enterprise or the entrepreneur. Different instruments (e.g. grants vs. loans) should be applied to address technology and business risk.

Putting dogma to the test: from ex-ante to ex-post impact evaluation

Impact evaluation is an extremely valuable methodological tool allowing policy-makers to rigorously analyze the actual impact of policies and funding and experiment with program design. Conscientious policy-makers expend tremendous effort attempting to tailor international good practice, design close-to-perfect programs and adapt incentive schemes to their country context. As a result, it is not uncommon for them to defend their institutions, programs and measures even when expected results cannot be delivered. Integrating impact evaluation into PRP at the stage of instrument design could help prevent that, as it would allow policy-makers to test various hypotheses or policy approaches, e.g. regional vs. national selection of innovation projects, evaluation procedures with or without interviews, tax incentives vs. grants to stimulate enterprise R&D, collaborative international research, mentoring programs on start-up success or serial entrepreneurship, etc.

Measuring impact will matter particularly in the forthcoming era of European smart specialization. First, impact evaluation will prudently justify future public intervention by assessing the additionality of each public zloty spent. Moreover, it will facilitate a more rapid adjustment of the features of program design — or even entire measures — within a single operational programming cycle, to improve uptake and/or adjust impact. For Poland to complete the transition from traditional process and disbursement monitoring to evaluation of program impact on an ongoing basis, policy-makers in Brussels must render their full support and managing authorities in Warsaw must exercise leadership and spearhead efforts to introduce rigor.

OP IE diagnosis: learning from experience

The World Bank's *Enterprise Innovation Support Review* acknowledges the role that OP IE has played in piloting policies and devising financing instruments that got Poland's innovation system off the ground. The Polish government invested notable effort into stimulating the participation of the Polish private sector in innovation activities in hopes of sustaining the country's economic growth in the long run.

OP IE has achieved some valuable results, particularly in technological modernization. OP IE funding has expedited Polish enterprises' rate of absorption, which has helped enhance productivity of the real sector, especially during the recent financial crisis. Yet, the emerging consensus among opinion- and policy-makers is that in the future, Poland's economic growth will hinge upon the ability of the private sector to innovate on the global market. In this vein, it is strongly recommended that keener emphasis be placed on redesigning instruments and using structural funds in a way that will build a powerful domestic innovation pipeline and position Poland on the global intellectual property map.

PRP policy realignment: how much and how fast?

The proposed PRP is an important landmark for Polish innovation policy as it proposes crucial policy realignment and sets ambitious targets aimed at maximizing the potential for enterprise innovation via the deployment of 2014-2020 structural funds. PRP focuses on leveraging the enterprise sector's creativity to experiment with novel concepts and develop new technologies, products and services, as well as on fostering innovative entrepreneurship. The revamped PRP also seeks to facilitate critical relationships between micro-enterprises/SMEs and the banking sector in order to sustain enterprise modernization in the long haul.

PRP has recognized the evolving needs of the Polish economy by departing from direct grant funding for enterprise modernization and rechanneling grant funding into riskier ventures at the early stages of the innovation process. Crucially, PRP has acknowledged the impact that technology absorption will continue to have on productivity growth in Poland's enterprise sector. It has therefore proposed to incentivize the private banking sector to increase access to finances for SMEs pursuing innovative projects. Most significantly, perhaps, the proposed PRP has outlined a more long-term, fiscally prudent approach to public financing of technology absorption via revolving instruments, enabling future reinvestment of returned proceeds into other firms.

This evaluation starts with the suggestion that the main policy goal stipulated in PRP should be redefined as: *"[Achieving] a high and sustainable increase in the productivity of the enterprise sector, resulting in improved competitiveness on international markets, as well as maximization of the efficiency and impact of public funding on strengthening indigenous R&D and innovation."*

In general, the specific goals and targets proposed for each policy priority in PRP seem to be well-matched with instruments. Under this framework, if implemented, PRP stands a good chance of achieving its goals.

Transitioning to a more balanced use of grants and revolving instruments for technology upgrading may encounter initial resistance in both the implementation agencies and among beneficiaries and could even result in a temporary slowdown in the absorption of funding. Officials might "miss" the system because it has enabled Poland to utilize the structural funds under OP IE with efficiency unparalleled in other EU New Member States

(NMS). As for enterprises, they could object against the changes to the system because they have become familiar with the existing programs and even reliant on "easy" public money, developing a diminished appetite for loans. More hurdles stalling the proposed policy realignment may be posed by the banking sector's relative lack of willingness to take on what may potentially be perceived as riskier technology absorption. PRP does not offer an assessment of the banks' stance on the issue. Last, policy-makers should be concerned that no thorough estimates exist for the size and efficiency of the existing innovation pipeline. The Polish enterprise sector, hitherto focused on the use of funding for technological modernization, may not have developed the absorption capacity that would enable it to adequately respond to a rapid increase in grant funding for innovation projects. All of these concerns warrant serious consideration by officials involved in PRP implementation design.

To spearhead a gradual shift from technology absorption to genuine innovation, agencies in charge of the next OP IE cycle should be afforded greater flexibility in deciding how to distribute funding between various instruments. It is desirable to send a signal to firms by earmarking a greater percentage of total OP IE funds (40-50 percent) for instruments supporting enterprise R&D and innovation. The total amount of funding disbursed via these instruments should rise at a measured pace. It will take time for enterprises to become better acquainted with the system and for their absorption capacity to increase. The flexible portfolio approach on the part of the implementation agencies would ensure that in the event that Polish enterprises remain uninterested in R&D and innovation incentive programs, policy-makers are able to react by re-allocating funds to other programs that may reveal themselves as more necessary, such as revolving technology upgrading schemes, skills upgrading, technology transfer, business development services or research infrastructure.

PRP programs and instruments: evaluation and recommendations

PRP proposes seven different blocks of instruments focusing on the following issue areas: friendly business environment, innovation finance, human resources, cooperation, e-economy, efficient economy and internationalization.

While this policy mix seems to be in line with the main goals of the program, the upcoming sections will focus on PRP's core instruments in greater detail, in an attempt to provide decision-makers with feedback on the relevance of the respective instruments to the stage of the innovation process that they are aimed for as well to highlight causes for concern that they should be aware of as they proceed with instrument design.

R&D grants: leveraging private sector creativity and facilitating investment in innovation

The R&D grant instruments proposed under PRP appropriately target the earliest and riskiest stages of the innovation process, which typically involve technology-intensive start-ups. Although matching grant schemes for firms are not new to OP IE, the updated framework should be commended for devoting distinct attention to the critical stages of start-up and technology development, i.e. proof of concept, development and prototyping and pilot installations. An important instrument upgrade featured in PRP is the fundamental matching principle, i.e. the requirement of a contribution from entrepreneurs or their investors, as a demonstration of their inherent stake in and commitment to the venture. It would be desirable if this best practice principle were overtly highlighted in PRP.

The PRP also incorporates another sophisticated feature in the matching grant instrument: the declining matching contribution from the public sector, intended to mirror diminishing technological risk over time. This set-up by default requires an increasing

contribution from entrepreneurs and their investors at later stages where the primary risk is related to the viability of the business and not the new technology. As the need for public funding diminishes, entrepreneurs are encouraged to focus on building capacity through necessary interactions with market realities and private investors. The first two R&D grant schemes proposed under PRP — for industrial research, proof of concept and prototype development — can be classified as acceptable.

As for the third matching grant scheme, supporting pilot installations, it will be important to clarify whether the scheme will finance the establishment of physical pilot facilities (i.e. cover capital equipment expenditures) or the outsourcing of such activities. The proposed differentiation of the extent and character of support for SMEs and large companies is appropriate, but it is key to ensure that large firms remain eligible for R&D grants, as research maintains its risky character regardless of company size.

The matching grant programs targeting ESTD will benefit from a revamp of the selection processes, by engaging significantly more international expertise, resources and time. Some key features that should be incorporated in the modernized selection system include the international technical peer review, as well as extensive research, industry, business and investment expertise, which should play a key role in the candidate evaluation process. From this perspective, the current selection procedures employed under the OP IE framework are inadequate. Integration of the abovementioned elements into the existing system would raise the bar and increase the probability of selecting truly entrepreneurial ventures that are innovative in the global context, boost the beneficiaries' chances of developing connections to international financiers and improve prospects for commercialization. PRP also proposes to include public administration representatives in the evaluation system. This review argues that while public officials would be a welcome addition, their role should initially be limited to observation that would inform policy articulation and program design. It should neither introduce undue political or sectoral pressures nor detract from the objective of merit-based selection of projects.

The current proposal to consolidate applied R&D financing schemes under one institution, e.g. NCBiR, is desirable. Such consolidation is warranted owing to issues of scale and should enhance the effectiveness of future capacity-building efforts. Furthermore, empowering the institution's investment committee to engage in risk-based grant making would be a major institutional architecture enhancement that would improve the odds of financing innovative ventures. The key operational principles that ought to be espoused by any selection committee under NCBiR — or any other institution implementing private enterprise support mechanisms — include: addition of private sector professionals with international commercial expertise, transparency of the application and selection procedures, obligation to complete the selection process within a short timeframe (60-90 days maximum) and independence from interest groups in the decision-making process.

This will require that policy-makers at all institutions holding a stake in the Polish innovation system develop a shared understanding of the innovation process, as well as the principles of sound selection, couched in global good practice. The Ministry of Economy, Ministry of Science and Higher Education, management teams at the various implementation agencies, e.g. NCBiR and PARP, national audit bodies such as NIK and, finally, the Ministry of Regional Development, which is currently responsible for monitoring and evaluating program impact, must demonstrate knowledge of: sound commercial practices of private sector professionals, the trial and error nature of R&D and the risk levels associated with early stages of technology-oriented entrepreneurship. This goal requires further elaboration in PRP. Substantiation of commitment by Polish authorities will need to find its way into operational documentation and procedures of the implementing agencies. Moreover, regulatory changes will be needed to fully ensure that selection committees within implementation agencies can pursue risk-based financing.

The description of the "system guide" proposed by PRP ought to be revised. PRP suggests the introduction of a two-stage selection process with a comprehensive "system guide" for applicants to rectify the reigning information asymmetry. The current description of the procedures can be misleading and would benefit from revision. The selection process itself would consist of a single phase. The system guide ought to be envisioned as a consultation mechanism, providing non-binding information on various non-reimbursable and revolving instruments. It should not be intended to serve as an actual selection round, per se.

The evaluation process should find a way of complementing "paper-based" modes of selection with interviews and presentations. Advising against the inclusion of interviews, PRP authors rightly note that they are likely to prolong the evaluation process and increase operational costs. Yet such obstacles can easily be overcome in an efficient institutional environment, for instance by engaging professional program managers. Importantly, experience from other countries suggests that early interactions between entrepreneurs and selection bodies often prove pivotal, as they allow entrepreneurs to acquire invaluable feedback on their business model, thus improving their future prospects for commercialization or helping them abandon projects that may already be under implementation elsewhere. Moreover, the empirical wisdom gathered from entrepreneurship programs suggests that successful entrepreneurs, particularly serial entrepreneurs, are often those who have had to abandon previous failing ventures, gone on to accumulate critical experience and develop resiliency through a string of failed attempts at entrepreneurship, to "make it" in the end. Public support cannot have a myopic focus that is limited to the specific venture or enterprise. Face-to-face interaction, therefore, is more than justified in the broader context of entrepreneurial mentoring and attempts to build real and lasting entrepreneurial capacity.

Preferential schemes: cooperation, smart specialization and regional convergence

The proposed PRP would benefit from an upfront presentation of the rationale for preferential schemes. Mission statements should be head-on in identifying the bottleneck being addressed, i.e. promotion of technology transfer or research commercialization, cooperation between international and local industry, cooperation between diaspora/foreign investors and Polish researchers via co-patenting, pursuit of subject-oriented platform-based research, support for entrepreneurial activity in laggard Polish regions or internationalization.

It is advisable that R&D grant funding earmarked under the OP IE framework adheres to a single set of rigorous national selection procedures and standards. A set percentage of additional funding (e.g. 10-30 percent) can be afforded to those public policy objectives such as internationalization (i.e. collaborative research involving Polish and foreign firms), regional projects, specialization in competitive sectors, etc., which may emerge from the regular rigorous selection process. Moreover, in the short-term, the system would benefit from specialized incentive schemes for nascent regions, which can stimulate R&D while policy-makers address the long-term structural problems of private sector development, which lie outside the realm of research and/or innovation policy per se. Those could range from skills shortages, to regional investment climate barriers and/or infrastructure aberrations necessary to activate regions with latent or unconfirmed competitive advantages.

Revolving instruments for technology absorption: towards sustainability

In order to transition innovation policy away from non-reimbursable instruments towards revolving financing instruments for technology absorption, PRP makes a quintessentially progressive policy move. Loans, rather than grants, are considered a more efficient and sustainable instrument of satisfying the permanent technology upgrading need of Polish enterprises. The associated efficiency gains include the speed with which financial intermediaries are able to issue financing decisions, owing to the lower level of technology and often also business risk associated with the introduction of new technologies or the implementation of later stage proven R&D projects by established enterprises. By contrast, non-reimbursable grant programs supporting the riskiest stages of R&D and innovation, especially in new companies, require more stringent due diligence. Evidence suggests that loan programs by nature do not attract truly innovative high-risk projects and for this reason they should never be considered as a replacement for R&D grant programs by policy makers, even in the long haul.

The appeal of revolving instruments lies in the greater renewability of these schemes. Loans repaid by enterprises or guarantees unused by financial intermediaries can be implemented or reinvested beyond the duration of any single programming period. Revolving instruments can also help establish credit history for a larger segment of Polish firms with financial intermediaries, thereby significantly reducing the current reliance on technology upgrading subsidies. Loan and loan guarantee programs recently piloted under JEREMIE could potentially observe greater uptake if they were adequately adjusted to the financing gap and/or collateral constraints afflicting Polish firms across sectors, if they identified and addressed the excessive risks faced by banks, and if they were coherently marketed to financial intermediaries.

Important principles that should be integrated in the design of revolving instruments include: targeting of specific structural problems, be they credit liquidity in the banking sector, collateral constraints faced by firms or inability of financial intermediaries to conduct technological risk screening; maintaining incentives for proper due diligence in assessments of business risk and creditworthiness of financial intermediaries; preserving existing private financial institutions active on the Polish market, and adopting instrument design based on changing market and economic circumstances.

In accordance with these principles, three features of the instruments proposed under the PRP framework deserve careful reconsideration during the design/implementation phase: (a) lowered interest rates, (b) deferred grace periods and (c) guarantee levels. The introduction of lowered interest rate loans, even at the stage of implementation of post-prototype projects, would need to be rethought to avoid unnecessary competition with traditional private sector credit lines, as it remains unclear whether or not higher interest rates actually reduce entrepreneurs' access to bank finance for technology absorption or R&D implementation projects. Again, if the technology risk is sufficiently high, relevant projects could be considered for matching grant programs, albeit with a lower public matching contribution, reflecting the lower risk levels. On the other hand, more lenient grace periods for projects with longer implementation phases, generally associated with assimilating technologies previously unknown to the company or unavailable in Poland, are more easily justified. With regards to the loan guarantee mechanisms, it will be crucial to ensure that guarantee levels do not distort the financial intermediaries' incentives to conduct relevant creditworthiness checks and rigorous due diligence vis-à-vis firms. Con-

siderations during the design/implementation phase should also include the introduction of the stop-loss mechanism for the initial 20-30 percent of an investment, with investments made on a pari passu basis with the intermediary. Experience suggests that introduction of high level guarantees (say suggested 80-100 percent) create a lax environment and that slippages on due diligence by intermediaries do occur, which increases the aggregates of non-performing loans. Hence, re-assessing the design's details will be necessary to prevent the excessive non-performance of loan guarantee schemes.

R&D tax incentives: a real relief, for whom, and when?

PRP proposes tax incentives as a supplemental instrument promoting the uptake of R&D activities by the private sector. PRP's justification for the introduction of tax incentives in Poland is the prevalence of similar schemes across several OECD countries where the observable share of private R&D and innovation is significantly higher. At present, national statistics indicate negligible R&D spending by firms in Poland. But the implementation of complex R&D tax incentive schemes has a mixed track record in Poland, complicated further by strained relations between tax authorities and smaller enterprises. For micro-enterprises and SMEs, the opportunity cost of tax inspections is significantly higher, and they are more susceptible to discretionary pressures. Hence, PRP's stated objective of depicting Poland as the fifth most generous country with respect to R&D tax credits from among the 24 countries surveyed appears somewhat misplaced.

More importantly, PRP authors astutely note the primary relevance and applicability of tax incentives to larger and more mature revenue-generating firms. The authors acknowledge the irrelevance of tax incentives for pre-revenue start-ups that are unable to claim tax deductions, and they duly highlight the immediate importance of R&D grant schemes for the entrepreneurial community focused on the early stages of the innovation process. Tax incentives can, indeed, serve as substitutes for grants, without the additional institutional expenses associated with maintaining grant programs and their selection bodies, etc. But the question remains whether tax incentives make sense in an environment where OP IE can continue to generously finance private R&D via grant schemes for the foreseeable future.

This review suggests that tax schemes can benefit larger, more established enterprises, and if clearly communicated as such, their introduction will not create disillusionment among early-stage start-ups. Given that in Poland, it is larger companies that primarily engage in R&D, the introduction of tax incentives could be justified as a means of creating spillovers in the budding R&D services sectors whilst still heeding EU state aid rules. It is suggested that the tax scheme be as simple as possible, ideally based on a flat rate for R&D deductions. This review would support the proposed experimentation with R&D tax credits, which could be fiscally neutral at a minimum if piloted and financed via OP IE or potentially positive if the tax credit experiences a draining uptake by larger firms within the trial period. The authors of this assessment would also support the scheme if the impact of the tax instrument were rigorously evaluated against the R&D grant program, specifically in the case of large companies that are expected to be the primary beneficiaries of the tax scheme.

The authors of this review acknowledge the motivation behind PRP's proposal to establish an institution pre-certifying R&D expenses to reduce uncertainty for the firms about to undertake R&D based on the tax incentive scheme. However, it is imperative that any institutional procedure of this sort espouses the clearest possible eligibility criteria for expenditures. Otherwise it risks becoming cumbersome and could end up reducing the appeal of what is envisioned as a simple tax instrument for innovative firms. It is suggested that any such institutional arrangement is consulted with a relevant focus group prior to implementation. If the tax incentive scheme is introduced, the Ministry of Finance needs

to be engaged in finalizing the eligibility criteria and supporting the pilot via a certification unit that could be spun off pending a successful trial period. The ministry should also remain involved in further operational modifications post pilot.

Incubating start-ups: the need for a revolution

PRP describes the shortcomings of start-up incubation in Poland with welcome candor and highlights the need to professionalize incubation management to promote early stage innovation evenly across the country and offset regional disparities. Most of the VC fund managers that were interviewed for the purpose of this report currently do not regard Poland's incubation system as a source of any meaningful project deal-flow. PRP seeks to prevent the emergence of a two-speed incubation system that favors startups from flourishing urban centers at the cost of those from laggard regions, which are in dire need of mentoring to realize their commercialization potential. Unless this scenario materializes, incubation institutions based in larger, prosperous academic centers such as Poznan, Krakow and Wroclaw, which are already bustling with ideas and start-ups, will continue to thrive, whereas those in under-developed regions might deteriorate in the absence of a strong pipeline and potentially become hostage to local interest groups.

Several factors will need to be considered in the instrument design phase: incentives with the greatest potential to facilitate new start-ups and develop existing incubators, pairing and phasing of instruments at different stages of incubation and the support/project cost ratio. In the incubation phase, which typically lasts three to four years, there are two main ways to support R&D with an absolute value of up to EUR 250,000: a) higher support for firms inside an incubator (maximum 85 percent), and b) lower support for firms outside an incubator (maximum 65 percent).

The use of public support instruments should reflect and address the differing needs of existing incubators and start-ups. Incubators need to expand their services, focusing on companies that are scaling-up their operations. At the moment, existing incubators mostly engage in renting real estate and providing basic administrative, legal and accounting services to its incubatees. Incubators and start-ups alike are, for the most part, ignored by leading investors who do not perceive them as institutions that generate a scalable deal flow or a pipeline of investable projects. Hence, in order to facilitate a shift and stimulate focus on service provision, PRP ought to consider support for two types of incubators, tailored to the technological intensity of the recipient companies: a) technological incubators focused on high-tech start-ups and b) business incubators providing services to companies from low-tech and mature sectors.

To deliver marketable output, Polish incubators will need to complement venture funding to qualified enterprises with services that are necessary to bring new technology from the lab to the market. Experience from developed, technologically advanced economies, like the US and Israel, suggests that incubators do well using venture capital. In Poland, however, support for "clusters" under OP IE 3.1 and 3.3.2 is wedged into grant support for "networks" under OP IE 5.1. Partly as a result of this arrangement, Poland only has 40 to 50 viable incubators, of the 180 existing ones. Therefore, PRP must ensure that incubators and technology parks build sufficient capacity and either develop in-house venture-investing skills (or tap into those readily available within the community), to support the commercialization of ideas developed in their startups.

At the regional level, the support system ought to focus on fostering local entrepreneurship, while decision-making on R&D project funding should be reserved to central authorities. This is perceived as an optimal solution, given the relative scarcity of the know-how and expertise needed to assess the quality of high-risk R&D and innovation projects in the regions. The centralization of R&D spending could enhance the quality of the chosen projects, but it is imperative to ensure that no selection bias is applied against projects from less

developed parts of Poland by earmarking specific amounts of funding for different regions. The ultimate objective for Poland is to develop globally innovative technologies regardless of the location while also supporting entrepreneurs nation-wide.

This assessment recommends that a multi-prong approach to improving efficiency of the incubation system also involves a national system of benchmarking, a national level technical assistance program focused on improving management skills and competitive national tendering. First, a unified method of classifying incubators would enable policy-makers to start using institutional typologies (based on management practices, mentoring programs, track record of commercialization, ROI, etc.). This would give implementation agencies a better sense of the needs and issues facing incubators across Poland. The second measure could help build capacity and support qualifying entrepreneurs via a combination of international study tours and twinning programs. Competitive national tendering should support the emergence of professional management teams. Finally, the incubation system and the abovementioned suggestions for its upgrading should be subject to impact evaluation.

Internationalization: supporting Polish globetrotter firms

PRP rightly proposes to strengthen support for a broad range of internationalization activities targeting beneficiaries from within existing SME exporter groups and knowledge-intensive business services, through to technology-intensive start-ups seeking a soft landing. The rationale for these programs is to buttress incumbent and non-incumbent exporters through both financial instruments, e.g. export credit loans, and non-financial programs, designed to promote new market and client reconnaissance, trade fairs and international market exposure in order to boost Poland's exports share globally.

Going forward, the Government of Poland should reflect upon the following considerations about program evaluation. Experience suggests that thorough evaluation is necessary when a country is piloting multiple parallel internationalization programs, which often have an overlapping mandate. It is imperative that any program that firms can access on a continuous basis, e.g. subsidized credit products or annual trade fair participation, introduces relevant targets allowing program managers to track the performance of the supported firms. In the case of subsidized financial support, incumbent export firms could be evaluated via methodologically rigorous comparisons with average exporters in the given sector, geographical market, etc. When it comes to non-financial programs, one-off support to enterprises could be treated more leniently. The impact of these programs takes time to translate itself into visible results, especially as it often includes decisions not to enter certain markets, which may prove themselves right in the end. Over time, program evaluation would allow policy makers to introduce more sophisticated internationalization programs such as technology extension programs to achieve quality requirements in more advanced export markets and design packages better suited to the needs of exporters based on firm age, firm size, sector, etc.

Risk capital funds: empowering and capitalizing KFK

Poland does not suffer from a pronounced equity gap that continues to trouble many of its CEE neighbors and even some West European states. The problem has been partially addressed through the establishment of a unique and noteworthy feature of Poland's innovation system: KFK. KFK, a fund of funds, with a current investment cap of EUR 1.5 million, has hitherto supported the establishment of over 10 new venture capital funds targeting innovative high-growth Polish companies.

The primary policy consideration is the proposed increase in KFK's investment limit up to EUR 2.5 million. While KFK's funding is aimed at SMEs, the most successful SMEs in the portfolios of VC funds capitalized by KFK are likely to need additional capital. Raising the limit for follow-up investment would increase flexibility when it comes to company growth. Yet such a step should not be taken at the discretion of any single VC fund manager. Rather, an exception should be requested by the VC fund and approved by KFK on a case-by-case basis. KFK ought to develop clear policies enabling such exceptional investments above EUR 1.5 million and submit them for approval to the managing authority. Experts have pointed out that isolated decisions to raise the investment limit will only have a negligible impact on increasing the inflow of KFK's capital into innovative Polish SMEs. As KFK, a fund of funds, is not a direct investor into SMEs, capital absorption largely depends on the intermediary VC funds' ability to become operational and start investing prudently.

If KFK's ceiling is lifted, PRP proposes earmarking 40 percent of the increased bulk of funding for high-risk ventures and 60 percent for companies with potential for high growth. Conceptually, it is critical that PRP clearly states that KFK cannot allocate its funds to seed, early-stage and expansion projects directly, but merely via its VC funds. KFK should propose how it would envision the mechanism for ensuring that a higher percentage of its capital is invested in seed and early-stage SMEs. One possible approach might be holding a tender dedicated to VC funds exclusively in this niche.

Proposals for the development of specialized VC funds focused on investment in sectors including but not limited to biotech and nanotech could be pursued in line with the smart specialization strategy. Yet due consideration should be given to whether there is private sector support on the market for such funds. If so, constraints on the development of specialized VC funds and the extent of public support that would be required to attract private investment in them should be carefully assessed.

In conclusion, Poland has experienced phenomenal growth rates, even during the recent financial crisis, yet its track record with regards to enterprise innovation, an internationally recognized source of sustainable economic growth, has remained unimpressive. It is of fundamental importance for decision-makers to boldly support the necessary and aggressive prioritization of innovation financing as proposed in PRP.

Human talent and skills: the super-glue of the innovation system

PARP as the main enterprise innovation support agency maintains that the development of specialized skills remains one of its over-arching goals, but in reality PARP appears legally limited in its ability to provide training. Though strengthening the business environment and building management skills are of great importance, SMEs often require hands-on, interactive support from seasoned business professionals, and PARP is legally obliged to avoid direct personal interaction with entrepreneurs in a systemic effort to diminish the potential for charges of favoritism and corruption. Smaller emergent business advisory service providers that entrepreneurs can seek out often do not have the essential capacity and know-how needed to advise effectively on the strategic and operational aspects of the business, especially in the regions.

Poland should conceive programs promoting international circulation of research and entrepreneurial talent to build a sustainable innovation pipeline. This could include: scholarships for Polish researchers to study abroad, ideally at leading global universities; specialized incentive schemes to attract Polish diaspora to return home; modernized immigration policy designed to entice international researchers and entrepreneurs to establish their base in Poland; vouchers for R&D personnel expenses; and support to Polish technology

firms to participate in international technology conferences, trade delegations and study tours.

Expected impact on the socio-economic development of Poland

Implementation of PRP should help reduce the perceived threat of economic slowdown, which could be caused by diminished investment in infrastructure, an aging population, difficulties with balancing public finances, the unfulfilled potential of R&D and challenges associated with regulation and law enforcement. Capitalizing on the strengths and comparative advantages of the domestic market, including large size, growing domestic demand, improvements in the development of human capital and favorable geographical location, PRP can help Polish companies and industries leverage R&D and innovation to enhance their competitiveness and play a significant role in the globalizing economy.

Coherence with other strategic documents

PRP, as an action plan of the Strategy for the Innovativeness and Effectiveness of the Economy, is focused on the implementation of four key objectives: (i) adjustment of the financial and regulatory environment to the needs of innovative and efficient economy, (ii) stimulation of innovation through increased efficiency of knowledge and labor, (iii) increased efficiency in the use of resources and (iv) internationalization of the Polish economy.

In the light of the abovementioned set of goals, PRP creates a coherent framework for the creation and development of innovative enterprises. The instruments described in the Program focus on creating a more favorable environment for entrepreneurs, strengthening entrepreneurship, enhancing the quality of human capital in the field of innovation and adaptability, supporting innovation and R&D, strengthening cooperation between entrepreneurs and scientists, promoting internationalization of business and striving towards sustainability.

PRP's goals are well aligned with the broader framework of Polish development policy, both in terms of Polish strategic documents, in particular the Polish National Reform Program, and the Europe 2020 Strategy. PRP will pursue four of eleven thematic objectives spelled out in the draft regulations for the EU financial perspective 2014-2020: promotion of research, technological development and innovation (objective 1), improving the competitiveness of small and medium-sized enterprises (objective 3), supporting the transition to low-carbon economy in all sectors (objective 4) and investing in education, skills and lifelong learning (objective 10). With this type of approach, complementarity and synergy of activities, as well as greater efficiency in the use of financial resources, will be ensured.

Given the early developmental stage of the EU's Smart Specialization Strategy, this review finds PRP's suggested approach acceptable. The authors concede that PRP and the eventual choice of policies, programs, instruments and related operational documentation could undergo considerable revision to accommodate the national and regional consensus emerging from the RIS3 consultation processes and the actual amount of funding allocated under OP IE.

Piloting the new OP IE: actionable next steps with the World Bank's support

Re-designing instruments of enterprise innovation

The World Bank team is readily available to assist with OP IE policy, program and financing instrument design for the 2014-2020 funding cycle. Based, in part, on the findings of this report, the World Bank can help review and redesign revolving instruments to finance capital investments, including JEREMIE loans and loan guarantee products managed by BGK that are not experiencing the expected uptake. The World Bank team could assist with the revamp of matching grant programs and introduction of royalty-bearing R&D grants to assess long-term grant effectiveness and generate resources for a potential revolving fund. It can also review Poland's incubation system and assess the need for and the feasibility of developing a national certification system, as well as conduct technical assistance programs to build capacity in national implementation agencies and design impact evaluation procedures where possible.

Capacity building in implementation agencies: upgrading PARP and NCBiR

The World Bank can also establish a hands-on twinning framework for capacity building between the Polish Agency for Entrepreneurship and Development (PARP), the National Center for Research and Development (NCBiR) and similarly mandated agencies elsewhere. Depending on the future institutional set-up in Poland, it could involve a single institution or a combination of institutions from abroad, including the Office of the Chief Scientist in Israel; CORFO Chile; TEKES, Finland; various manufacturing extension programs in the US, etc. The exercise would aim to facilitate an exchange of know-how and educate a cadre of experts well equipped to champion and apply best practices. PARP and NCBiR as the two main enterprise innovation support agencies are the primary targets. NCBiR, which reports to MoSHE, has already shown interest in the initiative and secured funding from the EU-funded OP HC.

Legislative review: identifying barriers to risk-based financing

The World Bank team also offers to conduct a legal review in order to propose relevant legislative changes that would actively encourage risk-based behavior by implementation agencies in the process of selection of innovative R&D projects for public financing.

Impact evaluation: integrating feedback mechanisms into innovation strategies

The World Bank team is also ready to help incorporate impact evaluation, highlighted during the RIS3 workshop as crucial, into the innovation system. From a macro-perspective, Poland is one of the countries best predisposed on the national and programmatic level to integrate impact evaluation methodologies into the institutional architecture of the innovation system. The World Bank team could assist the MoRD with doing so. It could also engage the managing authorities in implementation agencies in specialized impact evaluation and organize policy design workshops in preparation for smart specialization.

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ANNEX 1

Key Stakeholders and Beneficiaries

Government Officials

- Ministry of Economy (MoE)
- Polish Agency for Enterprise Development (PARP)
- Ministry of Science and Higher Education (MoSHE)
- National Centre of Research and Development (NCBiR)
- Ministry of Regional Development (MoRD)
- National Capital Fund (KFK)
- National Economy Bank (BGK)
- Central Statistical Office (GUS)
- Commercial Court Division of the Ministry of Justice
- Patent Office
- Chancellery of the Prime Minister

Consulting Firms

- Deloitte
- Portfel

Beneficiary Firms (Interviewed)

- General Motors Poland (Motor vehicles, MNC subsidiary)
- BBI Zeneris (Investment fund)
- General Electric Aviation (Aircraft engines, MNC subsidiary)
- Columbus Prime (Food products, large Polish firm)
- Vitaulic (Basic metals and fabricated metal products, MNC subsidiary)
- Globema (IT, Polish SME)
- Top Gan – Blue Laser Technologies (Optical instruments, Polish SME)
- Gajos Fashion (Services for apparel industry, Polish SME)
- EcoWipes (Cotton products, Polish large firm)
- Price Waterhouse&Cooper Services (IT, MNC subsidiary)
- Asseco Poland (IT, Polish MNC)

ANNEX 2

Summary of Innovation Support Programs Financed by the EU and the Government of Poland

EU-funded programs						
Program	**Action**	**Implementation body**	**Goals**	**Recipients**	**Projects**	**Budget (EUR million)**
Innovative Economy	1.1.	**Ministry of Science and Higher Education** (MoSHE)	Orientation of scientific research on fields important for economic development and the knowledge-based economy	NCBiR, RDIs, regional governments	• Foresight initiatives • Projects for strategic planning in science policy • Key research projects	1,846
	1.2.	MoSHE	Developing human capital in science and R&D	Foundation for Polish Science, RDIs, individual recipients: students, graduates, PhD students and active scientists	• Research projects carried out by students and prospective young scientists • International cooperation	400
	1.3.	MoSHE	Widespread application of innovative solutions essential for the economy	RDIs, universities	• Projects in applied sciences and extra-mural R&D • Refunds of patent and patent-related costs	1,363
	1.4.	MoSHE	Increasing innovative capacity of enterprises through intra-mural R&D	Enterprises	• R&D projects in enterprises (research phase, until a prototype is created)	1,315

EU-funded programs *(continued)*						
Program	**Action**	**Implementation body**	**Goals**	**Recipients**	**Projects**	**Budget (EUR million)**
Innovative Economy *(continued)*	2.1. 2.2.	MoSHE	Development of research infrastructure in RDIs with high research potential	Universities, RDIs, NCBiR	• Construction works (laboratories, buildings and infrastructure) • Purchase of specialized equipment • Developing research infrastructure for sharing and common use	4,132
	2.3.	MoSHE	Securing access to advanced ICT infrastructure for scientific institutions and international scientific networks	Universities, NCBiR, specialized local institutions	• Development of advanced ICT infrastructure • Purchase of advanced software and IT products • Development of public databases of scientific outcomes	1,027
	3.1.	**Ministry of Economy** (MoE)	Increasing the number of innovative enterprises	Business environment institutions	• Services for newly founded enterprises • Equity-based support for newly founded enterprises	436
	3.2.	MoE	Increasing access to external sources of financing at early stages of innovation	KFK, VC funds Target: innovative and R&D-based SMEs	• Support for KFK • Public support for VC funds	714
	3.3.	MoE	Creating favorable conditions for cooperation between private investors and finance-seeking entrepreneurs	Business environment institutions, SMEs	• Promotion activities • Advisory and consulting services	199
	4.1.	MoE	Increasing the innovative capacity of firms	Enterprises	• Commercialization and implementation of R&D outcomes created under OP IE 1.4.	1,549
	4.2.	MoE	Strengthening enterprises engaged in R&D, popularizing industrial design as a competitive advantage	Enterprises	• Private R&D projects • Projects aimed at developing own industrial / functional designs	739
	4.3.	MoE	Supporting implementation of modern technologies	SMEs	• Reimbursable support ("technological credit") for implementation of own or acquired technologies	1,335

EU-funded programs *(continued)*						
Program	**Action**	**Implementation body**	**Goals**	**Recipients**	**Projects**	**Budget (EUR million)**
Innovative Economy *(continued)*	4.4.	MoE	Supporting new investments and consultancy and training projects related to innovative technological solutions	Enterprises	• Purchase of new innovative technologies • Support for related marketing activities and organizational changes	5,931
	4.5.	MoE	Increasing competitiveness and innovative capacity of enterprises	Enterprises	• Large innovative investments	4,065
	5.1.	MoE	Improving competitiveness of enterprises, supporting cooperation between enterprises and business environment institutions, incl. RDIs	Enterprises, institutions engaged in creating networking activities	• New networking initiatives • Developing existing, inter-regional networking initiatives	414
	5.2.	MoE	Facilitate access to high-quality services necessary for innovation	PARP, Institute of Industrial Design, Patent Office	• System projects, performed by government agencies	261
	5.3.	MoE	Creating innovation centers in areas with high growth potential	Business environment institutions	• Consulting services — promotional activities • Modernization of technological infrastructure	754
	5.4.	MoE	Improving the effectiveness of the innovation market and the flow of innovative solutions	SMEs, Business environment institutions	• Financial support for patent and patent-related costs • Promotion of intellectual property rights	155
	8.1.	**Ministry of Internal Affairs** (MoIA)	Promotion of e-services	Newly founded SMEs	• Setting up e-services	1,551
	8.2.	MoIA	Supporting cooperation between entrepreneurs based on ICT platforms (B2B)	Enterprises, mainly SMEs	• Implementation of IT solutions for the purpose of cooperation between entrepreneurs	1,830
Human Capital	2.1.	**Ministry of Labor and Social Policy** (MoLSP)	Improving the skills of entrepreneurs and employees that are necessary for adaptation to a knowledge-based economy	Enterprises, institutions engaged in human capital development	• Consulting and training • Postgraduate education • Promotion and information	2,002

EU-funded programs *(continued)*

Program	Action	Implementation body	Goals	Recipients	Projects	Budget (EUR million)
Human Capital *(continued)*	2.3.	MoLSP	Improving the quality of services provided by institutions promoting entrepreneurship and innovation	PARP	• System projects: supporting specialized services with training, promotion of management and quality standards, incl. KSI and KSU	420
	4.2.	MoSHE	Improving skills of academic staff in R&D to assure effective collaboration between science and business	Enterprises, universities and RDIs	• Training for R&D staff	244
Eastern Poland Development	1.1.	PARP	Preparing universities for active participation in a competitive economy	Universities, local governments	• Construction works • Purchase of equipment	1,576
	1.2.	PARP	Improving access to external sources of financing at early stages of innovation-oriented activity Improving willingness to invest in SMEs	SMEs (target group)	• Setting up guarantee funds	93
	1.3.	PARP	Improving conditions for economic activity, esp. development and diffusion of innovations	Universities, local governments, RDIs, enterprises	• Construction works and R&D equipment purchases by RDIs and enterprises • Setting up technology transfer centers • Infrastructure for investment zones	1,457
	1.4.	PARP	Facilitating cooperation between various parts of eastern Poland	Polish Information and Foreign Investment Agency (PAIIZ), business environment institutions	• Promotional activities • Databases and systems for exchange of information between enterprises	47

Non-EU funded programs

Program	Implementation body	Goals	Recipients	Projects	Budget (EUR million)
National Capital Fund	**National Economy Bank** (BGK)	Increasing access to capital for SMEs, supporting start-up and seed initiatives, facilitating involvement of private investors	VC funds, SMEs	• Investments in VC funds • Investments in enterprises (equity)	253
Key R&D projects	**Polish Federation of Engineering Associations** (NOT)	Fostering private R&D to launch new products or adopt new technologies	SMEs	• Private R&D, focus on application	70

Non-EU funded programs *(continued)*					
Program	**Implementation body**	**Goals**	**Recipients**	**Projects**	**Budget (EUR million)**
Tax deduction for innovation	MoE	Supporting adoption of new technologies, increasing private R&D expenditure	SMEs, enterprises designated as R&D centers	• Purchase of new technologies, extra-mural R&D payments and other knowledge is eligible for tax deduction of up to 50% of costs • Creating tax-free "innovation funds", no larger than 20% of revenues, to finance recipient's R&D activity	68
Database of technologies	MoE	Creating a database of resources and achievements of RDIs attractive to entrepreneurs	RDIs	• Setting up a database	0,07
Patent Office	Patent Office	Simplifying and reducing costs of patent procedures	Patent Office	• Creating an e-services platform for enterprises, along with comprehensive patent registration and databases	
Patent PLUS	MoSHE	Supporting technology transfer, promoting intellectual property and patenting, fostering cooperation between RDIs and enterprises	RDIs, enterprises	• Support for patenting (patent and patent-related costs) • Dissemination of information on intellectual property and patenting	5
Innovation Creator	MoSHE	Facilitating cooperation between business and science	Universities, RDIs, technology transfer centers	• Facilitating commercialization of research outcomes • Creating procedures for intellectual property management • Setting up research databases in universities	16
Technological Initiative I and IniTech	NCBiR	Facilitating cooperation between business and science, creating highly innovative products and technologies	Enterprises, RDIs, business-RD consortia	• Applied science projects • Commercialization and technology implementation • Purchase of innovative consulting services	403

Non-EU funded programs *(continued)*					
Program	**Implementation body**	**Goals**	**Recipients**	**Projects**	**Budget (EUR million)**
Loans for innovation	PARP	Increasing enterprises' innovative capacity	SMEs and micro-enterprises	• Purchase and implementation of R&D outcomes • Purchase of technology or equipment • Construction work	7
Product of the Future	PARP	Promotion and dissemination of innovative technologies and solutions created by Polish researchers	Enterprises, RDIs, individual inventors	• A contest for innovative technological solutions	No data
Voucher for Innovation	PARP	Facilitating cooperation between SMEs and micro-enterprises and RDIs	SMEs, micro-enterprises	• Purchase and implementation of R&D products • Development of own products and technologies	35
Technology Credit	BGK	Facilitating and financing technology transfer	Enterprises (preferably SMEs)	• Purchase of innovative technologies	

Notes: budgets are in PLN m (current prices).
Source: IBS based on official detailed descriptions of relevant programs, regulations and other documents.

ANNEX 3

A Comparison of Polish and Central European Enterprises on the Basis of Productivity, Economic Performance and Innovation Capacity

TABLE 1.1 Polish and Central European Enterprises in Regional Perspective: Productivity, Economic Performance and Innovativeness

Code	Sector	TFP	Labor productivity	VA share	Export share	Innovation expenditure	Innovative companies	Reduce labor cost	Improve quality of goods
C10-C12	Manufacturing of food, beverages and tobacco	+	+	+	+	=	–	+	=
C13	Manufacturing of textiles	–	–	+	+	–	–	=	+
C16	Manufacturing of wood products	=	–	=	+	+	–	–	–
C17	Manufacturing of paper products	–	=	=	+	+	–	+	=
C20	Manufacturing of chemical products	–	–	–	=	–	–	+	=
C22	Manufacturing of plastic products	–	=	–	+	–	–	+	=
C23	Manufacturing of nonmetallic mineral products	+	+	=	=	–	–	+	=
C24	Manufacturing of basic metals	=	+	–	=	=	–	=	–
C27	Manufacturing of electrical equipment	=	=	–	–	–	–	+	=
C28	Manufacturing of machinery n.e.c.	+	+	–	–	–	–	=	–
C30	Manufacturing of transport equipment	–	–	–	=	–	–	+	–
C32	Manufacturing n.e.c.	+	=	+	+	–	–	–	–
F	Construction	+	=	+	n/a	n/a	n/a	n/a	n/a
G	Trade & repair of vehicles	=	–	+	n/a	+	–	–	=
G46	Wholesale trade	–	–	+	n/a	+	–	–	=
G47	Retail trade	=	–	+	n/a	n/a	n/a	n/a	n/a
H	Transport	+	=	–	n/a	n/a	n/a	n/a	n/a
I	Hotels and restaurants	=	–	–	n/a	–	–	=	–
J&H53	Post and communication	+	+	=	n/a	+	=	–	–
J62	Computer services	–	–	=	n/a	n/a	n/a	n/a	n/a
M w/o M72	Other professional activities	–	–	–	n/a	–	–	+	–
M72	R&D	–	–	–	n/a	n/a	n/a	n/a	n/a
N	Other business activities	+	=	–	n/a	–	–	+	–

Notes: "**+**" means that Poland has competitive advantage over neighboring countries in this area, "**–**" means a competitive advantage of comparator countries over Poland, "**=**" means that there is no significant difference between Poland and comparator countries, "n/a" means no data exist or not applicable for a given sector; For the three last variables, Poland is compared with Czech Republic.
Source: IBS based on AMADEUS data and Eurostat (CIS, EU KLEMS).

Industry-level Productivity Analysis in Poland in a Comparative Perspective

The aim of the following appendix is to offer an in-depth analysis of the efficiency of the production processes dominating in Polish enterprises from a regional comparative perspective. To this purpose, it will thoroughly examine productivity across sectors and over time, employing static and dynamic analytical tools.

The core initial sections of this supplemental analysis focus on TFP and labor productivity estimates, pitting Poland against peers from Central Europe and France, chosen as an approximation of the EU-15 as well as a point of reference for the comparison of patterns of productivity development. The next part of the analysis extends the comparison by exploring the relationship of productivity performance with VA and exports. Lastly, dynamic aspects of productivity development are also considered, although the nature of the dataset only allows for a limited inquiry.

As for data and methodology, productivity estimates have been obtained from the micro-economic data in the AMADEUS dataset, and they have been correlated with available macro-economic information, including VA and exports generated by each industry. Methodological considerations are reviewed in the introduction.

Methodological considerations

In recent years there has been a surge in the number of studies utilizing firm-level and plant-level data for the analysis of productivity and its covariates. As van Beveren (2011) notes, this can be attributed to two factors: an increased availability of high-quality firm-level data and substantial advances in econometric methods used to estimate and analyze productivity (most often in the form of TFP) on the microeconomic level. Estimates of TFP have been used to evaluate the impact of different policies and events, such as trade liberalization (Pavcnik, [2002], De Loecker, [2007]), anti-dumping protection (Konigs [2008]), corporate taxes (Arnold & Schwellnus [2008]) and increases in foreign ownership (Smarzynska & Javorcik [2004]). Though the literature has swelled, there is a distinct empirical gap in cross-country studies of firm-level productivity.

Hence, this section plans to focus on cross-country and cross-sectoral differences in productivity levels in CEE. To this purpose, the AMADEUS database has been used. AMADEUS is a comprehensive, pan-European database of comparable information about public and private companies.

Before the appendix proceeds with the analysis, several methodological issues have to be considered. First, despite widespread coverage, the AMADEUS database cannot be con-

sidered representative for all of the countries of interest. Although the sectoral structure (in terms of VA or employment) fits the national accounts very well, the firm size structure in the database reflects the actual enterprise structure in the economy less well. SMEs and micro-enterprises are considerably under-represented in AMADEUS, and the extent of their coverage also varies between countries. For example, the number of French micro-enterprises included in the dataset is satisfying, but in the case of most Central European countries, AMADEUS focuses on SMEs and large enterprises. Furthermore, the relatively large number of missing values for relevant variables greatly reduces the size of the final sample used to estimate total factor productivity. Strictly speaking, the representativeness of any results obtained through the analysis is ensured only in the case of enterprises for which it was possible to compute total factor productivity (Arnold & Schwellnus [2008]).

The next methodological concern is that despite a large initial sample size, the final sample used for the productivity estimation was too small to enable selected cross-country analyses. In particular, some sectoral sub-samples were too diminutive to serve as a basis for reliable comparisons. For instance, only four large Hungarian manufacturers of textile and textile products were included in the final sample. The representation of large manufacturers of wood and wood products was similarly low in the case of Hungary. In contrast, more than 250 large textile manufacturers made it into the final Polish sample.

Total Factor Productivity (TFP) serves as a measure of productivity throughout the analysis. Labor productivity is also used for validation and comparison where needed. The latter is calculated as a ratio of VA to the number of employees, while the former is estimated econometrically. Though various methods for calculating firm-level TFP have been developed, we restricted our analysis to the Levinsohn – Petrin (LP) method (Levinsohn & Petrin [2003]), (Levinsohn, Petrin & Poi [2003]). To account for sector heterogeneity and retain cross-country comparability of results, estimation is carried out separately for each NACE-31 sector (consistent with the classification used by Eurostat in the EU KLEMS data-

BOX. A.1 Sampling procedure

The comprehensive database that the authors received from the World Bank consisted of 33 country datasets, including all EU member states (except for Luxembourg and Cyprus), Ukraine, Russia, the Balkans and the remaining members of the European Economic Area. Initially, it was assumed that total factor productivity estimation would be carried out for all NMS-12 countries plus France or Germany as useful reference points in productivity analyses and approximations for the European frontier.

The exact composition of the sample was supposed to be determined after the cleanup of the database. First, all observations with missing values were dropped from country datasets. Second, all observations with non-positive values for inputs and outputs were also excluded from country-level datasets. Next, outliers (e.g. extreme changes in inputs or outputs) were flagged and removed. Datasets have also been scanned for other possible sources of bias (for instance, enterprises in liquidation or bankrupt firms as well as one-employee enterprises were deleted). Due to the substantial role of public ownership and a low number of observations, the manufacture of coke, refined petroleum and nuclear fuel was removed from the sample. Because of different financial reporting standards, financial intermediation was also omitted. Finally, due to a comparatively poor coverage of micro-enterprises, especially across Central Europe, all enterprises with less than ten employees were dropped from the sample.

After the tidying up, country datasets with sufficient coverage were pooled together. To ensure comparability between countries and employment size classes, TFP estimation was carried out separately for each NACE section and all sub-sections of manufacturing. After the estimation, the bottom and top percentiles of the estimated total factor productivity per each country–sector group were flagged as outliers and excluded from the sample. The estimation procedure was then repeated with the reduced sample.

Out of the planned twelve countries (NMS-10 except for Cyprus and France or Germany), seven made it into the final estimation sample. They included: the Czech Republic, Germany, France, Hungary, Poland, Slovenia and the Slovak Republic.The Baltic countries, as well as Malta, had to be removed due to poor (Estonia) or zero (Malta, Latvia and Lithuania) coverage.

base). To guarantee comparability across country datasets, all financial variables have been converted into EUR and deflated using country- and sector-specific deflators.

Productivity in Poland: patterns and trends

The aim of the following section is to conduct an in-depth analysis of patterns of development in firm-level productivity in Poland across sectors and over time. The inquiry will also examine the productivity gap in Poland in comparison with regional peers in Central Europe (Czech Republic, Hungary, the Slovak Republic and Slovenia).

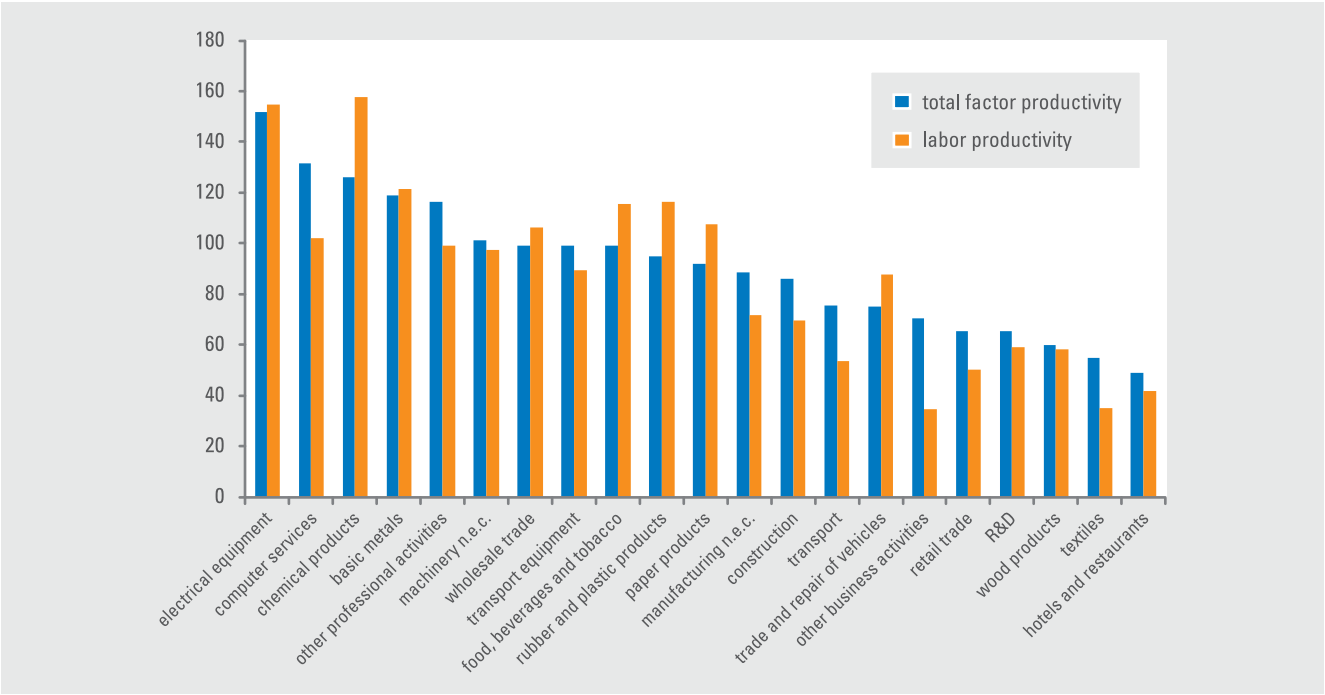
Before the section delves into the analysis of productivity differentials between countries, it is important to take a closer look at productivity differentials within the country. In Poland, productivity (both labor productivity and TFP) varies considerably between sectors and industries (see Figure A.1)

Levels of productivity in Poland

The highest levels of productivity in Poland are observed in firms in knowledge-intensive services (excluding research and development) and in certain industries, mainly high-tech and medium-high tech manufacturing. The former group includes computer services, telecommunications, and scientific and professional activities; while the latter consists of industries such as manufacturing of non-metallic mineral products, of transport equipment paper, of pulp, of chemicals and of chemical products, as well as print media. For instance, the average TFP in chemical industries or computer services pitted against the national average is 150 percent.

On the other hand, relatively low levels of productivity have been reached by enterprises in low- and medium-low tech manufacturing. The sectors in question include man-

FIGURE A.1 Labor Productivity and TFP Rise in High-tech Industries and Knowledge-intensive Services



Notes: on the vertical axis, the national average for each measure of productivity equals 100. On the horizontal axis, two outliers (with relative productivity levels higher than 200) were excluded: manufacturing of non-metallic mineral products and post and telecommunications, to make the graph more comprehensive.
Source: the AMADEUS database.

ufacturing of wood and wooden products as well as of textiles and textile products (about 70-60 percent of the national average), transport services and retail trade (80 percent), hotels and restaurants (about 50 percent), construction and trade and repair of vehicles. The same pattern in productivity development can be found in all countries included in the analysis — industry-level productivity relative to the national average is highly correlated regardless of the chosen measure of productivity.

Levels of productivity in Poland in a regional and European perspective

As the examination of productivity dispersion within the country does little to expose cross-country differences, a productivity gap has been calculated for each sector. It is defined as the ratio of TFP in Poland and the comparator countries to TFP in the benchmark country, which, in this case, is France, as the structure of its economy and its level of productivity closely resembles the EU-15 average (following Caselli & Tenreyro [2005] and IBS [2011]). Germany was also considered as a reference point, but ultimately, the size of the final sample and the insufficient coverage of firms smaller than 250 employees turned out to be unsatisfactory.

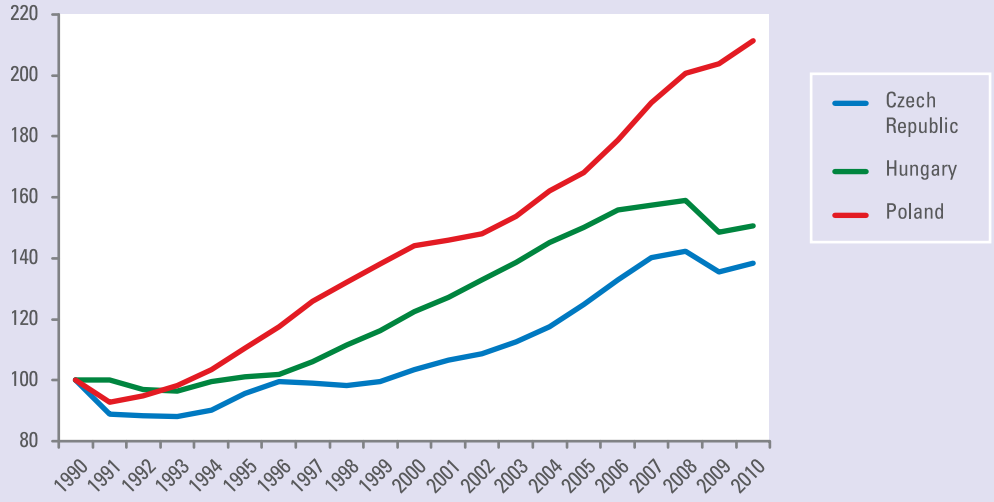
The average level of productivity in Poland, calculated from firm-level data, equals to 33 percent of the French average, which indicates that the country is a regional laggard. From a comparative viewpoint, the productivity levels in the Czech Republic and Hungary have reached 40 percent and 60 percent of the French average, respectively. Yet the proximity to the French benchmark varies greatly across sectors. In general, sectors with the lowest productivity gap tend to be in low-tech and medium-low tech manufacturing and traditional services (as opposed to knowledge-intensive services). Notable exceptions include post and telecommunication services and manufacturing of nonmetallic mineral products, which both exhibit very low values of the productivity differential (or conversely, very high proximity to the benchmark), indicating that when it comes to these sectors, Poland has converged with France. On the other hand, average productivity in sectors such as manufacturing of wood, of wood products and of furniture, transport services and hotels as well as restaurants, has only reached 50-70 percent of these sectors' average productivity in France. The ratio for medium-high tech and high-tech manufacturing (transport equipment, machinery, n.e.c.) and knowledge-intensive services (R&D, computer services and other professional and scientific activities) is even more unfavorable, barely reaching 25 percent.

Therefore, mindful of patterns common in developed economies, we can conclude that sectors constituting Poland's national frontier diverge from the international productivity benchmark more than their counterparts in low-tech manufacturing and less knowledge-intensive services. In terms of total factor productivity, the relationship between the proximity to France and the productivity level (relative to national average) tends to be negative or even non-existent (see Figure A.5). On the other hand, if labor productivity is considered instead of TFP, we detect a positive relationship between productivity and the proximity to French enterprises (see Figure A.6). This discrepancy can be attributed to capital accumulation. While the simpler measure (labor productivity) captures only the differences in the use of labor, total factor productivity considers main inputs, labor and capital. This finding indicates that in high-tech industries catching up is based on capital accumulation less than in low- and medium-tech sectors. This phenomenon might illustrate the fact that it is much easier to absorb technologies through capital accumulation in low- and medium-tech sectors than it is in high-tech sectors.

BOX A.2 Productivity and economic growth in Poland: a macroeconomic perspective

In the last two decades Poland has experienced — on average — high growth rates of both product per capita and labor productivity (measured as product per hour worked). In fact, Poland's economic growth in the past 20 years has been unparalleled in the CEE region (see Figure A.2). At the same time, the overall level of investment was lower than in other CEE countries, not to mention Korea or Japan, which noted historically unmatched levels during their convergence periods. Hence, it is possible to conclude that the main factor behind Poland's GDP growth in the decades after transition was TFP growth, while capital and labor inputs have had a discernible impact only during the last five years.

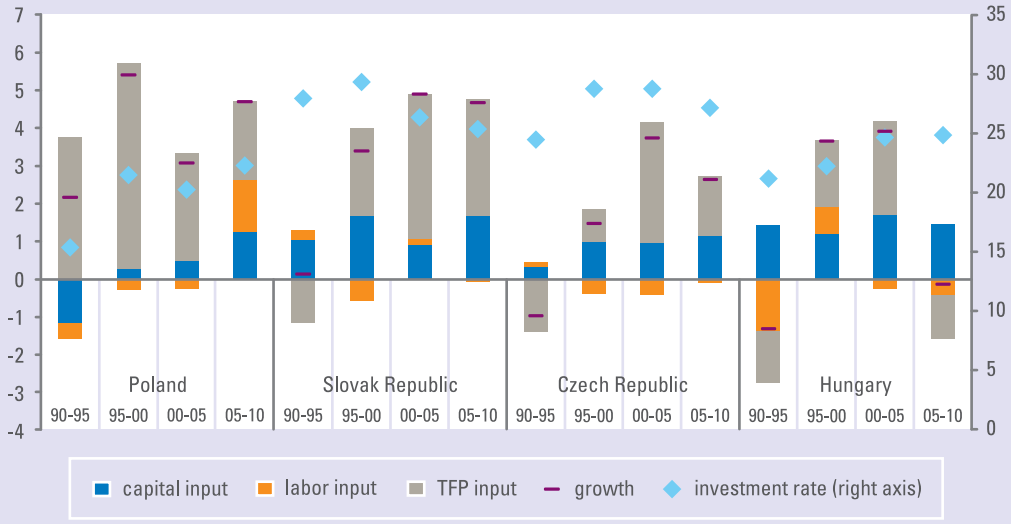
FIGURE A.2 Poland Is the Frontrunner in GDP per Capita Growth in CEE



Notes: the vertical axis depicts GDP per capita values as percentages. The horizontal axis plots them over time (1990 = 100).
Source: OECD.

This pattern of economic development can be partly attributed to the mode of Poland's economic transformation. In the early 1990s, it was deeper and more rapid than in the Czech Republic, Hungary or the Slovak Republic. It was also more dynamic (see Figure A.2), as Poland embarked on its growth path earlier than its neighbors. Therefore, the potential for growth was larger due to the organizational and structural changes.

FIGURE A.3 Poland's GDP Growth Is Driven by TFP



Notes: the figure evaluates the input of capital, labor and TFP (expressed as yearly averages in percent) into GDP growth in the Czech Republic, Hungary, Poland and the Slovak Republic. The left vertical axis represents the input into GDP growth in percentage points. The right vertical axis depicts the investment rate to GDP. The horizontal axis differentiates between four periods in the four countries: 1990-1995, 1995-2000, 2000-2005 and 2005-2010. Calculations are based on 1990-1995 estimates.
Source: IBS 2011 based on EUROSTAT data.

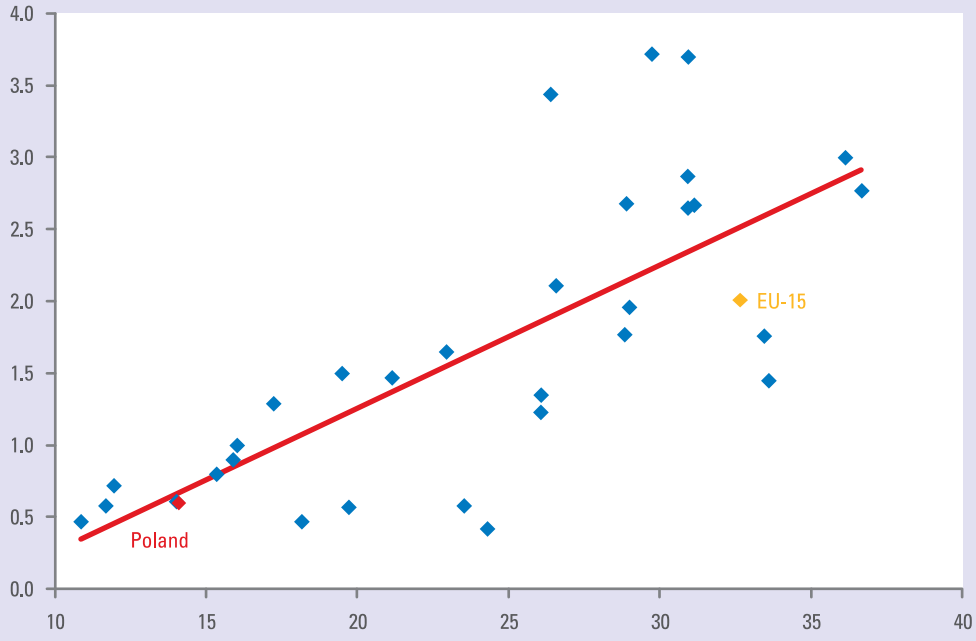
TABLE A.1 Average Annual Growth Rate of GDP Per Capita and Labor Productivity in Selected EU Countries and the US

	Average annual GDP per capita growth (percent)		Average annual labor productivity growth (percent)	
	1991-2000	2001-2010	1991-2000	2001-2009
Austria	2.1	1.1	2.3	0.7
Denmark	2.2	0.3	2.2	0.6
Finland	1.7	1.5	2.7	2.0
France	1.6	0.5	2.2	0.3
Spain	2.5	0.7	0.8	0.6
Netherlands	2.5	0.9	0.8	0.4
Ireland	6.4	0.8	4.8	2.6
Germany	-0.6	0.9	0.6	0.6
Sweden	1.7	1.5	2.7	1.0
United Kingdom	2.3	0.9	2.9	1.3
Italy	1.5	-0.3	1.9	-0.4
EU-15	1.5	0.7	1.7	0.6
Czech Republic	0.3	3.0	2.9	3.6
Estonia	6.6	4.1	no data	4.7
Poland	3.6	4.0	5.9	2.9
Slovak Republic	3.6	4.7	5.5	4.2
Slovenia	1.9	2.4	0.0	0.0
Hungary	2.3	2.1	1.8	2.4
United States	2.2	0.8	1.9	2.0

Notes: GDP per capita PPP, labor productivity as product in PPP per hour worked, time periods 1991-2000 and 2001-2010, values in percent.
Source: IBS 2011, based on Eurostat, OECD and KLEMS.

From a long-term perspective, however, Poland will require substantial increases in R&D spending and innovation expenditures to sustain high rates of growth. As the economy continues to expand, levels of R&D spending rise nonlinearly, as more developed countries spend a larger share of GDP on research and development. Hence, the relationship between GDP per capita and the share of R&D expenditures is unequivocal (see Figure A.4), especially in the long run. It must be noted, however, that a number of countries (most notably Spain) managed to converge while experiencing only modest increases in R&D spending.

FIGURE A.4 Poland Needs To Catch Up with EU-15 in R&D Expenditures



Notes: the horizontal axis shows GDP per capita in thousands of PPS in 2008 in a sample of 35 countries (EU-27, EFTA, US, Japan and Korea). The vertical axis depicts total expenditure on R&D as a percentage of GDP in 2008.
Source: IBS based on Eurostat.

FIGURE A.5 Poland's Slower Convergence with EU-15 in TFP

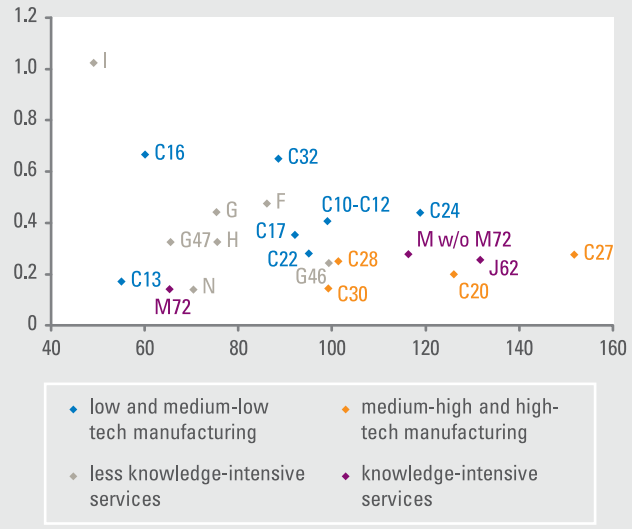
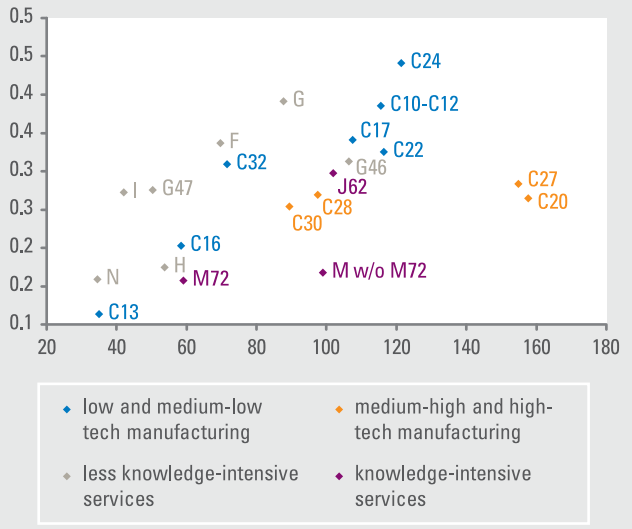


FIGURE A.6 Poland's Faster Catching Up with EU-15 in Labor Productivity



Notes: the vertical axis denotes proximity to the benchmark calculated for each sector as a ratio of average productivity in Poland and the average productivity of the same sector in France in 2008. The horizontal axis depicts productivity in different sectors relative to the national average (Poland = 100). Industry classification based on Eurostat (2010).
Source: own calculations based on AMADEUS data.

Productivity dynamics in Poland

Productivity dynamics have risen in importance over the last few years, as Poland has been experiencing rapid labor productivity growth in aggregate terms. The average growth of output per person was higher than in EU-15 countries, which helped close the productivity gap between Poland and advanced OECD and EU countries. Significant convergence has also been identified on the micro level. AMADEUS data suggest that between 2004 and 2008, the distance from the benchmarks in TFP has been decreasing by 8 percent on average. However, productivity growth differs substantially across sectors. In several cases the differences between Polish firms and their West European counterparts actually increased in the period of 2004-2008.

In terms of TFP growth, Poland has made a big stride towards catching up with the EU-15 in most manufacturing industries, while less knowledge-based services sectors have continued to lag behind. While manufacturing, excluding manufacturing of chemical products and plastic, has steadily crept up towards the EU average, most services sectors, including all less knowledge-intensive ones, have stagnated or diverged from their French counterparts in terms of productivity, with the exception of post and telecommunications as well as business services. Labor productivity differentials signal a similar pattern. Most manufacturing industries have approached the international standard (see Figure A.7 and Figure A.8), while the majority of the services sectors have been experiencing lower productivity growth than has been common in Western Europe (see Figure A.7 and Figure A.8).

Importantly, the data analysis has uncovered an inverse relationship between the proximity to France in 2004 and relative productivity growth in 2004-2008. Sectors and industries with a shorter initial distance to France have been experiencing more modest growth or even a decline relative to that benchmark. On the other hand, sectors with lower initial levels of productivity have been expanding faster. As a result, we can observe that while certain sectors of the Polish economy were converging in terms of relative productivity, those of them that were more productive (relative to Western Europe) on the outset have been growing more slowly than those that lacked the head-start and had to close a wider

FIGURE A.7 TFP Convergence Marked by the Delayed Ascent of Services

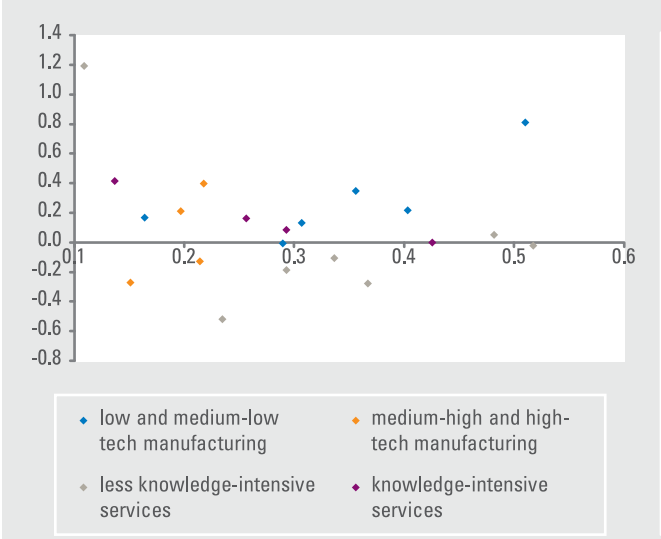
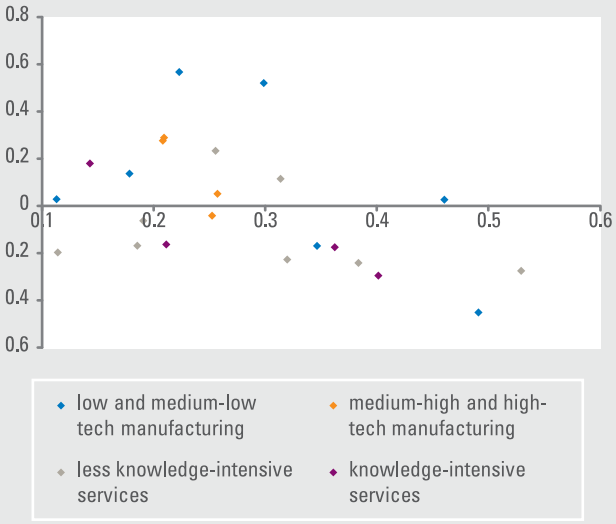
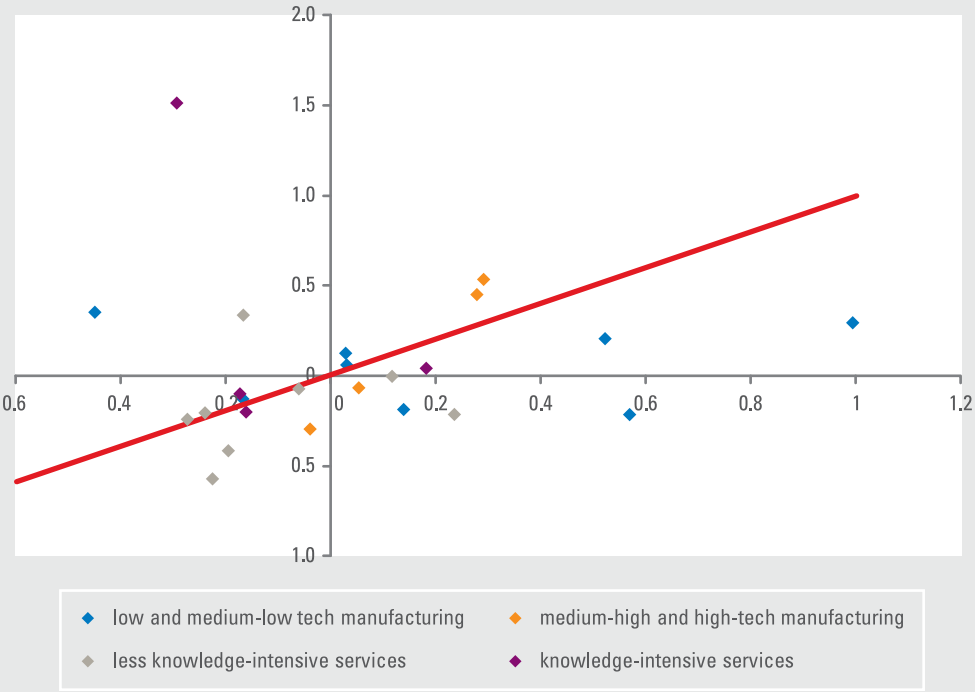


FIGURE A.8 Labor Productivity Convergence Characterized by the Head-Start of Manufacturing



Notes: the vertical axis depicts relative productivity growth in 2004-2008 (in terms of initial proximity to France); the horizontal axis shows proximity to France in 2004 calculated for each sector as a ratio of average productivity in Poland and the average productivity of the same sector in France. Industry classification based on Eurostat (2010).
Source: own calculations based on AMADEUS data.

FIGURE A.9 Poland is Catching Up with EU-15 Evenly in TFP and Labor Productivity



Notes: the vertical axis shows TFP growth in 2004-2008 (in terms of proximity to France), while the horizontal axis depicts labor productivity growth in 2004-2008 (in terms of proximity to France). Proximity was calculated as the ratio of productivity in Poland and productivity in France, adopted as a benchmark for this study. Industry classification based on Eurostat (2010). The red line connects the points at which the relative change in proximity to France is equal for both measures of productivity. Therefore, in sectors positioned above the line, TFP grew faster, while in sectors located below the red line, labor productivity grew faster in 2004-2008.
Source: own calculations based on AMADEUS data.

gap. The effect is more pronounced in labor productivity than in total factor productivity (see Figure A.7 and Figure A.8), which, again, suggests that capital formation has most probably played an important role in Poland's economic growth in select sectors — a conclusion in line with insights from the previous section and macroeconomic evidence.

The hypothesis that ascribes the uneven convergence across sectors to capital accumulation is partly confirmed by the changes in labor productivity and total factor productivity alone (Figure A.9). Except for a few outliers, in 2004-2008 the growth rate of labor productivity has not been significantly lower — and at times, even higher — than the growth rate of total factor productivity in 2004-2008. The conclusion indicates that most Polish sectors, especially the majority of the manufacturing industries, have been catching up by virtue of capital accumulation, i.e. increases in the capital stock per employee (see Box A.3).

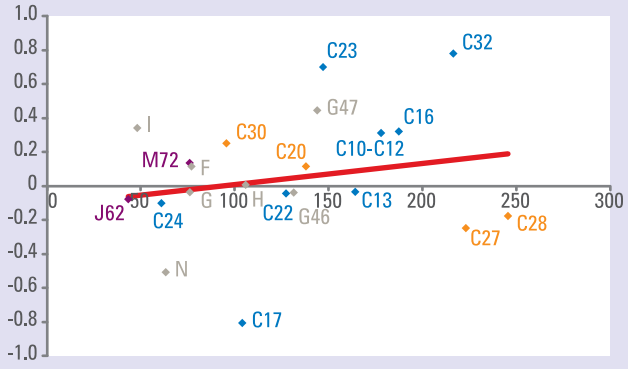
BOX A.3 Capital accumulation and productivity growth: a brief excursion

The role of capital in industry-level economic convergence must not be under-stated. Changes in capital stock are the most likely explanation for the observed differences in TFP and labor productivity rates of Poland's convergence with France. To test the hypothesis, we analyzed the distribution of capital intensity across industries and sectors and compared it to productivity growth. To ensure consistency, all relevant variables were computed using firm-level data (the AMADEUS database). Comparable macroeconomic data on capital stock proved to be difficult to obtain.

In confirmation of the initial hypothesis, it turned out that capital per employee growth in 2004-2009 was strongly correlated with TFP and labor productivity growth in the same period. Yet the data indicate that the positive relationship between labor productivity growth and capital per employee growth is significantly stronger (see Figure A.10 for illustration).

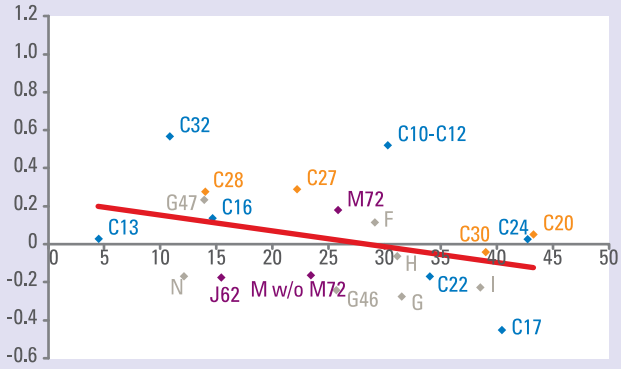
One can also note that the initial value of per employee capital stock is a good predictor of future labor productivity growth rate, as industries with low levels of capital have experienced higher capital accumulation rates and thus higher rates of labor productivity growth.

FIGURE A.10 Capital Intensity Growth Stimulates Labor Productivity More than TFP Growth



- low and medium-low tech manufacturing
- medium-high and high-tech manufacturing
- less knowledge-intensive services
- knowledge-intensive services

FIGURE A.11 Labor Productivity Growth is Strongly Linked to Capital Intensity Growth



- low and medium-low tech manufacturing
- medium-high and high-tech manufacturing
- less knowledge-intensive services
- knowledge-intensive services

Notes: the vertical axis depicts capital intensity growth in 2004-2008 (Figure A.10) and capital intensity in 2004 (Figure A.11). Capital intensity is defined as the value of fixed assets (EUR, real prices) per employee. The horizontal axis shows labor productivity growth (Figure A.11) and the difference in percentage points between labor productivity growth and total factor productivity growth (Figure A.10). Industry classification based on Eurostat (2010). All industry codes are listed in the Appendix.
Source: own elaboration based on AMADEUS data.

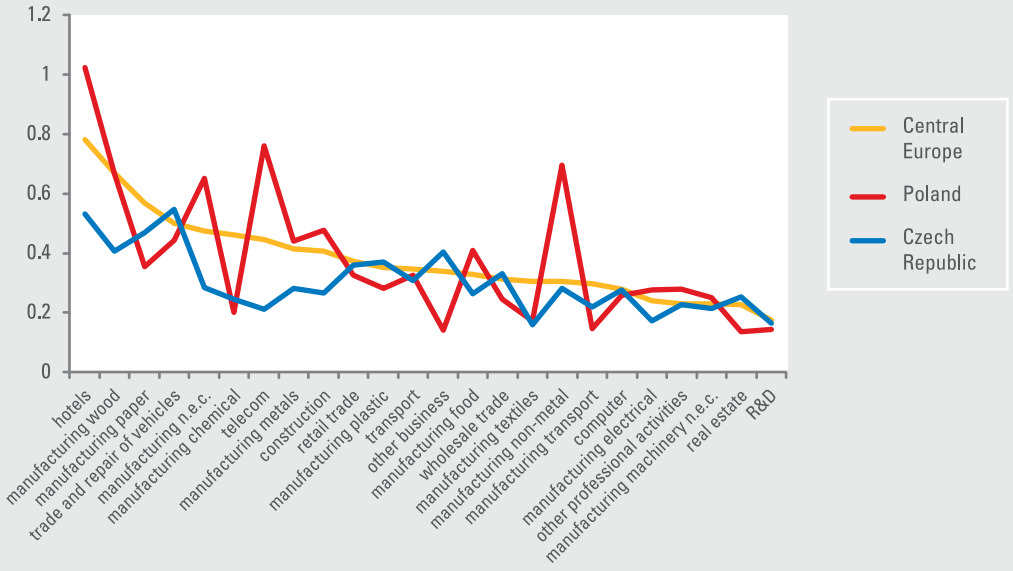
Productivity dynamics in Poland in a regional perspective

It is crucial to relate Poland's experience to those of similarly positioned economies, especially as comparisons between Poland and advanced Western economies might be misleading or incongruous due to the different structures of the economies or due to the different patterns of development. Poland's neighbors (i.e. the Czech Republic or Hungary) are natural reference points and — from another angle — natural competitors on the international markets. Identifying areas in which Poland is lagging behind its peers is an important step towards flagging industries and sectors that should be of great interest to decision-makers as they identify priorities of industrial and innovation policy.

The regional comparison indicates that while Poland might exhibit a higher overall level of total factor productivity, there are certain industries that trail behind when compared to other countries. For instance, Polish firms in sectors such as manufacturing of furniture, of wood and wood products and telecommunications are significantly more productive than their Czech counterparts. On the other hand, a significant difference in productivity — in the favor of Czech enterprises — has been noted in transport services, manufacturing of food products and of rubber and plastics. However, the variation in productivity is subtle, and differences rarely exceed 15 percent, suggesting that the Czech Republic's head-start is not substantial.

Overall, Poland's levels of productivity compare well to most neighboring countries in the CEE region. Figure A.12 depicts TFP proximities of Poland and the Czech Republic to the average for four CEE countries. Slovenian levels of productivity are considerably higher across all industries, which is not surprising, given that Slovenia is more developed and wealthier than Poland. On the other hand, productivity levels estimated for Bulgarian and Romanian enterprises indicate that differences between these two countries and the other new EU members are significant.

FIGURE A.12 TFP Proximities to France in Selected Sectors in Poland, Czech Republic, and CEE Highlight Notable Sectoral Divergence



Notes: the vertical axis estimates TFP proximity to France in the Czech Republic, Poland and CEE in selected sectors as a ratio of average TFP in the given sector and average TFP in the same sector in France (France=100). The proximity for CEE is the ratio of average TFP in Hungary, the Slovak Republic, Slovenia and the Czech Republic and average TFP in France. The horizontal axis depicts a variety of sectors.
Source: own calculations based on AMADEUS data.

FIGURE A.13 Poland is in Line with Regional Trends in TFP Convergence

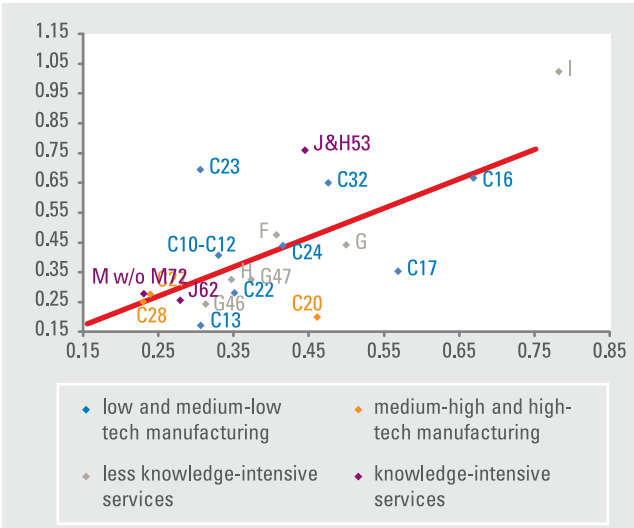
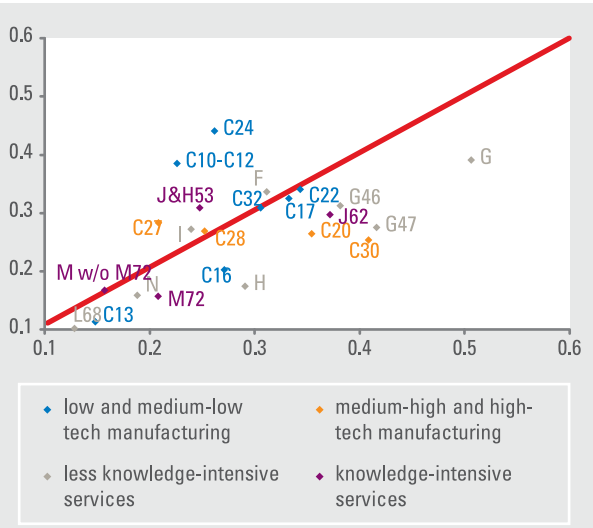


FIGURE A.14 Poland and CEE are Aligned in Labor Productivity Convergence



Notes: proximity to France is calculated as the ratio of TFP in Poland (vertical axis) and Central Europe (horizontal axis) to TFP in France. Industry classification based on Eurostat (2010). The red line represents equal proximity to the benchmark, therefore in sectors positioned above the line, proximity to the benchmark is smaller in Poland, and in sectors located below the line it is smaller in Central Europe.
Source: own calculations based on AMADEUS data.

Overall, similarities between Poland and the comparator countries are striking. Industries and sectors more productive in comparator countries are also the ones where Poland has reached higher levels of productivity (with the exception of manufacturing of non-metallic mineral products and of chemical products). In high- and medium-high tech industries, the level of productivity across the region should be classified as uniformly low in comparison to Western Europe.

Distinguishing between two-digit NACE industries and services sectors sheds more light on the nature of the differences in productivity between Poland and its regional peers. Polish industries and sectors can be divided into three categories according to productivity:

a. Industries whose productivity levels are characterized by *greater distance from the international benchmark*. In manufacturing, this has been true for textile and chemical industries, pulp and paper as well as motor vehicles and other transport equipment. In services, Poland has a comparative disadvantage in wholesale and retail trade, research and development information services and publishing.

b. Industries in which the Polish level of productivity is *on par with that of its peers* (i.e. the differences are small or there is no consistent pattern across comparator countries). This category includes, for instance, the manufacturing of rubber and plastic, of basic metals and of fabricated metal products as well as manufacturing of other machinery. The list of services in this category includes trade sectors, hotels and restaurants, architectural and engineering activities and computer services.

c. Industries where productivity levels suggest that Poland holds *a comparative advantage* in the CEE region. In manufacturing, this applies to food and beverages, nonmetallic mineral products and furniture. In some services sectors, Poland has also been performing consistently better than its peers, namely in specialized construction activities, postal and courier activities, telecommunications, information services and management and consultancy services.

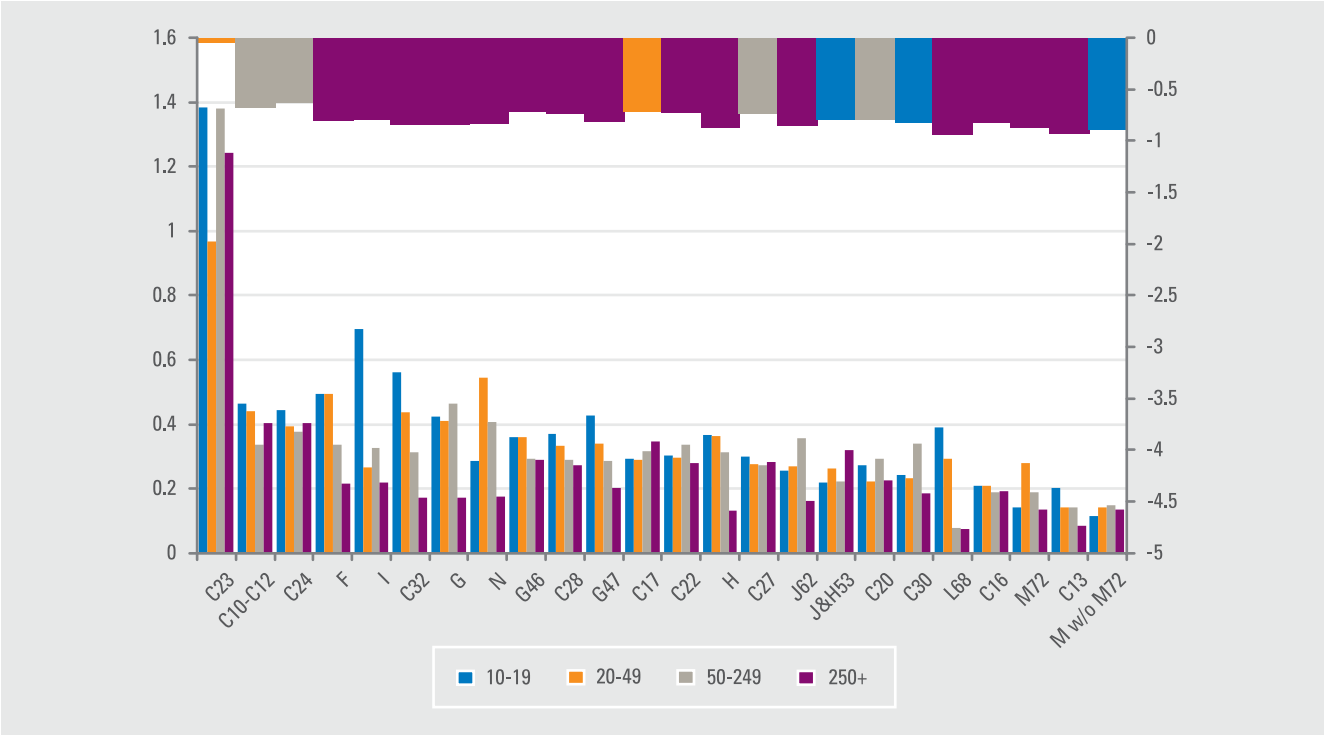
The poor performance of Polish firms in many knowledge-intensive services (for instance, R&D, computer services and other professional services) is a cause for concern. Furthermore, there is no meaningful relationship between the proximity to France and the differences with comparator countries. Contrary to prior expectations, firms operating in sectors characterized by the highest productivity gap are not lagging behind their Czech and Hungarian counterparts more significantly than firms operating closer to the benchmark. In this sense, the sectoral distribution of productivity differences between Poland and comparator countries is sector-specific and not systemic.

Productivity and firm size in Poland and comparator countries

Further analysis was conducted to determine whether the proximity to France depended on enterprise size. Most empirical studies suggest that firms of various sizes play different roles in innovation systems. Hence, the existence of significant size-specific differences between Polish firms and enterprises from other countries, if proven, would highlight problems in the innovation system that could otherwise go unnoticed.

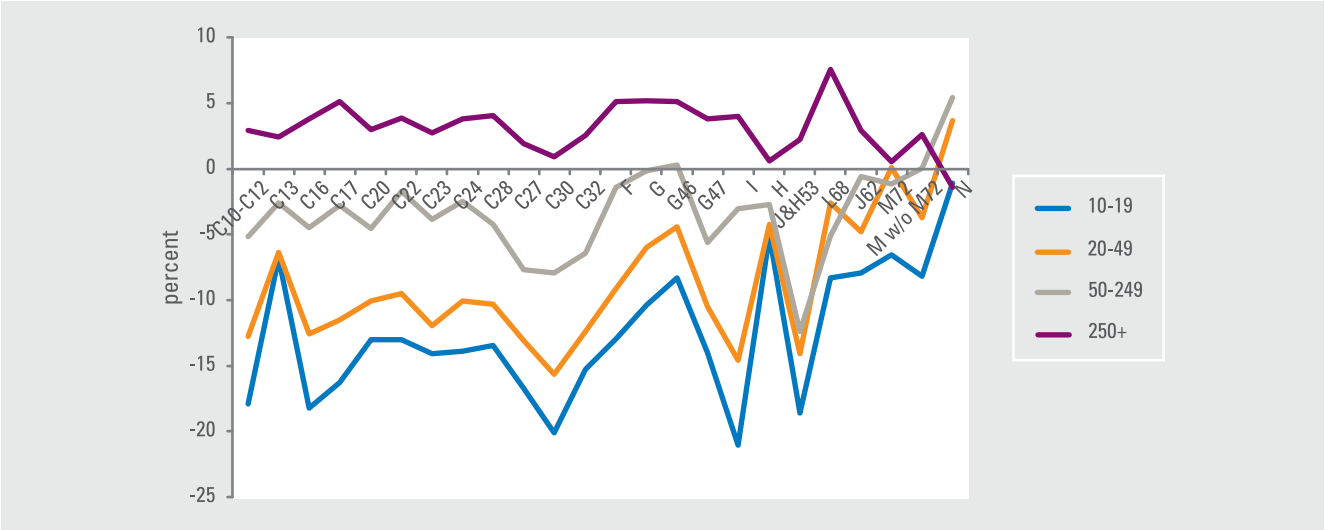
AMADEUS data reveal that there is indeed great variation in the proximity to France of differently sized firms within most industries and services sectors (see Figure A.15). In several cases, the variations are dramatic. For instance, in the case of real estate activities, enterprises larger than 50 employees are nearly three times as far from the benchmark as their smaller competitors. Incidentally, this has been observed in services sectors, as productivity variation within manufacturing industries generally appears to be smaller.

FIGURE A.15 Smaller Firms Are Catching Up Faster in TFP than their Larger Counterparts



Notes: sectors are ranked according to the average proximity to the benchmark in Poland. Proximity to the benchmark was calculated for each sector and firm size category as TFP ratio with France as the benchmark for small and medium enterprises (10 - 250) and Germany as a reference point for large enterprises. The left-hand vertical axis depicts proximity to the international benchmark for Poland. The right-hand vertical axis shows the maximum (for each sector) distance between Poland and the benchmark. The colors of the bars correspond to the firm size categories (refer to the legend below the graph), and their height equals to the distance between Poland and France or Germany.
Source: own calculations based on AMADEUS data.

FIGURE A.16 SMEs Exhibit Higher Productivity Levels Than Bigger Enterprises



Notes: the vertical axis plots the percentage deviations of natural logarithms of TFP from the industry averages. The horizontal axis shows trends in differently sized firms across sectors.
Source: own calculations based on AMADEUS data.

One of the most striking conclusions emerging from the analysis is the relatively lower level of productivity in large firms in comparison to SMEs. The trend holds across sectors, regardless of the measure of productivity used. It can probably be ascribed to the fact that the average "large company" is smaller in Poland (and other CEE countries) than in France. Even so, the average (absolute) level of productivity in each sector seems to be strongly correlated with firm size. Except for other business services, average productivity levels increase monotonically with the size of the firm (see Figure A.16). The larger the firm, the more output it generates for a given set of inputs.

The inverse relationship between productivity and firm size is pronounced in almost all services sectors and in some low-tech manufacturing industries, namely the manufacturing of basic metals, of food and food products and of nonmetallic mineral products. In services, a notable exception is post and telecommunications. Interestingly, the pattern has also been observed in neighboring countries. In the Czech Republic, as well as in other Central European countries, large firms tend to be less productive when compared to their West European counterparts than smaller enterprises. The extent to which the productivity differentials of large enterprises deviate from industry averages correlates fairly strongly between Poland and other Central European states.

The poorer performance of large enterprises in Central Europe seems to stem from their actual size. When compared to French and German counterparts, big firms in Central Europe are generally much smaller (see Table A.2). While in France and Germany, they employ more than 1100 people on average, the mean employment for big firms in the Czech Republic and Poland is less than 800. Interestingly, average firm sizes in other categories are comparable.

TABLE A.2 Average Firm Size in Poland, CEE and Western Europe

Country	10-19	20-49	50-249	250+
Czech Republic	14.97	33.07	115.40	738.49
Germany	14.32	34.18	110.67	1151.33
France	13.60	31.81	103.48	1131.62
Hungary	13.51	30.11	104.29	859.70
Poland	13.57	30.46	106.80	755.47
Slovenia	13.66	31.24	109.13	807.49
Slovak Republic	14.95	33.96	110.15	631.66

Source: authors' calculations based on AMADEUS data.

Even though productivity differs by firm size, the impact of this phenomenon on the sectoral aspect of the productivity problem remains limited. In fact, industry level productivity is highly correlated across firm sizes, with correlation coefficients higher than 0.80 (see Table A.3). This suggests that sector-specific factors are more important for productivity differentials than firm size-specific factors. The proximity to the international benchmark appears to be a matter of a sector-specific endowment with production input and the level of technology. Variations in these two respects between firm size categories seem to matter much less.

TABLE A.3 Relative Productivities (TFP) in Poland: Correlation Matrix

	10-19	20-49	50-249	250+
10-19	1			
20-49	0.93	1		
50-249	0.89	0.89	1	
250+	0.81	0.80	0.84	1

Source: authors' calculations based on AMADEUS data.

Productivity and economic performance in Poland and comparator countries

The following section will focus on the importance of industries with different productivity levels for the economy. In other words, it will explore the relationship between the level of productivity and the VA generated by the industry or the value of goods exported by the industry. The aim of the analysis is to ascertain whether the sectors that are more productive in Poland also generate more VA (especially in comparison with other countries), and whether they contribute a greater share in exports than their less productive counterparts.

By placing existing productivity differentials in the context of VA and export shares, it becomes possible to assess their consequences for the overall economic development. It is worth noting that an industry's higher proximity to France does not imply that the industry is more important for Poland in terms of generated VA or volume of exports. Certain industries have converged with their West European counterparts to a high degree in terms of total factor productivity, but they still account for a relatively low share of total VA in the economy. Despite high productivity levels or high growth rates, their direct contribution to Poland's total productivity growth is negligible. At the same time, there are also industries that contribute a large share of the total VA in the Polish economy, despite their continued divergence from the European benchmark.

The relationships between productivity and industry shares in VA and exports have their static and dynamic aspects. The former represents the current state of affairs; the latter encompasses short-term trends (if they exist) and the evolution of the economy in the recent years.

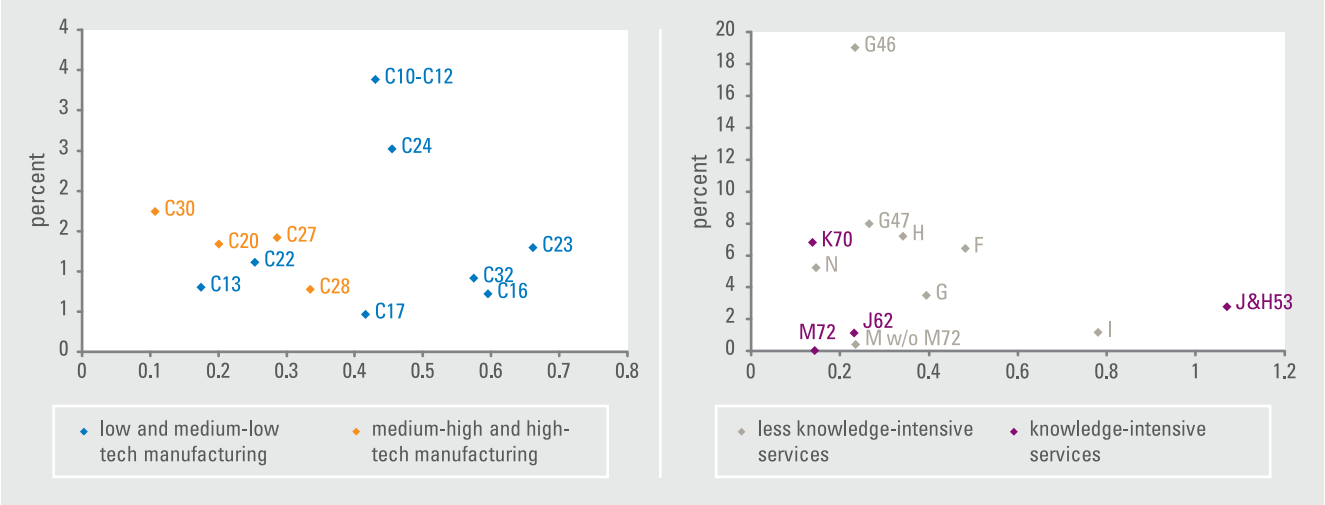
Productivity and the current economic outlook in Poland

Poland's growth is currently driven largely by low-tech industries and sectors with low productivity. In general, strong inverse relationships exist between the level of productivity in a sector and its share in either the total VA or the value of exports in the Polish economy. While the former seems to stem from vast differences between manufacturing and services, the latter is far more pronounced. This finding suggests that the overall wealth of the Polish economy is largely determined by sectors positioned closer to the benchmark, despite their lower productivity in absolute terms.

In terms of VA, manufacturing sectors make up for no more than 20 percent of the economic output, but their importance cannot be overstated, as they play a major role in export and procurement of investment goods. The most productive — relative to France — Polish industries (manufacturing of nonmetallic mineral goods, of furniture and of wood and wood products) matter very little in overall economic terms and especially in exports. Conversely, certain less productive sectors contribute a much greater share of VA or exports to the Polish economy. They include manufacturing of textiles, of food and food products and of basic metals. Special attention should be paid to high-tech and medium-high tech manufacturing (such as transport equipment), which has disproportionally high shares in exports and faces intense competition on international markets. Yet when it comes to productivity, high-tech and medium-high tech sectors diverge from the French reference point more than industries traditionally characterized as low-tech, which suggests that the former has unfulfilled potential.

FIGURE A.17 Manufacturing: TFP Convergence and Share in VA

FIGURE A.18 Services: TFP Convergence and Share in VA



Notes: the vertical axis shows the share in total VA in Poland (2006), while the horizontal axis captures proximity to France in 2008. Industry classification based on Eurostat (2010). All industry codes are listed in the Appendix.
Source: own calculations based on AMADEUS data (relative productivity), EU KLEMS (industry-level VA).

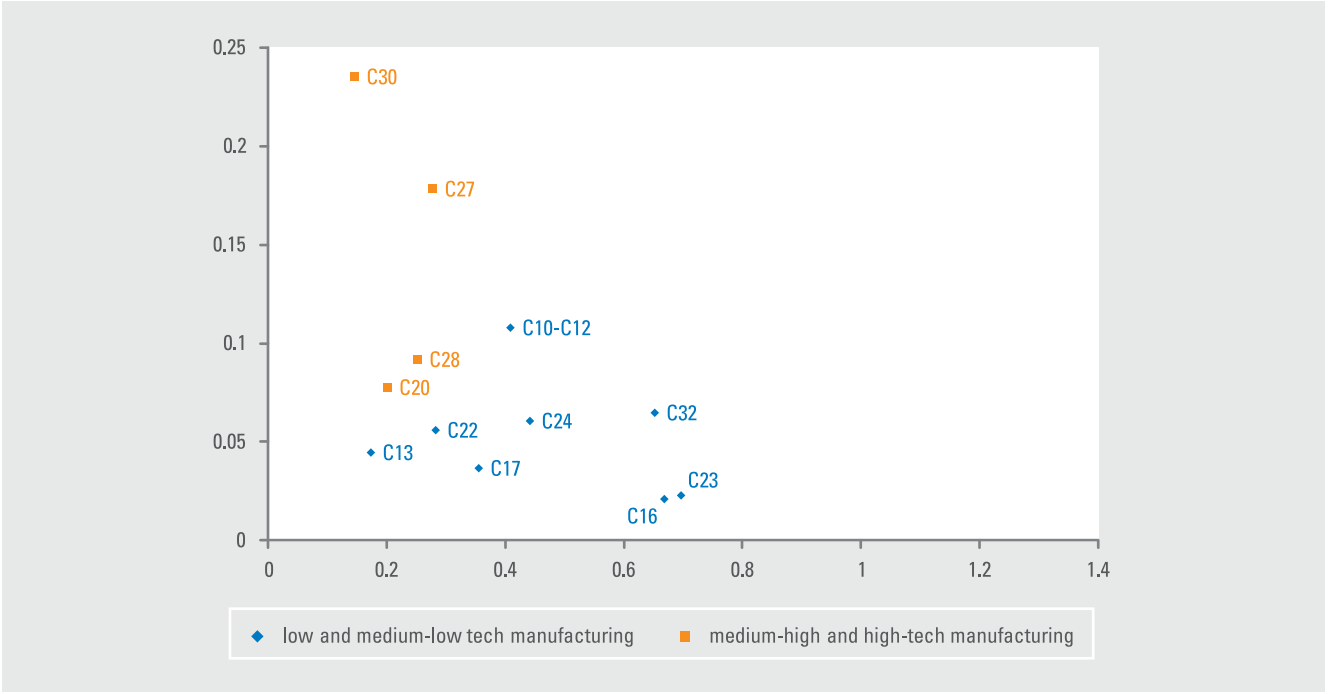
Similar trends have been observed across services sectors, dominated by less knowledge-intensive traditional industries, such as trade, transport, hotels and restaurants.

A regional comparison reveals that Poland almost entirely lacks a group of sectors that would exhibit favorable levels of productivity *and* VA or export shares at the same time. A priori, we would expect that there are industries in which Poland has a comparative advantage. Yet according to the data analysis, the number of sectors with the desired combination of properties is in fact very limited. Figure A.20 and Figure A.21 present these conclusions in a concise way.

Based on the two criteria of productivity levels and VA or export shares, Polish industries can be divided into four groups:

- **Stars:** sectors characterized by higher productivity and, in relative terms, larger VA or export shares than in comparator economies. Considering the overall economic performance, this group is likely to be the most important one, as it includes a group of industries that both utilize production inputs in a more efficient way and make more significant contributions to the overall output. They include: manufacturing of food, food products, beverages and tobacco, of textiles (VA), of wood and wood products (export) and of basic metals (export).

FIGURE A.19 TFP Convergence and Share in Exports of Manufactured Goods



Notes: the vertical axis depicts the share in total exports in Poland (2009), and the horizontal axis shows proximity to France in 2008. Industry classification based on Eurostat (2010). All industry codes are listed in the Appendix.
Source: own calculations based on AMADEUS data (relative productivity), OECD STAN database (industry-level exports).

FIGURE A.20 TFP Proximity and Exports Share Relative to CEE in Manufacturing

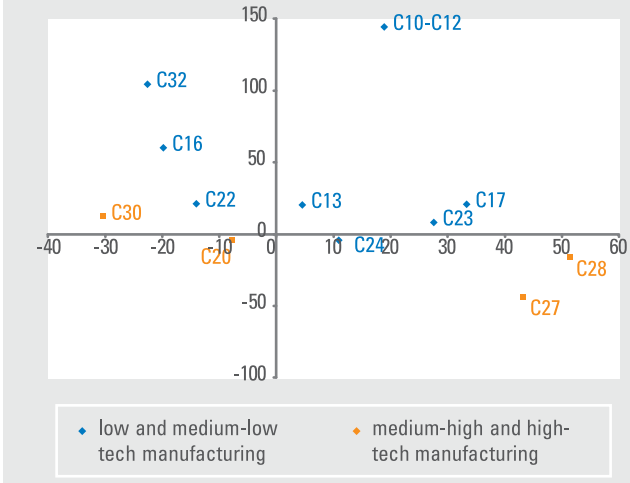
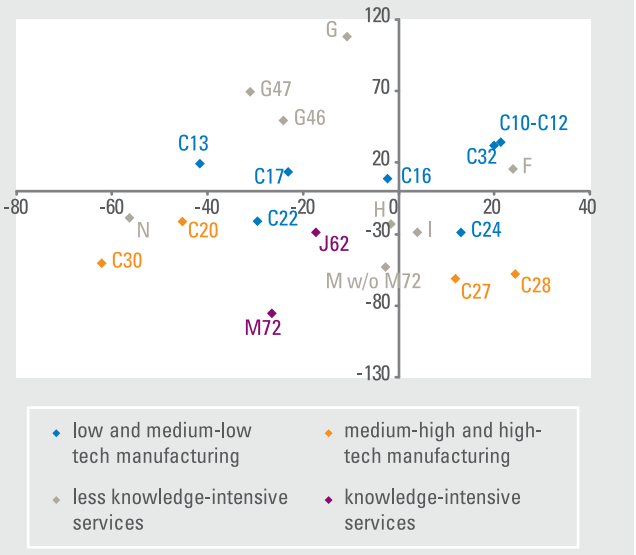


FIGURE A.21 TFP Proximity and VA Share Relative to CEE Across Sectors



Notes: the vertical axis shows the relative share in VA (2006) or exports (2009), while the horizontal axis depicts relative TFP proximity to France (2008). Relative variables are constructed as follows. The upper right quadrant — sectors with higher productivity and a relatively larger share in either VA or exports in Poland than in other countries. The lower right quadrant — industries with higher productivity but smaller VA or export shares. Upper left quadrant — higher shares in VA or exports but lower productivity. Lower left quadrant — a lower share in VA or exports and lower productivity. Industry classification based on Eurostat (2010). All industry codes are listed in the Appendix.
Source: own calculations based on AMADEUS data (relative productivity), OECD STAN database (industry-level exports) and EU KLEMS database (industry-level VA).

- **Promises:** industries that are more productive than their Central European counterparts but account for a lower share of VA or exports (in other words, "promising" sectors). This group consists of the following industries: manufacturing of electrical equipment, of machinery n.e.c., of basic metals (VA), transport and professional services.
- **Problems:** industries with lower levels of productivity than in neighboring countries, which are of higher importance to the Polish economy as they account for larger shares in VA and exports. This group should be of extreme interest to Polish policy-makers in several respects: Poland trails behind its peers, but these shortcomings wield a greater impact on the overall economic performance. The industries include: trade sectors, manufacturing of chemical products, of paper products (exports), of furniture and manufacturing n.e.c. (exports).
- **Laggards:** sectors characterized by lower levels of productivity and smaller shares in overall VA and exports. The group comprises: scientific R&D, computer services, manufacturing of transport equipment as well as of plastic products (VA).

Whether these patterns of productivity development across sectors are associated with the structure of the Polish economy is questionable. To fully unpack this stack of issues, dynamic aspects of productivity and other industry characteristics need to be factored in. These patterns of productivity development are either a consequence of an undesirable short-term trend or a result of long-term stagnation. They could also be associated with the structure of the Polish economy. To fully unpack this stack of issues, dynamic aspects of productivity and other industry characteristics need to be factored in. Furthermore, the analysis has to incorporate CIS data on enterprise innovation efforts. The next subsections address both of these concerns.

Short-term dynamics of productivity and economic growth in Poland

Growth patterns in VA and exports across industries indicate that while VA in manufacturing expanded faster than the economy as a whole, VA in services increased at a slower pace. Two knowledge-intensive services sectors in particular can be labeled as laggards: real estate and R&D, both growing at about 20 percent of the total VA growth, i.e. much slower than other industries. At the same time, less knowledge-intensive services very nearly reached the growth rate for the total VA in 2002-2006. In 2002-2009, export shares of high-tech and medium high- tech industries increased faster than the Polish average, with the exception of manufacturing of chemical products and transport equipment, which did not enjoy rapid productivity growth.

Higher productivity levels did not necessarily translate into a boom in exports. The analysis reveals that exports in sectors approaching the international benchmark (i.e. low- and medium-low tech) grew slower than total Polish exports, while the exports shares of industries diverging from the EU-15 increased faster. High-tech and medium-high tech manufacturing, much less productive on average (none of the industries in this group exceeded 30 percent of the productivity levels observed in France), grew at a brisker pace in terms of exports than the Polish economy as a whole (see Figure A.22 and Figure A.23).

The dynamics suggest that the inverse relationship between productivity and VA and/or exports shares is not a permanent feature of the Polish economy. If the abovementioned short-term trend continues, sectors with greater leverage on the economy will start enjoying higher rates of productivity growth, and the current pattern of economic development will be overcome.

FIGURE A.22 VA Growth and Productivity Growth Across Sectors

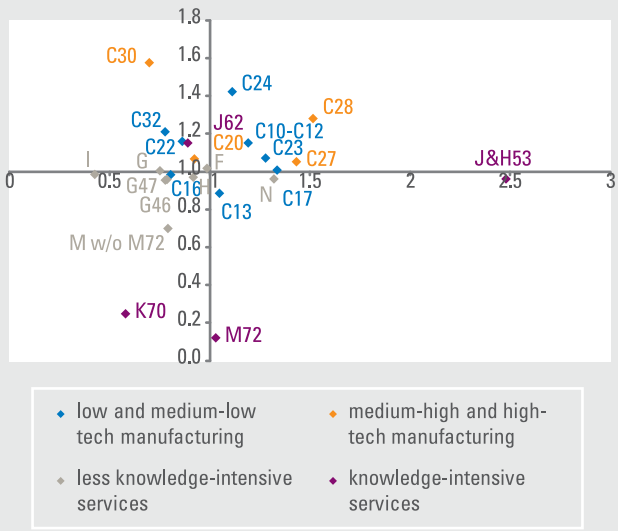
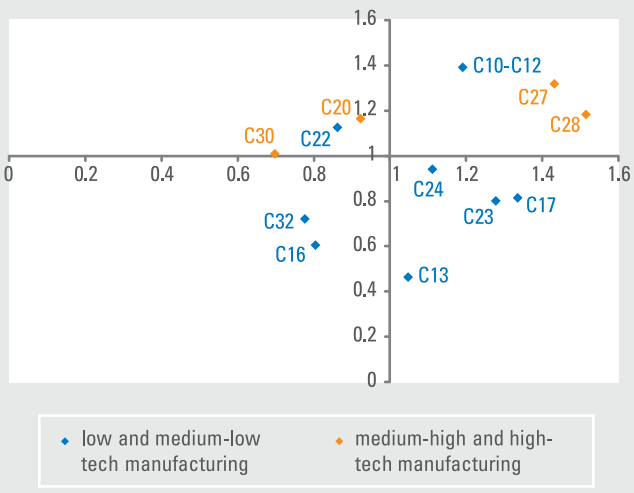


FIGURE A.23 Export Growth and Productivity Growth in Manufacturing



Notes: the vertical axis depicts real VA or real exports growth relative to national average, while the horizontal axis shows TFP growth (in terms of proximity to France) relative to national average, in 2002-2006 across sectors, and in 2002-2008 in manufacturing. Industry classification based on Eurostat (2010). All industry codes are listed in the Appendix.
Source: own calculations based on AMADEUS data (relative productivity), OECD STAN database (industry-level exports) and EU KLEMS database (industry-level VA).

Poland's current model of economic development defies expectations in several respects. First, assuming that the structure of France's economy, as well as the levels of productivity there, are a reasonable approximation of Poland's economic future, one would anticipate that industries that are currently less productive would be catching up with the EU-15 at a faster pace. Moreover, long-term trends in productivity growth in Poland would suggest that the initial state of the economy (especially the differences between various sectors and industries) was less favorable than it actually was, with even lower productivity levels and VA and/or exports in high and medium-high tech industries (compared to the French benchmark).

Productivity and economic growth: conclusions

Productivity levels vary greatly across sectors. On the industry level, micro-economic data suggest that the most productive sector (manufacturing of nonmetallic mineral products) is, on average, up to five times more productive than the least productive one (hotels and restaurants). Similar divergence in sectoral productivity levels has been reported in macro-economic studies. Patterns of productivity development across industries indicate that in general, the higher the technological sophistication or knowledge intensity, the greater the distance from the EU-15 benchmark.

Despite the strong positive correlation between labor productivity and total factor productivity, the two differ in their capacity to approximate convergence. Each productivity indicator signifies a different relationship between the productivity level and the distance from highly developed Western economies. This variance in TFP and labor productivity growth patterns can be explained by changes in the capital stock per employee, which seems to be playing an important role in the convergence process. In other words, the differences in TFP and labor productivity growth can be explained by changes in the capital stock per employee: the larger the difference, the faster the capital stock per employee has grown.

The rate of convergence with the EU-15 has been more even across sectors in the recent years. This trend is much more pronounced in labor productivity. Once again, it can be traced back to capital accumulation, which has been more significant in sectors characterized by faster labor productivity growth compared to TFP growth.

The observed differences between labor productivity and TFP growth rates across sectors suggest that Poland's convergence with developed Western economies has been sustained by capital accumulation, at least in low- and medium-tech industries. High-tech industries, where capital stock increased at a slower pace, maintained a greater distance from France. Therefore, the role of capital formation in economic growth cannot be underestimated, and it should be factored in at the stage of policy design.

From a regional perspective, there are industries in Poland that are either significantly closer to France or notably further from it, suggesting that Poland is at a comparative disadvantage in selected sectors. The two groups of leaders and laggards include both low-tech and high-tech industries. Central European countries share, on the whole, the cross-sectoral distribution of productivity differentials as well as the overall productivity gap.

Firm size as an additional variable does not significantly alter the general conclusions. As expected, larger firms are generally more productive than smaller ones. Yet interestingly, it has also been established that large firms are struggling to catch up with France much more than their smaller competitors.

As for productivity vs. VA and exports, sectors with higher productivity levels seem less important for the economy as a whole than their less productive counterparts. In fact, there is a strong inverse relationship between the level of productivity (relative to the international benchmark) and the share in VA or exports. This finding is crucial, as it indicates that less productive high-tech industries have turned out to matter a lot to export. In turn, industries that are more productive in Poland than in comparator countries rarely hold a large stake in VA or exports.

However, when the dynamic aspects of productivity and economic performance are included in the analysis, the picture changes dramatically. Productivity growth appears to have a direct impact on economic performance, as sectors that are catching up with France at a brisker pace also tend to grow faster than the economy as a whole in terms of VA and exports.

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