Policy Mix for Innovation In Poland

Key Issues and Recommendations

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BACKGROUND

Since the early 1990s, Poland has undergone significant political, economic, and social changes related to its transition to a market-based economy and the EU accession process. Although Poland has recently enjoyed seven years of uninterrupted growth at an annual growth rate averaging 5 percent, living standards remain low compared with other middle-income countries in the European Union (EU). Raising living standards will require a comprehensive growth strategy, mainly in creating an environment conducive to business development and investment, while recognising the important role of knowledge creation and absorption for Poland's comparative advantage. Meeting the goals of the EU's Lisbon Strategy will also require a strong policy focus on knowledge and innovation.

Recent policy efforts, linked to Poland's entry in the EU in 2004, have been marked by a renewed interest in the development of an innovation policy that could help sustain future economic development and the convergence with other EU countries. The government's Strategy for Country Development 2007-2015 and the National Strategic Reference Framework 2007-2013 or the "Strategy for increasing the innovativeness of the economy for the years 2007-2013", called the "innovation strategy" both aim to strengthen the focus on innovation.

As Poland moves ahead with these new policies, the government has requested that the OECD undertake a peer review of the "policy mix" for innovation. The main purpose of the review by the OECD is to assess the policy mix for innovation, including the individual policy instruments, drawing on international experience. This paper presents the main findings from the peer review undertaken by an OECD expert panel and reflects input from the Polish authorities and stakeholders in the national innovation system. It also draws on a background report submitted by the Polish authorities[1]. The findings of the review are intended to provide the Polish government and stakeholders with fresh insights and recommendations on priorities that could help develop a more coherent and effective innovation policy.

The main policy recommendations to enhance Poland's policy mix for innovation are shown in Box 1 and are elaborated further in the remainder of this report[2]. Concrete examples from other OECD countries as regards possible approaches to follow are provided in the text. The report incorporates comments on an earlier draft provide by OECD delegates at the December 2006 meeting of the TIP as well insights and written comments received following a meeting with the Polish authorities in Warsaw on 27 June 2007.

(1) The background report was prepared jointly by the Ministry of Science and Higher Education and the Ministry of Economy. Krzysztof Gulda, Director of the Economy Development Department at the Ministry of Economy and Dariusz Drewniak, Director of the Strategy and Science Development Department at the Ministry of Science and Higher Education, together with Ms. Justyna Długosz, specialist, were the main interlocutors for the OECD panel.

(2) The expert panel taking part in the OECD Peer Review of the Innovation Policy Mix for Poland was comprised of Dirk Pilat and Mario Cervantes of the OECD Secretariat; Jacek Warda, independent consultant to the OECD from Canada; Tae-Seog Oh, Ministry of Science and Technology, Korea and currently seconded to the OECD; and Jutta Guenther, Halle Institute, Germany.

Box 1.

Recommendations to improve Poland's innovation policy mix

- ***Strengthen the science and technology base; focus on excellence and critical mass.***
  - Encourage more competitive and focused funding that rewards excellence and builds critical mass in universities and public research organisations.
  - Link public funding closely to co-operation and networking; focus resources on institutions and organisations that are able to achieve success or results.
  - Strengthen the role of public research institutions (branch institutes) by focusing their efforts and by consolidating their number.

- ***Improve the incentives for business R&D and innovation.***
  - Improve the framework conditions for entrepreneurs and business by reducing and improving regulations, encouraging competition, simplifying the tax system, and providing longer-term stability in business regulations and in business R&D support mechanisms.
  - Boost support for business R&D including through direct and indirect incentives. Use of fiscal incentives R&D should be carefully designed so as to complement efforts to reduce complexity in the tax system.
  - Foster innovation in services and leverage public procurement to boost demand for innovation in lead markets.
  - Improve the support for early stage venture financing.

- ***Foster industry-science linkages.***
  - Improve the regulations that govern public-private partnerships (PPPs) for R&D and innovation by granting actors more flexibility and autonomy in the management and financing of PPPs.
  - Rationalise the number of intermediary institutions by linking public support for the institutions closer to performance.
  - Continue the process of decentralisation of innovation measures to regional actors, but tie these efforts to reporting requirements and independent evaluation.
  - Non-governmental actors play an important role in linking public and private research and should be encouraged.
  - Encourage capacity building for the management of intellectual property rights in universities, focusing on the strongest research performers.

- ***Strengthen human resources for science and technology (HRST).***
  - Develop stronger incentives for scientists to achieve excellence and enhance co-operation with business, such as financial incentives and research performance criteria.
  - Ensure faculty and research recruitment is based on open competition and transparent promotion criteria so as to enhance quality and mobility. Promotion criteria may need to be revised to recognise the contribution of researchers to more applied activities such as technology transfer.

- Improve the labour market conditions for graduates in science and technology by better linking vocational and higher education to industry skill needs.
- Strengthen entrepreneurship education and awareness programmes to help overcome negative attitudes towards risk taking.

- ***Improve the governance of the innovation system.***
- Develop a stronger capacity for long-term planning of public research and innovation.
- Enhance attention at the highest political level for innovation (in its broadest sense), to build a coherent and well coordinated approach to innovation across the government, involving relevant stakeholders.
- Enhance business involvement in S&T policy making, especially in priority setting. Enable and encourage the involvement of business representatives on university boards.
- Improve institutional co-ordination in policy design and implementation.
- Mainstream evaluation as a core element of science and innovation policies.
- Strengthen the evidence base for science and innovation policies, by developing pertinent statistics and analysis.

1. OVERALL BALANCE OF THE POLICY MIX FOR INNOVATION

1.1. Current situation

Increasing and shifting government support for R&D

The overall balance of Poland's innovation policy mix is characterized by very low investment (in absolute and relative terms) in R&D and the predominance of public funding for R&D. Poland lags far behind other EU and OECD countries in terms of gross expenditure on R&D (GERD) in relation to GDP and also ranks unfavourably when compared with other countries that became members of the EU in 2004 along with Poland. In 2005 Poland spent 0.57% of GDP on R&D, down from 0.63% in 1995 and below the level in the Czech Republic (1.42%) and Hungary (0.94%) (Figure 1).

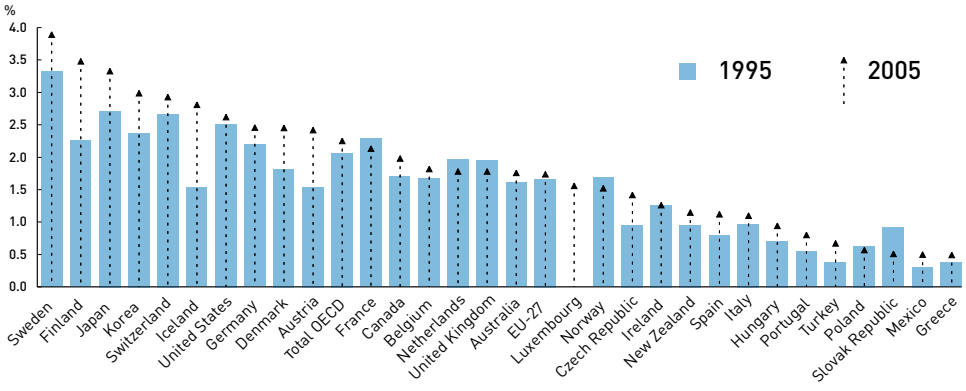


Figure 1. Gross expenditure on R&D intensity per capita relative to GDP per capita, 2005

Source: OECD, Main Science and Technology Indicators, 2007/1. September 2007.

The relatively low level of Poland's GDP per capita also reflects it catch-up stage of development and its relatively low level of GDP per capita (Figure 2). Indeed, while the Czech Republic spends more on R&D per capita population than Poland it also benefits from a higher GDP per capita. At the same time, other countries with low levels of per capital GDP are succeeding in increasing investments in R&D. Hungary for example exhibits a lower GDP per capita than Portugal yet spends more on R&D per capita population. In other words, while development levels affect overall investment in R&D, the relationship between GDP and R&D is not perfectly linear although there is a strong correlation between the two.

Most financing of R&D in Poland comes from the government. In 2005, industry financed 33.4% of gross expenditures on R&D, up from the level in 2004, while government financed 57.7% and 5.7% was financed from abroad. The low spending by business on R&D, although it is rising, is also reflected in the structure of its exports in which low and medium-low technology products account for more than half of total manufacturing exports (Figure 3).

In terms of performance, in 2005 the business sector performed 31.8% of GERD while the government sector performed 36.4% and the higher education sector performed 31.6%. In addition to the predominance of the public sector (government and higher education) in funding and performing research, the government has thus far lacked the capability to set long-term priorities. Most priority setting is set "bottom-up" which also reflects the dispersion of public research funding around small projects. In universities for example, funding consists mainly of institutional funding with very little competitive funding (16%) for larger and priority projects linked to strategic goals.

1.2. Challenges and opportunities

The environment for innovation and entrepreneurship in Poland has improved compared to the 1990s but there remain significant barriers to firm creation and entrepreneurship, to business R&D investment and to the exploitation of intellectual property rights in the public and private sectors as well as financing for innovative firms. Public funding for research is also fragmented and spread too thinly while the level of industry-science relationships is relatively weak. The quality of education and human capital are also of concern, especially given the need to improve labour productivity in order to improve industrial competitiveness. At the regional level, many of these national challenges are amplified and, in some cases, are made more problematic due to historical, economic and institutional factors. While a few regions (e.g. Mazowsze, Pomerania, Wielkopolska, Silesia and Lower Silesia) have had significant success with efforts to boost innovation and entrepreneurship, the majority of them continue to lag behind in competitiveness and lack the capabilities to stimulate innovation. The current macroeconomic climate in Poland and integration into the EU, including EU funding, present an opportunity for Poland to shift or rather integrate its policy mix for innovation by strengthening public research and at the same time linking it better to the productive sector in Poland. The EU Regional Development Fund (ERDF) also presents an opportunity to improve the contribution of innovation and entrepreneurship to regional economic development. Currently, Poland's regions rank towards the bottom of all EU regions – six

Figure 2. Gross expenditure on R&D per capita relative to GDP per capita, 2005

Source: OECD, Main Science and Technology Indicators, 2007/1. September 2007.

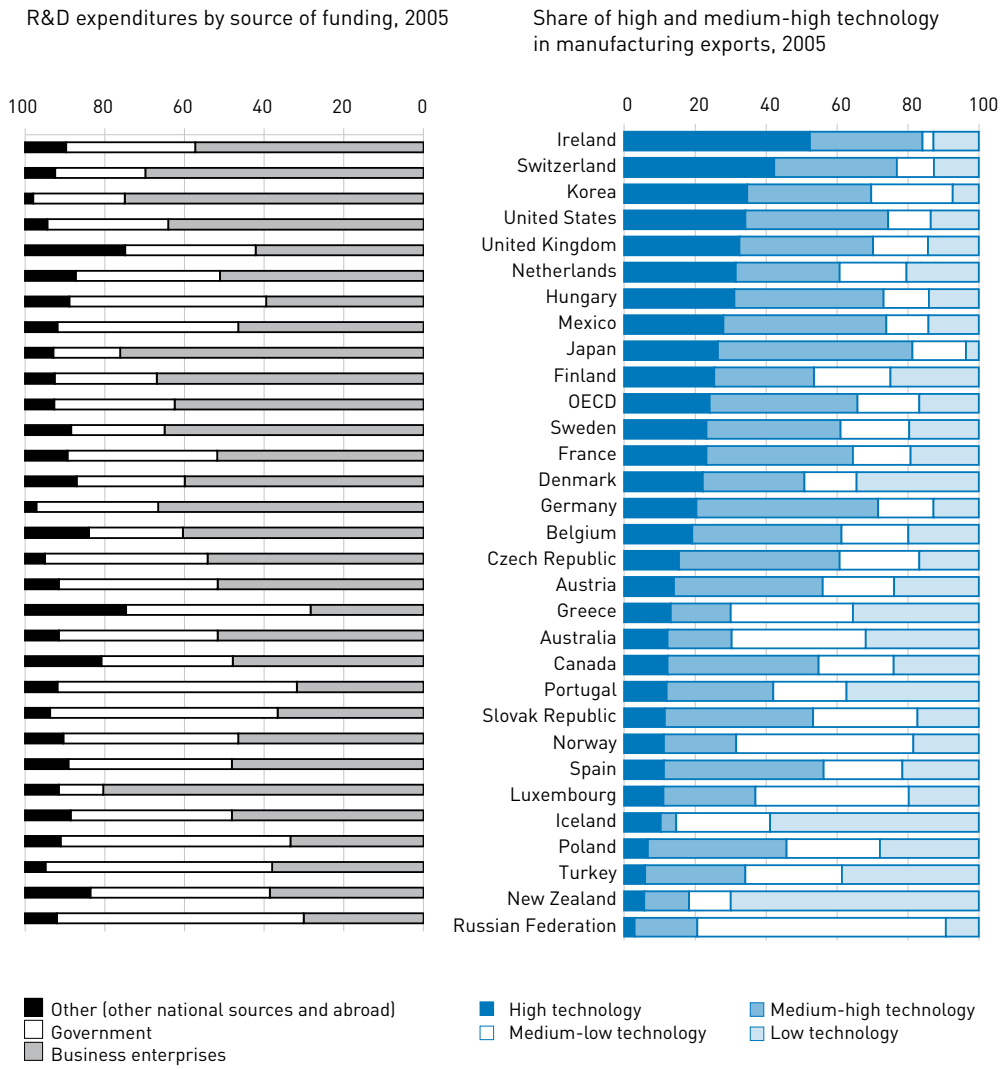


Figure 3. Distribution of R&D funding and breakdown of manufacturing exports technological intensity

Source: OECD, MSTI Database and STAN Bilateral Trade Database 2007.

1.3. Policy responses

After several years of piecemeal reforms in S&T policy, Poland's entry in the EU in 2004 was marked by a renewed interest in developing an innovation policy in order to help sustain future economic development and continue the process of convergence with other EU countries. The government's Strategy for Country Development 2007-2015, the National Strategic Reference Framework 2007-2013 or "innovation strategy"[3] aims to rebalance the policy mix for innovation by shifting the focus away from basic research to innovation. The main directions in innovation policy in Poland are *i)* human resources for the modern economy, *ii)* research for the economy, *iii)* intellectual property for innovation, *iv)* capital for investment, and *v)* infrastructure for innovation. In order to co-ordinate and manage innovation policy, the government plans to establish a high level innovation council and an Agency (e.g. along the Vinnova model in Sweden) responsible for implementation of the policy.

One of the key instruments of the national strategy is the Operational Programme "Innovative Economy 2007-2013" which will mobilise EU Regional Development Funds of the order of EUR 7 billion and an additional EUR 1.2 billion from national public sources and as yet unspecified support from the business sector to promote high quality research centres; research infrastructure, business R&D and innovation, as well as capital funds for small and medium-sized enterprises (SMEs) and new technology-based firms (NTBFs).

Box 2.

Priority axes for the Operational Programme "Innovative Economy (2007-2013)"

- ***Research and Development of New Technologies (Ministry of Science and Higher Education, MSHE)***
- ***R&D Infrastructure (MSHE)***
- ***Capital for Innovation (Ministry of Economy, ME)***
- ***Investments in innovative undertakings (ME)***
- ***Diffusion of innovation (ME)***
- ***Polish Economy on the International Market (ME)***
- ***Information Society Establishment and Development (MIA)***
- ***Technical Assistance (Ministry of Regional Development, MRD)***

(3) The "Strategy for increasing the innovativeness of the economy for the years 2007-2013".

The expected increase in funding for research and innovation presents an opportunity to re-orient the policy mix towards developing critical mass in research that is better linked to business innovation. It is also an opportunity to improve Poland's attractiveness as a destination for foreign R&D related investments.

1.4. Assessment and discussion

R&D in Poland is predominantly financed by government and mainly conducted by higher education institutions and the Polish Academy of Science. Together the higher education and government sectors perform 67% of R&D. In international comparisons, this is a high share, which compares with some other transition economies, e.g. Czech Republic. While the current policy measures taken, backed by increases in funding, represent a broad-based strategy to strengthen science and innovation in Poland, they will have to be closely monitored and evaluated. It would be especially helpful if evaluation of various policies could be built in from the outset. The overall policy mix can also benefit from measures to improve co-ordination and to avoid duplication between ministries and between the various implementing actors (e.g. funding agencies). Some recommendations on the overall governance of Poland's policies towards science and innovation are discussed in section 6 of this paper.

2. THE POLICY MIX FOR THE SCIENCE AND TECHNOLOGY BASE

2.1. Current situation

Public research in Poland is split between higher education institutions (143), the Polish Academy of Sciences (76 entities) the development units (603 – business entities that within their economic activity are also carrying out R&D) and the 194 sectoral branch institutes, half of which are supervised by the Ministry of Economy with the remainder spread across other sectoral ministries (e.g. Ministry of Agriculture)[4]. The universities are autonomous and obtain most of their R&D funding from block grants from the Ministry of Science and Higher Education.

As regards the branch institutes, although funding is allocated through the Ministry of Science and Higher Education, the majority of the institutes are under the supervision of other Ministries, notably the Ministry of Economy. Branch institutes mainly focus on providing applied research and technology development services to traditional industries, although some are active in non-research activities (including real estate). Their size ranges from 30 employees to 800 employees. Some institutes earn no revenue while others earn revenue ranging from EUR 1 to 50 million. Some branch institutes have been consolidated and further consolidation is planned. There are no legal obstacles to the merger of institutes supervised by different ministries. This has already happened, for example with one institute from the Ministry of Economy with one from the Ministry of Infrastructure. The main obstacles arise from the Ministries and agencies concerned. The criteria for consolidation or reform are primarily based on economic

(4) Data for 2005 – Nauka i Technika w 2005 r. (Science and Technology); Informacje i opracowania statystyczne; GUS, Warsaw 2006.

variables but there is currently no common approach given the diversity of institutes. Another problem with the branch institutes is that some of them are a hybrid between an institute and a company which could limit their eligibility for public funds under EU state aid rules. The government envisages changing the status of some institutes into non-profit research organisations.

2.2. Challenges and opportunities

Much of the public research funding in Poland is fragmented and spread too thinly. University research projects are typically funded by small grants (EUR 10-30 thousand) and individual grants rarely exceed EUR 140 000. Most of the funds for universities are taken up by salaries and operating costs. Furthermore, the small amount of competitive funding is insufficient to improve the quality of academic research. Thus far, funding has not been used to strengthen links between industry and academia.

An important opportunity for Poland is to benefit more from the EU's funding for science, both through the framework programmes, as well as the structural funds. Poland benefited considerably from the FP5 programmes, which often involved small research consortiums, but has found it more difficult to participate in the FP6 programmes, that were often larger and involved considerable co-funding. Drawing more on the available resources from the EU, and focusing these on clearly defined strategic priorities, should clearly be an urgent task for the government.

2.3. Policy responses

The government is creating a new funding agency, the National Centre for R&D (NCRD) which will focus on managing and funding large strategic projects, on a competitive basis, with possible allocation of 10 to 40 million EUR. The new funding agency will account for 10% of the budget of the Ministry of Science and Higher Education or EUR 100 million. The establishment of another agency is envisaged with a view to providing small grants for researchers in basic research and allowing the Ministry of Science and Higher education to concentrate its activities on planning and evaluation rather than financial implementation. The main idea behind the National R&D Centre (an agency managing R&D and granting funding) is to address the problem of institutional fragmentation. Currently, the Ministry asks research institutions to run projects on behalf of the Ministry, often on a scale ranging from EUR one to three million per project (the so called "ordered-projects" on subject matter specified in the National Framework Programme). The National R&D centre will be responsible for issuing the calls for proposals to implement strategic R&D programmes. Those programmes will be formulated by the Minister of Science within the National Programme of Scientific Research and Experimental Development (in the process of developing the strategic R&D programmes the minister will seek the opinion of representatives of the government, regional governments, scientific and business communities' representation after receiving the first draft proposal of the programme from the Committee on Scientific and Technology Policy of the Council of Science)[5].

(5) The Centre will support the minister responsible for science in performing some of the state's scientific, technology and innovation policies. In particular, it will play a coordination role and manage the strategic R&D programmes. The NCRD activities are expected to significantly contribute to the concentration of public means on priority tasks, especially in financing a limited number of large R&D programmes, strengthening the cooperation between science and business (through collaboration with enterprises in the performance of selected programmes announced by the NCRD), as well as through the restructuring and consolidation of R&D entities. The establishment of NRCD will be a crucial element in the public R&D financing reform.

The government has developed a new funding formula for allocating money to individual universities that will provide additional (premium) funding for universities engaged in high quality research projects including at the international level. However, the amount of premium funding will not be sufficient to significantly raise overall levels of university research.

2.4. Assessment and discussion

Creating a separate funding agency and allowing the Ministry to focus on policy making and evaluation is an important step in improving the synergy between policy design and implementation. The establishment of new National Centre for R&D will help enhance the quality of research and create critical mass. The new ranking system for allocating funds appears to be a step in the right direction but the ranking mechanism may not be regarded as sufficiently transparent to ensure trust in the system. While the government is clearly aware of the low level of competitive funding, its responses in terms of changes in funding formula or rankings may not be sufficient to change the existing incentives in the system.

The main policy recommendations from this review as regards the policy mix for the science and technology base are to:

- Encourage more competitive and focused funding that rewards excellence and builds critical mass in universities and public research organisations.
- Link public funding closely to co-operation and networking; focus resources on institutions and organisations that are able to achieve success or results.
- Strengthen the role of public research institutions (the branch institutes) by focusing their efforts and by consolidating their number.

3. THE POLICY MIX FOR PROMOTING BUSINESS R&D AND INNOVATION

3.1. Current situation

Although Polish firms have improved competitiveness on world markets as illustrated by the rise in exports, most Polish firms lack a culture of technological innovation and consequently are slow to introduce new or improved products and services. According to the CIS survey, the share of innovative firms in all Polish firms dropped from 37.6% in 1994-1996 to 16.9% in 1998-2000. A recent study by the Polish Confederation of Private Employers Lewiatan found that 64% of Polish SMEs view price as the main source of competition and only 0.6% viewed innovation as an important source of competitiveness. The same survey found that R&D spending was becoming slightly more important to SMEs (Lewiatan, 2006). Nevertheless, the expenditure of private firms on R&D is very low (Figure 4), accounting for only 0.18% of GDP in 2005 and accounting for 30% of total GERD funding in 2005. Furthermore, the majority of expenditure on innovation activities in 2004 was allocated to machinery and technical equipment (59.8%) while 23.2% went to building and structures and only 7.5% went to R&D activities and about 3% on the purchase of patents, licenses and know-how. Poland also has a very low level of patenting (OECD, 2006).

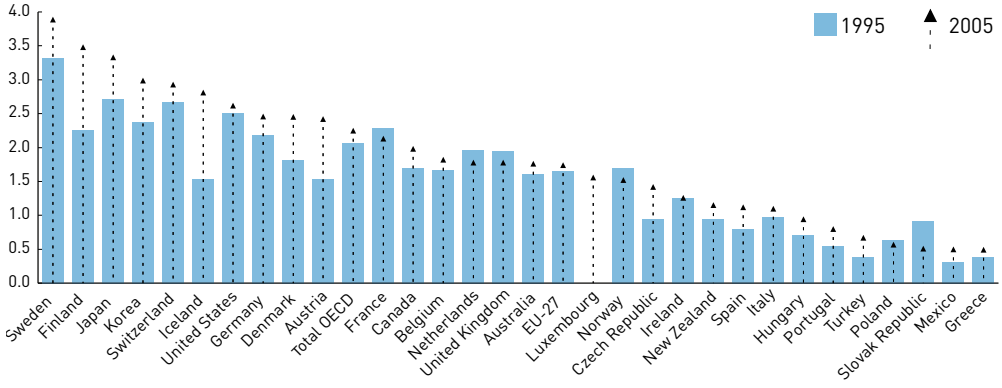


Figure 4. Intensity of business expenditure on R&D by country, 1995 and 2005. As a % of GDP
Source: OECD, Main Science and Technology Indicators, 2007/I.

The main source of business expenditure on innovation activities is private funding and the share is increasing, because of the drop in expenditure from other sources. The share of SMEs implementing their own innovation in the total number of SMEs in Poland accounted for 12.5%, which was low in comparison with the shares in countries like Austria (44.7%) and Denmark (43.4%).

The lack of technological innovation and the low spending on R&D does not necessarily imply that Polish firms are not focusing their efforts on enhancing performance or on "innovation" in a broad sense. Poland has experienced rapid productivity growth over the past decade (OECD, 2006), partly owing to a strong uptake of new technologies, including information and communications technologies (ICT), and a range of non-technological changes in the production process, including organisational changes, aimed at enhancing efficiency. Moreover, the low level of technological innovation partly reflects Poland's industrial structure, with few large domestic firms, an industrial structure primarily focused on low-technology activities, and foreign multinational firms that typically conduct little R&D in Poland.

The Polish government has developed and implemented several policy instruments to promote business R&D and innovation. "Increasing innovativeness of the Polish economy to the year 2006", a government programme adopted by the Council of Ministers on July 2000, resulted in the successful implementation of 19 out of 21 initiatives. Most of these are being implemented as part of the Sectoral Operational Programme. In addition to the strategy, Poland has introduced the Act of 29th July 2005 regarding some forms of support for innovative activity. To boost innovation capacity in firms the act provides for the provision of technology credits, the creation of the status of R&D centres, and provides for R&D tax credit. Participation by firms in the tax credit scheme has however been low thus far.

Other players that support innovation in Poland include the Industrial Development Agency (IDA) of the Ministry of Economy which plays an important role in supporting innovation in the regions. It provides

access for innovative companies to modern industrial and logistic infrastructure in two Special Economic Zones – Mielec and Tarnobrzeg – which are operated by the Agency and which target foreign firms setting up in Poland. The IDA exercises corporate supervision (together with other relevant bodies) of over 33 regional development agencies and developed many industrial and technological parks in most of the Polish regions. The IDA is one of the Implementing Institutions for the Strategic Operation Programme on Increasing the Competitiveness of Enterprises. It is responsible for the development of industrial and technological parks. Regarding direct support to innovative start-ups and for the implementation of new technologies in enterprises, the policy of the IDA is to use its specialised foundation called the Centre of Innovation – FIRE. The FIRE is a non-profit foundation which selects R&D projects of high commercial potential that bring together public and private partners, including investors. It supports companies in their establishment and development, provides organisational and financial solutions addressing particular projects, assistance in obtaining intellectual property rights, as well as coaching in the area of project management.

The Polish Agency for Enterprise Development (PAED) is a governmental agency subordinate to the Minister of Economy. It was established by the Act of 9 November 2000 on the establishment of the Polish Agency for Enterprise Development. Its task is the management of funds assigned from the State Budget and European Union for the support of entrepreneurship and the development of human resources, with particular consideration given to the needs of small and medium sized enterprises (SMEs). PAED is among the institutions responsible for the implementation of activities financed from the Structural Funds. The objective of the Agency is the implementation of economic development programmes, in particular with respect to:

- SME development.
- Export development.
- Regional development.
- Application of new techniques and technologies.
- Creation of new jobs, tackling unemployment and human resources development.

These objectives are carried out through:

- The provision of grants to SME, institutions supporting the development of SMEs, training institutions and labour market institutions;
- Advisory and expert services;
- Facilitating access by entrepreneurs to knowledge, economic information, studies and analyses to entrepreneurs;
- The informational and promotional activities.

The PAED also provide loans to SMEs for innovation activities. In 2003, the loan portfolio was valued at PLN 4.4 million. Such loans can also be used to cover the purchase of domestic and international licences and machinery or equipment necessary to implement innovations. Many of the PAED programmes, however, are quite recent and have yet to be evaluated.

An encouraging development is the growing number of multinational enterprises that are setting up R&D centres in Poland. A recent count suggests that more than 30 multinational enterprises have now established R&D centres in Poland, with a strong presence in information technology. The relatively high availability of qualified researchers, e.g. software developers and programmers, at a low cost may be among the factors that have made Poland an attractive location for such centres in recent years. Poland has traditionally been less successful in attracting FDI than its Central and Eastern European partners.

3.2. Challenges and opportunities

Stimulating business R&D expenditure

Like other OECD countries, one of the main challenges facing the Polish government is increasing business R&D expenditure from a very low level. This will be a difficult task, especially given the low innovative propensity and the low level of technological innovativeness among enterprises and entrepreneurs. The main barriers to building innovation capacity in Polish firms are:

- Limited financial means for investment in innovation compounded by lack of awareness of funding sources, as evidenced in business surveys.
- Specialisation in low value added goods, reducing incentives for spending on innovation.
- Product /service specifics that do not require spending on innovation.
- Weak infrastructure for R&D commercialisation.
- High risks associated with investments in new technologies and the creation of technology based firms.

Providing easier access to financing to firms

As shown above, Polish firms have difficulty accessing external sources of financing for innovative activity; this is particularly difficult for start-ups. As in other OECD countries, the financial sector is cautious about providing finance for innovative activities and start-ups due to the relatively high risks and the lack of a track record among start-ups. In 2004, the Polish Private Equity Association numbered 28 Venture Capital / Private Equity funds, but in fact none of them invested in enterprises in the start-up or seed phase. To address this, the government is launching 6 funds valued at 18 million PLN.

Changing attitudes and improving infrastructure

According to the survey conducted by the Polish Confederation of Private Employers, only about 1% of enterprises perceive innovation as a source to gain future competitive advantage in their development strategies. Changing the mind-set for entrepreneurs and improving awareness of the significance of innovation is an urgent challenge, even though it will be a long term process.

With regard to physical infrastructure to support technology uptake, broadband access has begun to increase quite rapidly but still lags behind many European countries. This is aggravated by a low level of competition in the telecommunication sector (OECD, 2006c).

3.3. Policy responses

The recent actions aimed at strengthening framework conditions in favour of innovation in Poland are the adoption of *i)* the Act of 8 October 2004 on the Principles of Financing Science, *ii)* the Act of 29th July 2005 regarding some forms of support for innovative activity, in which the government introduced the status of "Research and Development Centre" to entrepreneurs in order to develop private R&D centres and increase demand for R&D services, and technology credit for the purchase of new technologies as well as tax incentives *iii)* Act of 4 March 2005 on the National Capital Fund and *iv)* Act of 20 April 2004 on the National Development Plan; *v)* Act of 6 December on the Principles of Conducting Development Policy. Due to the adoption of the Act on some forms of supporting innovation activities, a private entity can now apply for the status of R&D Centre. Before this, all public research institutions were exempt from a significant

part of taxes, but practically no such measures were available for the private sector. There are at least three conditions, which need to be fulfilled in order to be able to receive this status. Firstly, the annual net income should be at least 800 000 EUR. Secondly, 50% of this income should be generated by a centre's own research and development activities. Thirdly, an applicant cannot have outstanding payments for taxes, social and health security. Once the status of R&D centre is granted there is also a possibility to establish an innovation fund, in order to finance R&D activities. The amount spent on the innovation fund reduces the tax base. An R&D centre is allowed to make a payment to the fund of up to 20 % of its monthly income. In addition, an entrepreneur is given a tax relief on land property, forestry or agricultural land tax used to run R&D activities.

One of the public schemes to stimulate private sector investment in R&D and innovation, the National Capital Fund (NCF), a fund-of-funds capitalised at 180 million EUR from the EU Structural Funds and based on revolving capital is expected to be operational by early 2007 (Box 3). The main rationale behind the creation of the NCF is to provide the capital for funds to invest in innovative SMEs and those in the expansion phase. It is expected that investor capital funds will invest up to EUR 1.5 million per project or company.

Box 3. Poland's National Capital Fund (NCF)

The Nation Capital Fund is a unique institution in Poland that was established in response to the equity gap for SMEs'. NCF operates as a fund of funds, a public investor that alongside private investors invests in PE/VC funds with the aim of supporting SMEs. The NCF was modelled on similar initiatives such as the Enterprise Ireland's Seed and Venture Capital Programme and the EU Seed and Venture Capital Measure. The experience showed that such initiatives give measurable results both in number of supported enterprises as well as in number of newly established VC/PE funds.

In order to attract management teams to invest in innovative SMEs, the NCF supports VC funds in two ways:

- Provides capital for investments (equity investments or long-term debt financing in the form of bonds),
- Offering grants to cover a part of the cost of preparing and monitoring of the fund's investment portfolio. The grant can cover up to 65 per cent of the cost of preparing and monitoring of the portfolio. However, the instrument is strictly limited in amount to stress the revolving character of the NCF initiative. Moreover, its availability depends on the managers' performance.

On the other hand, the NCF incorporates multiple procedural and organisational solutions to make sure that the fund chosen to be co-financed by NCF is the one with the best competence and experience. The open tender formula of the NCF means in-depth analysis of offers (formal, economical and legal analyses developed based on proven

international standards) at consecutive stages of the evaluation process. Transparency of the evaluation procedure guarantees that the winning fund is of the highest quality. Nevertheless, the NCF cannot be a panacea for all financial problems faced by Polish SMEs. The NCF is but one element of a broader system for supporting innovative SMEs.

Source: NCF

In the development plan 2007-2013, new actions are considered to foster an increase in business expenditure on innovative activities: *i)* providing support for R&D activities carried out in enterprises by changing the tax regulations (including regulations concerning taxes on purchases of technology, as well as value-added taxes (VAT) and local taxes) and *ii)* the application of new tax instruments which would encourage enterprises to finance various forms of R&D activities.

Public procurement is another tool that is used to boost innovation in many OECD countries. The government is currently considering ways to leverage procurement policies. Observers in the meetings noted that the main challenge is not laws on procurement but the risk aversion inherent in public administration. Given concerns over corruption, the Supreme Chamber of Control, for example, is considered to be apprehensive towards procurement. Poland is currently taking part in an EU working group and is studying good practices rules to foster an innovation-friendly public procurement policy and plans to launch the recommendations and action plan.

As regards regional policy, the government, at the initiative of Parliament, recently brokered an agreement with the marshals of 4 southern regions –Lower Silesia, Silesia, Lesser Poland and Opole to develop an "Innovation Highway" (Autostrada Firm Nowych Technologii). The aim is to foster the economic development of the Southern part of Poland, especially in the area of new technologies and through the location the high-tech companies along the A4 motorway. These regions, which benefit from good communication, land and air transport links, have the potential to develop knowledge based industries. There are more than 125 high schools with more than 600 thousand students (one third of all students in Poland).

3.4. Assessment and discussion

The Polish government has already made important efforts to strengthen the innovativeness of business firms. To date, a focus has been to improve the take-up of technologies by business. To this effect, Poland has introduced in recent years a number of tax based and direct policy instruments from tax credits for investing in innovative technologies to technological credits to loans and loan guarantees system. However, these instruments do not directly address business R&D. Although the government focus on the uptake of technologies is appropriate, evidence points to a strong correlation between R&D spending and the capacity of firms to adopt and use technology so the two goals should be mutually reinforcing. There are also several other issues to be considered in enhancing the innovativeness of Polish firms. For one, Poland does not differentiate between services and manufacturing in innovation support mechanisms (non-R&D). Services innovation is somewhat different from innovation in manufacturing, being more related to the adoption and adaptation of technologies rather than to the introduction of new technologies. Service innova-

tion may thus require different kinds of support mechanisms including policies to promote IT diffusion. The Ministry of Economy has recently launched analytical work on innovation in services. One important advantage in promoting innovation in the service sectors such as retail and business services is that the introduction of existing technologies and modification of existing processes could generate important gains in productivity along the entire value chain.

Providing long-term vision and a stable business environment

Building an innovation system requires a long-term strategy and sufficient predictability in government policy so that entrepreneurs can plan ahead and make investment plans accordingly. Frequent amendments and changes in legal acts vital for a running business increase the costs and risks for business operations. Accordingly, improving the framework conditions for entrepreneurs requires fewer and better regulations, simplifications in the tax system, and greater stability in government policy.

Boost business R&D via direct and indirect incentives

There is more emphasis on innovation, especially the adoption and integration of existing technologies and know-how than on R&D activities per se. However, while it is true that much of the demands by Polish firms for innovative solutions do not involve high technology or R&D, it is important that Poland strengthens its capacity to absorb new technologies, including through more applied R&D in order to shift production up the value chain.

To promote R&D, the government allows a full write-off of R&D expenses (wages, salaries of researchers and operational costs) in the year in which these are incurred. This is a positive step which equalizes the tax treatment of current R&D expenditures with the majority of other OECD countries. However, this still represents rather a weak form of support for R&D since it merely recognises R&D spending as a cost eligible for deduction from annual revenues before pre-tax profits.

Poland does have a tax credit for R&D but only firms that make profits, typically large firms, can use the credit. Different types of tax incentives (such as those used in Norway) could be considered to support R&D in SMEs and NTBFs, and not just incremental improvements in established firms. Several options are available to consider if Poland wishes to leverage tax credits to promote R&D.

- A volume-based tax credit covering broadly current business expenses (R&D wages and salaries, supplies and materials) and capital expenses (R&D machinery and equipment and perhaps R&D buildings and structures). Such an incentive would have to be broad-based – likely a volume tax credit, which is simpler to use and monitor rather than an incremental tax credit.
- A collaboration tax credit to encourage private-public sector R&D linkages. Such a credit could be in the form of a standalone incentive, or given as a premium on the top of a regular R&D tax credit as described above and only on the R&D expenditures performed by business in collaboration with public research institutes.

The use of such tax credits, however, would have to be balanced with a reduction in the overall complexity of the current tax system in Poland. Without reducing complexity and improving ease of use,

such tax credits may not have their desired effect. Corruption is also a risk with any kind of tax credit and the government will have to ensure that there are clearly defined eligible tax expenditures and that the system of certification and control is robust. Several OECD countries such as the UK have created dedicated units in the tax revenue departments to ensure that R&D tax credits are effectively used.

In this respect a major problem in Poland is that much of current business R&D may go unreported as there is no system that defines and explains to business what constitutes R&D (e.g. as in the context of the OECD's Frascati manual on the measurement of R&D Reference). It may be that wider use of R&D tax incentives would help generate interest and awareness in business R&D, as demonstrated by the case of Finland in the mid 1980s. Finland temporarily introduced an R&D tax incentive (for three years) which boosted the interest of Finnish companies in performing R&D. The incentive was then replaced by other forms of coordinated (direct and indirect) support e.g. through Tekes (see Box 4).

Box 4.
The Finnish experience with R&D tax incentives

During 1983-87, Finland operated an R&D Tax Deduction Enhancement scheme on an experimental basis. The decision to implement the policy was based on a concern that industrial R&D was too low, and to compete in the future Finland had to increase both its use of technology and develop new technology-based products[6].

The R&D Tax Deduction Enhancement was abandoned in the wake of a major taxation reform carried out in 1987, which had simplicity and neutrality as important goals. Although short-lived, the scheme produced some long term benefits. It made it possible for some companies to build up their R&D capabilities that were required for accessing selective project funding and paved a way to testing new models of coordinated collaborative innovation support such as Tekes – the Finnish Funding Agency for Technology and Cooperation. The Finnish tax incentive scheme is considered to have been a useful signal emphasizing the importance of technological innovation and defining R&D as a government and business priority[7].

Enhancing the efficiency of public support to private venture capital

The introduction of the National Capital Fund poses a challenge in ensuring that the available funding becomes effective in strengthening innovation. The aim of the NCF is to attract as many PE/VC funds' managers as possible and what is more important, to choose the most experienced and capable of them to ensure that no "easy money" goes to inexperienced fund

(6) European Commission – DG XII European Technology Assessment Network, An International Compendium of Indirect Schemes for Supporting RTD in Enterprises, August 15, 1999 pp.11-12

(7) Hannu Kemppainen, "Some Good Reasons to Abandon R&D Tax Credits: The Case of Finland". Presentation to European Trend Chart on Innovation: Policy Workshop on the Use of Tax Incentives to Boost Innovation, April 15-16, 2002, European Union, Brussels; hannu.kemppainen@tekes.fi

managers. As suggested by the Polish Forum of the Lisbon Strategy, venture capital is often looked upon as a panacea for the shortcomings of the capital markets.

The challenge for Poland is to build a solid foundation for its own potential investors insofar as most angel investment is locally based. Attracting foreign angels and venture capitalists that can invest in small companies is also important but requires more efforts at improving capacity. To ensure the supply of risk capital for start-ups and close the perceived financing gap, OECD member governments have developed a variety of policies and programmes. Examples include loosening of regulations on the types of institutions that can make venture investments (e.g. pension funds, insurance companies), the provision of loan and equity guarantees, schemes for direct equity infusions, and tax incentives such as tax credits for direct investors in small innovative firms[8].

Direct tax credits for risk investment, functioning alongside the NCF, may also be an option to consider. There is some accumulated experience in Europe in attracting business angel investment – examples are the Enterprise Investment Scheme (EIS) and its sister program – Venture Capital Trusts (VCT), established in the United Kingdom[9]. (see Box 5). While the NCF will help address the long-term supply side, tax credits can directly influence investors and entrepreneurs and help address urgent capital market constraints that the NCF alone may not be able to address.

Box 5.

U.K. enterprise investment scheme

- ***Rate of tax credit – 20 per cent of the investment up to a total of £150K***
- ***Holding period for full tax credit 3 years after April 5, 2000 and 5 years before***
- ***Blended with 100 per cent capital gains tax exemption, assuming funds are not withdrawn before the holding period ends***
- ***Full loss offset given***
- ***Available for individuals and corporations***
- ***Available for start-ups and established firms***
- ***Broadly targeted to manufacturing, services, retail and wholesale trade***
- ***Explicitly excludes financial, leasing, real estate, oil extraction, hotels and agriculture***
- ***R&D activities must be carried out immediately after the shares are issued or better be performed concurrently to be eligible***
- ***Administered by U.K. Small Company Enterprise Centre, which is not a financial intermediary***

Source : Sources: HM Revenue and Customs, http://www.hmrc.gov.uk/pdfs/ir137.htm

Unlike the preferential taxation of capital gains, which addresses the back-end of innovation financing, tax credits for risk capital investments can be considered as front-end incentives. They are open to everyone with money to spend. Overall, tax credits appear to be more convenient than capital gains tax treatment to obtain seed finance because they act quickly and target a broader spectrum of risky investments and investors. However, there is a drawback that cannot be overlooked in designing direct investment tax credits. The broader the reach the higher is the likelihood of inexperienced (and less patient) investors joining the group[10].

Three points come to mind in the context of the NCF instrument[11]:

- Public sector funds cannot substitute for private sector financing but can be used to leverage private capital in order to reduce the financing gap. The Act on the National Capital Fund states that the amount of the financial support granted by the NCF shall not exceed the total of payments to the risk capital fund made by the entities investing in that fund. Thus, indeed, public sector funds will be used to leverage private capital in order to reduce the equity gap.
- Policies to promote availability and accessibility of risk capital to innovative small firms need to concentrate mainly on the firm's early stages.
- The proximity between suppliers of funds and those who require finance, particularly for small-scale investment, cannot be underestimated. Being close to the recipient company seems an important factor in building a strong network of angel investors and entrepreneurs and, ultimately, for developing strong entrepreneurial communities. Proximity enables not only the development of valuable relationships and sharing of experiences but also the grooming of newcomer investors by the experienced ones. This implies that any programme that supports local start-ups should stay as close to the local level as possible.

Strengthening awareness of entrepreneurship and innovation

Finally, education and awareness programmes concerning entrepreneurship and innovation need to be strengthened to help overcome negative attitudes towards risk taking in business. Technical students could be a particularly attractive focus for such programmes, as these may have the right skills to develop new innovative firms.

The main policy recommendations from this review as regards the policy mix for promoting business R&D and innovation are to:

- Improve the framework conditions for entrepreneurs and business, by reducing and improving regulations, encouraging competition, simplifying the tax system, and providing longer-term stability in business regulations and in business R&D support mechanisms.
- Boost support for business R&D including through direct and indirect incen-

(8) OECD, Entrepreneurship and Growth: Tax Issues, Directorate for Science, Technology and Industry, Paris, February 2002, p. 15.

(9) The EIS provides relief to investors' direct equity holdings in qualifying companies, whereas the VCT program provides relief for indirect portfolio investments administered by professional fund management companies.

(10) Professional angels differ from novice investors in that they are better diversified, more patient and capable of offering advice in running the business. See, Daniel Sandler, Venture Capital and Tax Incentives: A Comparative Study of Canada and the United States, Canadian Tax Paper No. 108, Canadian Tax Foundation, Toronto, 2004, p. 217

(11) OECD, Financing Innovative SMEs in a Global Economy, June 2004, p. 6

tives. Use of fiscal incentives R&D should be carefully designed so to complement efforts to reduce complexity in the tax system.
- Foster innovation in services and leverage public procurement to boost demand for innovation in lead markets.
- Improve the support for early stage venture financing.

4. POLICY MIX FOR STRENGTHENING INDUSTRY-SCIENCE LINKAGES

4.1. Current situation

All OECD countries seek to strengthen industry-science relationships through various types of initiatives ranging from cluster policies, support to technology transfer and intellectual property rights management at universities, spin-off policies, to researcher mobility schemes. While the policy tools are rather well established, their relative usefulness or effectiveness in a given country is bound by the historical, cultural, institutional and economic factors. In Poland, linkages between industry and the science base have traditionally been weak. In large part, this is a result of the historical legacy of a planned economy which decoupled the science base from production. The drop in business R&D during the 1990s also manifested itself in less support from business to higher education R&D. In 2005, the share of higher education R&D financed by industry was 5.4% down from 6.3% in 2001. Furthermore, the legal and regulatory frameworks to promote industry-science relations through public-private partnerships or through academic entrepreneurial activities are rather recent. In this respect, two legal instruments, the Act on Higher Education and the Act on Some Forms of Support for Innovative Activity are noteworthy.

Over the past decade many intermediary institutions have been established to strengthen the linkages between industry and science. The main bridging institution is the Polish Agency for Enterprise Development (PAED) established on 9 November 2000. The most important activities of the PAED are supporting the collaboration of SMEs with public research entities and promoting the commercialization of R&D results, providing a databank of technologies and products, supporting academic entrepreneurship and providing the Innovation Portal. The PAED is among the institutions responsible for the implementation of sectoral operation programme activities financed from the Structural Funds. In particular, the programme on "Improvement of Competitiveness of Enterprises (856 million EUR)" and the Human Resources Development programme (253 million PLN, approximately 110 million EUR).

Another important player in the system is the Polish Federation of Engineering Associations (NOT) which is a non-governmental network of around 50 branch institutions. The important role of NOT in the area of boosting innovation is the management of small grants for development projects run by SMEs. Some PLN 230 million have been invested in 400 goal-oriented projects in different sectors (e.g.

agriculture, but also high tech industries, and environmental protection) and regions involving SMEs. Of this amount, PLN 150 million was allocated to R&D projects.

Other linking institutions are the Industrial Development Agency (IDA), Centres of Advanced Technologies (CoAT), technology parks, and centres of technology transfers. In the second half of 2005 there were 77 actively operating innovation centres (44 centres for technology transfer, 7 technology incubators, 18 academic business incubators and 8 technology parks) in Poland and circa 86 other initiatives at different levels of advancement.

The Polish Academy of Sciences (PAN) institutes, while are mainly devoted to high level academic research, also conduct advanced applied research. Yet they show the greatest 'distance' from industry. Manufacturing firms rarely place orders with even the most renowned institutes of the Polish Academy of Science. The vast majority of PAN partners come from outside industry – usually other scientific institutions. The PAN institutes seldom work together with innovation incubators nor do they establish many spin-offs. The weaknesses of the Polish spin-offs sector may result from the attitude of the main actors as well as the unfavourable business and regulatory environment for spin-offs, especially the lack of exit possibilities through secondary financial markets.

There are thus many intermediary institutions in Poland. With the exception of the PAED and the PAN institutes, most bridging institutions (innovation centres, etc.) were initiated at the grass roots level and date back to the late 1990s/early 2000s. Funding comes mainly from public funds – state funds, regional funds, university funds, and other sources including EU infrastructure funds. As some of these were initially supported by international funding (Phare programme, USAID, World Bank), they developed on the sidelines of government activity. In 1996, the government started building networks on top of these activities in order to improve their performance.

4.2. Challenges and opportunities

Restructuring intermediary entities and enhancing awareness

The challenge for the government now is to support the stronger intermediary institutions and consolidate them. Many of these centres must improve the services they can provide to firms to remain relevant to the growing needs for knowledge. Another challenge is linking SMEs to universities. Larger firms, especially multinational firms, with small R&D units typically have links with universities. SMEs, however, do not consider knowledge and technology as their main comparative advantage, relying instead on cheap labour. But labour costs are going up as Poland continues its process of convergence with EU so there is a need to make firms aware of the importance of developing a stronger knowledge and technology base. Regulations on universities in Poland also appear to be a barrier to greater involvement by firms. Currently, university boards cannot involve firms as they can in other countries. In addition, universities cannot own nor have equity stakes in spin-off companies.

In 2006 the Institute of The Knowledge Society (Instytut Społeczeństwa Wiedzy), The Conference of Rectors of Academic Schools in Poland (Konferencja Rektorów Akademickich Szkół Polskich) and the National Economic Chamber (Krajowa Izba Gospodarcza), in cooperation with the Polish Agency for Enterprise Develop-

ment (PAED) prepared the first part of the Code of Science and Economy Partnership on regulations, good practices, concerning use by economic entities of the results of scientific works and other intellectual achievements of academia and the scientific world. In February the Jagiellonian University (JU) put on the CITTRU web page (Centre for Innovation, Technology Transfer and University Development of JU – www.cittru.uj.edu.pl) the regulations and rules on the creation of spin-off companies used by the JU and the rules concerning the intellectual property and legal protection of JU intellectual assets.

Another challenge with regard to policy is to ensure stability in programmes. Entrepreneurs and business representatives interviewed in the course of the Review expressed frustration with changing programmes/initiatives to promote industry-science relationships, especially in the heavy financed programmes.

Increasing entrepreneurship from the academic sector

The Polish government is focused on increasing entrepreneurship from the academic sector. Academic entrepreneurship is a relatively recent development in Poland and therefore, up until recently, most actions in this area were bottom-up. Moreover, there were no mechanisms to assist companies with access to technological solutions created in public scientific units. Because universities in Poland are very autonomous, there is a clear limit to direct forms of government intervention.

Improving the environment for IPR in the business and public sectors

Another challenge for Poland is to improve the environment for Intellectual Property Rights in Poland. Given the low level of business R&D, patenting is quite low in comparison to other OECD countries but also to countries of similar size. Poland has implemented legal changes to clarify ownership of IP. According to the Act on Industrial Property Rights, in the case an invention (or industrial design or design patent) is developed as a result of the performance of duties under a contract of employment or any other agreement, the patent rights (as well as the right to the registration and, consequently, the protection of such an industrial design or design patent) is granted to the employer or the contracting entity. The parties to the employment contract or any other agreement, however, may regulate the matter otherwise (Dąbrowa-Szefler and Jabłecka-Prysłopska, 2006). Still, there are administrative barriers to better use of the patent systems. Delays for receiving a patent ranges from between 3 and 5 years. Improving procedures for granting patents would help support government initiatives to stimulate innovative SMEs and academic spin-offs who could leverage IP to attract equity investors.

4.3. Policy responses

In order to stimulate entrepreneurship in the academic sector, two important regulations were recently adopted: the Act on Higher Education and the Act of 29 July 2005 regarding some forms of support for innovative activity. There are no remaining legal barriers concerning innovative activities in universities but significant cultural barriers remains. Other policy actions include the organisation of contests for academic entrepreneurship incubators and support of EU structural funds for academic entrepreneurship development. The FIRE Foundation for example funds a matching scheme linking scientists and coaches. Coaches are offered equity in exchange for training young scientists.

In addition, the government has begun to put in place a regulatory framework to enable a variety of transactions, including the expansion of public-private partnership (PPPs), the creation of spin-off companies, IPR management and public support for technology transfer at public research organisations. Until now, PPPs have not been fully developed, although pilot projects have been implemented particularly in the transport sector. The current legal arrangements for PPPs are somewhat restricted for their use in science and innovation, as the relevant act is primarily aimed at the transport sector. The number of academic spin-off firms is also rather limited in Poland as is university patenting and licensing.

To increase the flow of innovations, the Polish government is planning a few initiatives for the promotion of IPRs in 'the strategy for increasing the innovativeness of the economy for 2007-2013:

- Support for intellectual property management.
- Support for entities submitting patents, especially abroad.
- Facilitation of the process of obtaining industrial property rights.
- Industrial design as a source of competitive advantage.

According to the National Reform Programme (2005-2008), the government plans to restructure the almost 200 Branch R&D units (Jednostki Badawczo-Rozwojowe – JBRs), particularly through consolidation and ownership transformation in order to increase the effectiveness of their activities in stimulating cooperation with industry.

Box. 6

Fostering industry-science relations through people: recent measures in Poland

Supporting the career development of young doctors – financing the research of outstanding young researchers.

The programme is addressed at young PhD holders and aimed at:

- supporting young researchers in acquiring competence, knowledge and abilities required from an independent researcher;
- stimulating the researcher's career;
- increase the level of mobility of Polish young scientists;
- creating new linkages between researchers and research entities.

The programme provides financing for the participation of a researcher in a project carried out in an entity different than the one that awarded them the title. The project's topic must be in line with the principles of Polish research policy and/or those mentioned in the document "Polish position on research policy of the EU".

Academic entrepreneurship.

The programme targets:

- performers of research and development projects, including projects generating the most risk on the scientific side;
- young scientists with experience in inter-sectoral mobility;
- other scientists wanting to commercialise their R&D results;
- SMEs.

The programme aims to support innovation based on R&D activities. The Ministry provides programme financing only for the institutions and the activities should be performed by entities supporting the business environment. The programme will provide:

- Training in management, marketing and finance,
- Advisory services to reach "investment readiness",
- Advisory and financial support in obtaining industrial property rights,
- Assistance in obtaining venture capital.

Programme for patenting of inventions created in Polish research institutions.

The programme is addressed at intermediaries between science and economy and will comprise two modules:

- Training module. This will stress the need for patenting and the importance of patents for the commercialisation of R&D; financing is assigned to the costs of training people wanting to be patent attorneys.
- Financing of activities of entities. This includes the costs of financing of an in-depth survey of the state of technology in case of commercialisation of an invention; financing of study costs in case of commercialisation of the invention; searching for an investor and preparing an investment offer.

4.4. Assessment and discussion

Policies for strengthening science-industry linkages remain under-developed in Poland, even though many instruments have been introduced recently or will be implemented soon. Furthermore, much of the legal and regulatory actions have focused on removing barriers to collaboration but not necessarily on providing sufficient incentives. One exception is the focus on human resource-based industry-science relationships, in particular researcher mobility and training programmes. Much of the knowledge transfer takes place through tacit knowledge flows embodied in people. Mobility and researcher training in industry are important channels for increasing absorptive capacity in firms and thus creating market demand for public research services. While the government seems to be moving in the right direction, there remain several issues that must be addressed to improve policy in this area.

Focusing efforts

The remarkable growth in the number of initiatives supporting science-industry linkages does not seem to have influenced innovation performance favourably thus far. The majority of innovation centres

are mainly providing training services. It is important to monitor and evaluate the activities and performance of institutions supporting innovation and technology transfer. In addition, the restructuring and/or consolidation of institutions, through hard incentives (regulations) or soft incentives (money), need to be considered.

Even though there are few remaining legal barriers for technology transfer, commercialisation, or co-operation between academia and industry, there is a continued lack of incentives and motivation among actors in the system. In order to create an innovation-oriented atmosphere, achieve excellence and enhance co-operation in universities, R&D institutions, and firms, stronger incentives, such as financial incentives for researchers and engineers should be considered. One possible way is public/private partnerships whereby actors compete to take part in strategic areas that link research to industry. A particular problem at universities and public research organisations is that links to business are often only considered by individual researchers, not at the strategic level. Focusing funding for public research in excellent researchers and institutions, as recommended above, could help address this problem.

Deepening co-operation and networking between institutions; building critical mass

In order to improve the effectiveness of the Polish innovation system, public funding needs to be better linked to co-operation and networking and financial resources should be concentrated on institutions and organisations that are able to achieve success. Those links need to be strengthened in order to build a new innovation system in Poland. However, networking must also be extended towards foreign firms which have recently increased their presence in Poland. At the same time, networking activities should be encouraged from the bottom up, in particular at the regional level. This requires a horizontal approach.

Strengthening support for local and regional initiatives

Support for local and regional initiatives should be emphasised because they help build the innovation system from the bottom up. In addition, local groups are sometimes better positioned to identify promising initiatives and actors, and are closer to the local market. Thus linkages between local governments and local universities should be strengthened. While there are a number of exemplary cases of regions successfully promoting innovation – the Warsaw area is strongly specialized in electronic industry, Krakow and Łódź perform particularly well in pharmaceuticals and cosmetics and Lower and Upper Silesia is an attractive region for the automotive industry, including for some foreign investors and their suppliers from abroad – there are many regions that are not doing well. Even those that are doing well cite regulatory barriers at the national level.

The around 200 existing Branch R&D units (Jednostki Badawczo-Rozwojowe – JBRs) are important providers of skilled and knowledgeable R&D sources. They employ 11 000 researchers, 3800 technicians and technologists, including 814 professors, and represent a unique linking mechanism that has existed for many years (dating back to the communist era). The role of these institutions needs to be carefully assessed with respect to their effectiveness and role in providing a strong link between science (universities) and industry. While the JBRs are being consid-

ered for rationalisation and consolidation, their contribution to the economy has been under-exploited. A strategy to benefit more from the JBRs would be to focus efforts on the strongest JBRs by providing them with the means, a time frame and the environment to improve their innovation performance. The other JBRs would likely have to be dissolved or consolidated. However, for this to occur, co-operation from rather powerful sector ministries will be required.

Reforming Centres of Advanced Technologies (CoATs)

There are over 20 regionally located Centres of Advanced Technologies (CoATs) which are consortia involving public R&D units and other entities. However, only a few are performing well. CoATs were to play a seed role in developing regional or interregional clusters in Poland but with little effect. One reason is that CoATs tend to be active in too many technology areas while they might be better focused on one technology field or research theme, building their expertise and catalysing local resources. In this respect, Poland can explore Canada's experience with science and technology networks – the so-called Networks of Centres of Excellence (NCEs). The mission of the Networks of Centres of Excellence is "To mobilize Canada's research talent in the academic, private and public sectors and apply it to the task of developing the economy and improving the quality of life of Canadians." The NCE approach is competitive and focused on a specific research theme with clearly identified deliverables (See Box 7).

Box 7. Canada Networks of Centres of Excellence (NCEs): Developing Public-Private Research Partnerships

o *About the Programme*

For over 15 years now, the NCE program has been providing Canadian universities and companies with the support they need for pre-competitive research. NCEs stimulate increased research and development in the private sector and provide a window on discovery and early-stage development in universities. The NCEs enhance the ability of companies to compete globally by giving them working access to the world-class expertise of Canadian universities and government lab researchers. Collaboration is the principal mechanism through which industry–university–government lab interactions occur in the networks. In particular, networks offer industry an opportunity to work in teams and build synergies in truly multilateral settings, predominantly with universities but also with government researchers.

o *Networks Today*

There are 25 NCEs operating in the areas of strategic interest to Canada, such as advanced technologies, biotechnology and health, and natural resources and environmental science and advanced social sciences research. This is on the top of 16 networks for which programs have been completed. The funding for research and training in Canadian universities through Canada's three granting agencies' peer-reviewed research

programs is the foundation upon which the successful network approach is built.[1] The annual budget is approximately CAD $80 million.

o *Benefits*

In 2004-2005, 830 companies, 266 provincial and federal government departments and agencies, 51 hospitals, 194 universities, and more than 365 other organisations from Canada and abroad were involved in the NCE program. The active involvement of Canadian industry provides stimulating training environments and employment opportunities for students. In fact, about 88 per cent of network graduates are successful at finding jobs. The networks stimulated outside investments of over CAD 71 million, including more than CAD 28 million by participating private-sector companies.

Source: www.nce.gc.ca

(1) Three Canadian federal granting agencies – the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council of Canada (SSHRC) – and Industry Canada combine their efforts to support and oversee the NCE initiative.

In summary, Poland has a way to go to promote greater collaboration between the science sector and the business sector. There is not yet a "culture" of inter-organisational R&D and innovation co-operation in Poland. Business firms on the one hand and public science organisations on the other hand are in the process of transformation as regards industry-science linkages. Scientists are in a learning process with respect to the commercialisation of scientific results, while businesses are only now starting to discover that collaboration with the science sector can be advantageous. The socio-cultural aspects should not be underestimated here, and people's attitudes only change over (a longer) time. There are examples for functioning innovation cooperation (networks) between business sector and scientific organisations (such as in the IT sector), but in general there is still a relatively strong hesitation to engage in joint R&D or innovation projects on both sides.

Foreign investment companies – most of them in Poland coming from western Europe and the US and used to co-operation activities – can only partially make up for the lack of science-industry relations. The foreign subsidiaries are often part of a global value added chain, and mostly integrated in multinational rather than in the local innovation networks. Given the low amount of formal R&D and innovation in the business sector, policy attention should be given to stimulating demand in the business sector for knowledge sharing and development with academia as opposed to "pushing out" research from universities. This is a key role for bridging institutions, including non-profit and non-governmental players. The main policy recommendations from this review as regards the governance of the policy mix for industry-science relationships are to:

- Improve the regulatory frameworks for public-private partnerships by granting actors more flexibility and autonomy in the management and financing of P/PPs.
- Rationalise the number of intermediary institutions by linking public support for the institutions closer to performance.
- Continue the process of decentralisation of innovation measures to regional actors, but tie these efforts to reporting requirements and independent evaluation.

- Non-governmental actors play an important role in linking public and private research and should be encouraged
- Encourage capacity building for management of IPRs in universities but focus on the best research performers.

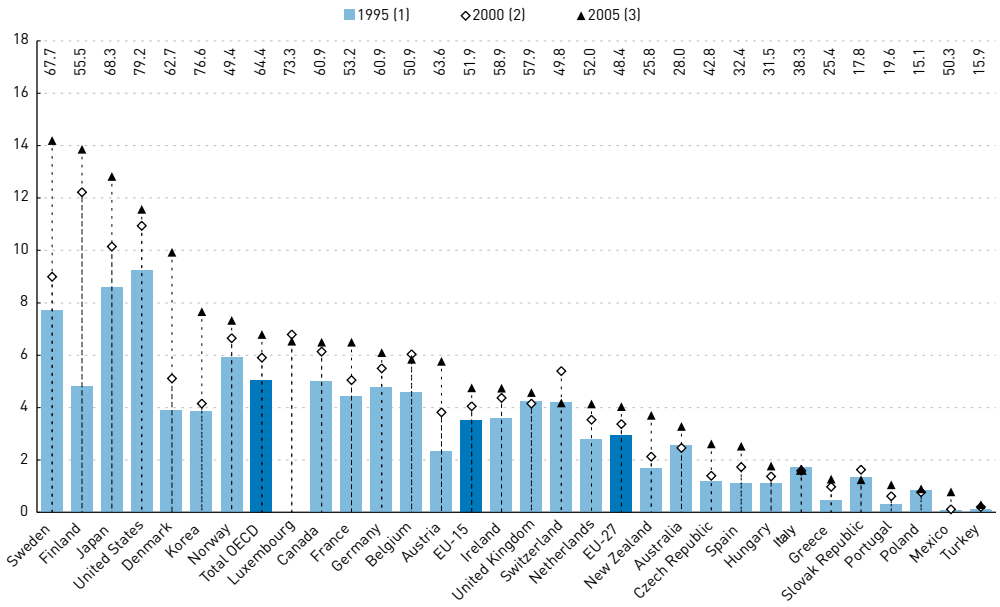
5. POLICY MIX FOR HUMAN RESOURCES IN SCIENCE AND TECHNOLOGY

5.1. Current situation

Poland has invested heavily in human capital since the 1990s. There are some two million students in higher education of which some 30 000 students are undertaking PhD training (over 5 000 of them graduate each year). The share of university graduates in science and technology in Poland, however, lags behind that of other OECD countries. In 2002, only around 12% of university graduates obtained a degree in science and engineering. On the brighter side, Poland ranks ahead of Italy, Hungary and Norway in terms of PhD graduates in science and engineering in S&T. According to results from the OECD's Programme for International Student Assessment (PISA), Polish 15-year-old students perform similar to the OECD average in terms of their ability in mathematics, science and reading. Part of the reason for the low enrolment in S&T studies is perhaps related to demographic factors (i.e. the rapid decline in school enrolments as a result of the fall in birth rates after 1990) as well as low demand for researchers, especially in the business sector. Of the total number of Polish researchers, only 13.7% work in the business sector (OECD, 2006a). This represents less than 1 per 1 000 employees (Figure 5). At the same time, Polish PhD graduates encounter difficulties in the academic job market. One reason is the large share of graduates in the social sciences and the limited number of faculty positions. The dual requirements for a PhD as well as a habilitation degree to obtain an academic position act as a quality control mechanism but also as an additional barrier to entry. In addition, there is little external competition in the recruitment of faculty which could affect the flows of knowledge as well as quality.

In terms of output, Polish research stands out respectively well given its size. In 2003, Poland's share in the world scientific publications accounted for 1.45% (11 600 citations). In terms of citations, the average number of citations was 266 per thousand inhabitants compared to 673 for the EU. Another characteristic of human resources in Poland is the low level of mobility within public research as well as between public research and industry. Housing markets in metropolitan areas where research institutes are concentrated and relatively low salaries also act as a barrier to mobility.

Although Poland experienced a significant brain drain of researchers and other highly skilled workers in the 1990s, this outflow is viewed as an opportunity to create a more open innovation system insofar as expatriate Polish researchers can be linked to the national science base. While informal contacts are the main channel, the government has created a programme to recruit expatriate researchers and is also studying the possibility to use overseas embassies to link overseas Polish researchers to Polish research institutes and firms.



1. 1993 instead of 1995 for Austria; 1996 for Switzerland.
2. 1998 for Austria, 1999 for Denmark, Mexico, New Zealand, Norway and Sweden.
3. 2004 for Australia, Canada, France, Switzerland and Turkey; 2003 for New Zealand.

Figure 5. Business researchers per thousand persons employed in industry

OECD: Main Science and Technology Indicators database, 2007-1.

5.2. Challenges and opportunities

While the Polish economy as a whole faces the challenge of increasing the stock and quality of human capital, there are specific challenges for the science base as well as the business sector. As a result of the brain drain discussed above, scientific organisations in Poland face the problem of aging scientists. In addition, the relatively low incomes in the public science sector make it difficult to recruit talented graduates for an academic career. It is quite common for scientists and even professors to engage in dual employment (e.g. consulting) to supplement pay. There is also a clear lack of mobility of researchers within the country. As concerns university faculty, this is partly related to the fact that a candidate for a professorship can be recruited from the same university from where she/he received her/his habilitation.

An additional challenge is better linking education curricula to industry needs. In particular, public universities have been ill equipped to provide professional training (e.g. communication and business skills, English language skills, accounting). Although this gap has partly been filled by the emergence of private universities, this has raised questions of quality control and finance (OECD, 2007).

Another area where Poland faces a human resource challenge concerns life-long learning and adult worker training. This is both a supply and demand problem.

For firms, the high level of unemployment and a supply of new young and more educated workers reduce the incentive to train workers. The lifelong learning culture has not yet been accepted by older and less educated generations who still tend to believe that this is important for their children, not for themselves. Access to information on training availability is also a problem (OECD, 2006b).

Attracting more foreign students and researchers

While attracting foreign expatriate researchers remains a challenge, a related change is attracting foreign (non-Polish) students and researchers to Poland due to low salaries. This is especially a problem in the context of Polish participation in Framework programmes as scientists earn less money in Poland than they earn abroad. One solution that has been raised is to use the EU Structural Funds to reduce the pay gap.

5.3. Policy responses

The government is focusing on improving the quality of human resources. Like other OECD countries, Poland has made efforts to improve teaching. The Law on higher education introduced the University Quality of Teaching/Study System that institutions will need to adopt and which will be evaluated and supervised by the National Rectors Conference. A recent proposal by the National Rectors Conference to put mathematics back into compulsory curricula at secondary level was approved by the Ministry.

There is also a recognition in Poland that HRST can be used to attract R&D-related FDI. The programmes to attract expatriate researchers (i.e. Homing programme and the forthcoming Welcome programme) are focused on post-docs coming back from abroad but most of the applicants have actually been recruited from within Poland. This suggests that the problem is not one of a lack of willingness to return but rather limited possibilities to obtain grant funding and low career prospects. The government also plans to attract, within the framework of the Welcome programme, expatriate "senior researchers" to let them establish new labs. However, this has generated public discontent regarding the potential discrimination vis-à-vis national researchers; therefore, the government is now opening access to foreign researchers and returnees alike.

To improve mobility to industry, the government will introduce a programme for inter-sectoral mobility. The government is also considering adopting R&D tax incentives for R&D personnel that would lower social charges to facilitate the hiring new researchers in SMEs.

The initiatives to strengthen life-long learning were included in 'the Strategy for increasing the innovativeness of the economy for 2007-2003': 1) the development of an open and flexible life-long learning and 2) increasing the access to life-long learning and improving its quality. The government will fund life long learning programme at institutions (financing up to 100% per cent but institutions will charge a small fee for participants, either firms or individuals). Institutions will also receive financial support to prepare new curricula and to organise courses.

5.4. Assessment and discussion

Attracting more talented young students into S&T related careers

Given the low number of S&T students and the recent decline in enrolments in

Poland, it is surprising the government is placing little attention at increasing incentives for young people to study science. The policy response seems limited to strengthening professional training, entrepreneurship, firm-based training and life-long learning which are very important but not specific enough to build a researcher workforce. In addition, many of the instruments involve "soft measures" such as seminars, workshops etc. While these are useful to promote new thinking and a culture of openness and risk, Poland should not ignore the need to encourage interest in science among youth. After all, if one of the objectives is to increase R&D and innovation, new graduates will be required to perform these activities. While this is a responsibility of the Ministry of Education, it is also one that should concern the Ministry of Science and Higher Education, the Ministry of Economy and the business community at large as well as the regions.

Better linking curricula to industry needs

Another area where Poland needs to put more effort appears to be the inter-sectoral mobility of researchers as well as improving the relevance of PhD training to industry. One mechanism that has been long used in other countries like Denmark and Netherlands are Industrial PhD training programmes (Box 8). The government's Operational Programme for Human Capital (2007-2013) will include initiatives for mobility and training.

Box 8. Industrial PhD training: some policy examples

Denmark: Since 1970, the Danish Industrial PhD initiative has aimed at enhancing R&D in the Danish business sector. It provides funding for 200 PhD fellowships for candidates to work on a project defined by a company in co-operation with the university. A subsidy goes to the company (50% of researchers' salary) and to the university for supervision costs and training and complementary business-targeted courses. The university may be foreign.

Netherlands: The Casimir programme, launched in 2004, provides financial incentives for companies and knowledge institutions to organise exchanges between talented researchers in the public and private sectors and offer them enhanced career prospects. The Casimir programme budget for 2005 is approximately EUR 3 million. The programme is open to PhDs, Bachelor's-level research staff, post-doctoral researchers, university lecturers or senior lecturers, professors and researchers working in the private sector. It is targeted primarily at researchers in science and technology. Applicant companies and knowledge institutions must be based in the Netherlands. The knowledge institution may be a university or PRO.

Portugal: The Enterprise PhDs programme of the Foundation for Science (FCT) aims to promote career diversification as well as collaboration between firms and universities. In addition, during 1997-2003, the FCT helped to place 77 PhD holders and 63 Masters in nearly 50 firms, through the support of the Innovation Agency.

Source: OECD Science, Technology and Industry Outlook 2006.

Poland's brain drain likely concerns not only researchers but also entrepreneurs and other highly skilled workers (OECD, 2006b). The government's programmes to foster return migration of top researchers is a positive initiative but not one that alone will be sufficient to help Poland retain its human capital. The framework conditions for entrepreneurship as well as the specific conditions for researcher employment in the public sector must be improved to make research careers in Poland attractive. In summary, the main policy recommendations from this review as regards the policy mix for human resources in science and technology are to:

- Develop stronger incentives for scientists to achieve excellence and enhance co operation with business, such as financial incentives and research performance criteria.
- Ensure faculty and research recruitment is based on open competition and transparent promotion criteria so as to enhance quality and mobility. Promotion criteria may need to be revised to recognise the contribution of researchers to more applied activities such as technology transfer.
- Improve the labour market conditions for graduates in science and technology by better linking vocational and higher education training to industry skill needs.
- Strengthen entrepreneurship education and awareness programmes to help overcome attitudes towards risk taking.

6. GOVERNANCE OF THE INNOVATION SYSTEM

6.1. Current situation

Governance of the innovation system in Poland has historically been weak, partly due to a lack of horizontal co-ordination between the main ministries and limited linkages between the business sector and the science community. Various government S&T committees are still mainly made up of academic scientists and professors, and include few business representatives. Since 2004, the main body responsible for S&T policy is the Council for Science. The Council is made up of four committees:

- The Committee for Scientific and Technology Policy (CRTP).
- The Commission on Research for Scientific Development (CRSD).
- The Commission on Research for Economic Development (CRED).
- The Team of Appeal (AC).

The task of the Council for Science, which constitutes a formal representation of the research community, is to play an advisory role to the Minister of Science, who has a decision-making role in the field of scientific policy and funding of R&D. The role of the Council for Science is to advise on setting general rules on how to evaluate science. Among its organs, the CRTP provides opinions on draft documents concerning national research and technology policies and innovation policy; it gives opinions on draft legislation and economic and financial arrangements concerning the development of science and technology; as well as on financial plans concerning the State budget allocated for science. The CRDS is devoted to the advancement of science (blue sky) while the CRED focuses more on applied science. Another actor in the design and implementation of policy is the Ministry of Economy which deals with innovation policy from the demand side (e.g entrepreneurship). Within

that Ministry, the Economy Development Department is responsible for innovation policy, strategy and policy making as well as programming and analytical work concerning the creation of new instruments and legislative activities.

Priority setting for R&D and innovation is carried out at different levels and is often the result of a complex process of conformity with world trends, strengths of Polish scientific activities, the needs of the Polish economy as articulated through the various advisory instances and at institutional level. Poland is carrying out a National Foresight exercise to better define priority fields for R&D.

At the sub-national level, the regions are important players and have had their own regional innovation strategies (RIS) since 2002. Currently 15 regions, except Mazovia, have started implementing RIS using EU structural funds and their own budgets. The Mazovia region carries out its own RIS as a 6th Framework Programme project. While the Ministry of Economy does not directly influence policies of the regions it can involve and advise them to use policies at the regional level to complement national strategies. It is envisaged that some of the funding for innovation will be devolved to the regions while the central government will focus on more high-end and large scale projects. Support for simple investments to the level of 2 million EUR will be channelled through the regions in the future. If investment is related to existing technologies, it will also be channelled through the regions.

6.2. Policy responses

The government is now trying to strengthen the governance structure for innovation. One proposal is to create a High Level Innovation Council which will provide advice to the Prime Minister. In practical terms it will also merge activities of the Ministry of Economy (demand side) and the Ministry of Science and Higher Education (supply) and address co-ordination between the two ministries. Furthermore, the Innovation Council will act as a Forum for the stakeholders of the national innovation system insofar as its composition will represent the different actors. The existing Council for Science and Technology Development was supposed to serve this purpose but representation has not been strong enough and its main weakness is that it worked on an ad hoc rather than a permanent basis. The High Level Innovation Council will be established in the third quarter of 2007 and the government is currently focusing on strengthening the Council on Science and Technology Development.

The establishment of the Innovation Agency responsible for the process of implementation of innovation policies aims to improve the efficiency of implementing the innovation policy on the national and regional level. The agency will be created by transforming an existing institution (Polish Agency for Enterprise Development). The government wants the agency to play the role as not only a distributor of financial resources, but also an active element of the National Innovation System.

The government has introduced a system for the evaluation of research institutions. The focus is on the quality of scientific output (e.g. publications, citations) as well as on investment in infrastructure. With regard to applied research, a holistic approach is used since information on patents, licenses, or research contracts are only one aspect of output. In the case of the branch institutes, evaluation takes place vertically via the individual ministries that have the responsibility for steer-

ing (e.g. Ministry of Economy) and from the Ministry of Science and Higher Education. One possible problem with this arrangement is that the different evaluations and their results are not linked. In other words, the Ministry of Economy's assessment does not influence the funding from the Ministry of Science and Higher Education even if the former has the remit to close or consolidate the institutes. As regards operational programmes, responsible Ministries including the Ministry of Economy and the Ministry of Science and Higher Education have built-it an evaluation/monitoring systems as part of the requirement of implementing projects funded via EU structural funds.

6.3. Assessment and discussion

The Polish system for the governance of science, technology and innovation has undergone substantial changes. A number of laws and new institutions have been created to improve capacity for policy making. However, in practice, support and attention to innovation at the higher levels of government remains too weak to galvanise cross-ministerial co-operation. The relatively weak incentives for co-operation between the Ministry of Education and those at the Ministry of Science and Higher Education illustrate this. The low level of business involvement in strategic planning and in policy advisory instances has also been identified as a challenge. Many OECD countries including Finland and Korea have implemented reforms to raise the involvement of senior officials across ministries; Poland could draw on the lessons from these experiences (see Box 9).

Box 9.

Reform of STI policy governance for better coordination: the example of Korea

Prior to recent reforms, Korea's governance system was characterised by:

- Lack of comprehensive coordination;
- Weak links between S&T policy and the government budgets;
- Excessive competition among ministries and problems in management of government research institutes (GRIs).

Since 2004 Korea has undertaken reforms to improve the coordination and co-operation among R&D related ministries to reinforce the transition to an innovation-driven economy and improve the effectiveness of its national innovation system. The Minister of Science and Technology was elevated to one of three Deputy Prime Ministers and commissioned to supervise not only planning, coordination and evaluation of micro-economic policies related to Science and Technology, but also to coordinate and allocate the government R&D budget on behalf of the Ministry of Planning and Budget. The government research institutes (GRIs) under the Prime Minister's Office were transferred to the National Science and Technology Council (NSTC), in which the President is Chair and the Minister of Science and Technology is vice-chair. In addition, an independent Office of Science, Technology and Innovation (OSTI) was established under Ministry of Science and Technology (MOST).

Source: OECD (2005), 'Governance of Innovation Systems'

Reinforce capacity for evaluation

Evaluation remains a weak priority although there have been improvements such as in ex ante evaluation for funding. That said there is a potential to benefit from good practices in evaluation related to participation in EU projects as well as the Framework Programmes. However, Poland will need to do more on evaluation and should strengthen the training and culture of evaluation at both the new funding agencies, the operational branches of the Ministries, the universities and the proposed Innovation Agency.

The main policy recommendations from this review as regards the governance of the Polish innovation system are to:

- Develop a stronger capacity for long-term planning of public research and innovation.
- Enhance attention at the highest political level for innovation (in its broadest sense), to build a coherent and well co-ordinated approach to innovation across the government, involving relevant stakeholders.
- Enhance business involvement in S&T policy making, especially in priority setting. Enable and encourage the involvement of business representatives on university boards.
- Improve institutional co-ordination in policy design and implementation.
- Mainstream evaluation as a core element of science and innovation policies.
- Strengthen the evidence base for science and innovation policies, by developing pertinent statistics and analysis.

CONCLUSIONS

1.
To compete globally, Poland will increasingly require world-class science and innovation. Polish industry will not be transformed overnight but by adopting existing technologies to foster innovation, it can further stimulate productivity growth. At the same time, the lack of a world leader position in high technology sectors does not mean Poland should not invest in R&D or in highly skilled workers. On the contrary, adopting and integrating foreign technologies requires investment in people as well as in infrastructure and equipment. Poland's traditional strengths in basic science are a base on which the country can build in order to expand capacities in applied research, especially in the business sector.

2.
Thus far substantial changes have taken place in the Polish S&T and Innovation System since the beginning of the transformation form a planned to a market economy. Progress is clearly visible in all areas related to the policy mix for innovation. Business companies, now operating under world market conditions and international competition, have technologically modernised substantially. Foreign investment enterprises have contributed to some extent. In the science sector, however, there are some difficulties stemming from the socialist past, such as the large number of R&D units (branch institutes), the fragmentation of funding and underdeveloped level of competitive funding as well as challenges related to human resources (e.g. age of the scientific workforce in the public research, low mobility). Some of these problems will resolve themselves over time but others need concerted policy actions and political commitment. One important point is the need to focus on scientific excellence. Linkages between the elements (organisations) of the innovation system need to be strengthened, but this cannot be dictated or initiated in a short time period. It needs to develop over time since it requires changes in people's mind sets and attitudes towards cooperation."Best practice" examples with a signalling function might be helpful here. Initiatives to foster better linkages between industry and academia such as public/private partnerships must also be expanded. In addition, specific policies and instruments to boost innovation and R&D will be required, but these should be market-based to reward risk taking.

3.
It is thus of utmost importance that Poland continues to strengthen the framework conditions for innovation and entrepreneurial activity. Poland has nearly all the institutions and tools of a "modern" innovation system. What is needed is to align the instruments, institutions, and emerging networks to a coherent innovation system. A co-ordination of national efforts can help build a stable legal and financial environment that provides a more "innovation friendly" environment, which should include an appropriate mix of policy instruments to support innovation. While some gaps remain, several of which are examined in this paper, the review also underscores that there is a strong awareness of the need to strengthen innovation, and a promising range of new policy proposals that go in the right direction. The recommendations of this review are intended to help Poland adjust its mix of policies and instruments further and foster innovation.

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ANNEX 1.
OECD Experts Participating in the Review of the Policy Mix for Innovation in Poland
Warsaw, 14-17 November 2006

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OECD PEER REVIEW OF INNOVATION POLICY MIX IN POLAND, 14-16 NOVEMBER 2006

Interview Schedule – version 1 November 2006

Hours	TUESDAY, 14 NOVEMBER	PARTICIPANTS
9:00-09:30	**OPENING**	Welcome reception by the Vice-Ministers of Science and Higher Education; the Vice-Minister of Economy.
09:30-11:00	**S&T and innovation policy (1,5 hour) – Overall innovation system**	The Vice-Minister of Economy, The Vice-Ministers of SHE Education, the Council for Science (the Chairman, the heads of the Committees), The GCHE, the PAN, the MCRDU, The CRAS (Smólski), The PAED, the IDA. The representatives of the Departments (Gulda, Drewniak).
11:00-11:20	**COFFEE BREAK**	
11:20- 13:10	**Science system in Poland (2 hours)**	The representatives of the Committee on Scientific and Technology Policy, the Committee on Research for the Development of Science and the Committee on Research for the Development of Economy of the Council for Science The representatives of the consortia (CoE) The representatives of the Departments (Drewniak, Mazur, Wielec, Kołodziejski, Szumańska, Żbikowski, Jędzejczak, Gryzik, Sieczek, Hebda, Kowalak, Gulda)
13:10-14:10	**LUNCH**	
14:10-15:40	**Human resources for RDI (1,5 hour)**	The representative of the Council for Science, The GCHE representative, The CRAS representative (Woźnicki), The CRN-UHEIs, The CCADT, The FPS, NCP of the EU RP. Representatives of the Departments (Dr Drewniak, Jędzejczak, Gryzik, Sieczek, Wierzbicka, Trojanowska).
15:40-16:00	**COFFEE BREAK**	
16:00- 17:30	**Panel discussions (1,5 hour)**	Researchers and R&D managers roundtable (representatives from different fields and institutions)

Hours	WEDNESDAY, 15 NOVEMBER	PARTICIPANTS
9:00-11:00	**Business R&D and Innovation (performance, challenges, governance, policy objectives) – 2 hours**	The ME's Economy representatives: The Economy Development Department (Gulda), the Department of Supervised and Subordinate Unit (Hebda), the Support Instruments Department (Kowalak); The MSHE representatives': The Department of Strategy and Development of Science, the Department of Research for Economy, The CPE, The PCC, the PAED, CTTs, The PFEA - NOT, The MCRDUs, The CASE, The PO RP representative.
11:00-11:20	**COFFEE BREAK**	
11:20- 12:50	**Business R&D and innovation financing (National Capital Fund, seed capital, business angels, tax incentives, PO-IE, pilot projects of PAED - techno starters, innovation loans) – (1,5 hours)**	The Ministry of Economy representatives, The Economy Development Department (Gulda, Lubos), The Ministry of Science and HE representatives': The Department of Strategy and Development of Science, the Department of Research for Economy. The BGK, The PPEA, the NCF.
12:50-13:50	**LUNCH**	
13:50-15:20	**Industry-science linkages (policy packages – performance, challenges, governance, policy instruments) – (1,5 hour)**	ME's representatives (Gulda, Lubos, Kowalak) The MSHE's representatives (Drewniak, Wielec, Gryzik, Sieczek) The PAED, The IDA, The NCP EURP, The FPS, PBICA, The IPC, The PFEAs – NOT, The KSU.
15:20-15:40	**COFFEE BREAK**	
15:40- 17:10	**PANEL DISCUSSIONS**	Business roundtable (representatives from different sectors and firm-sizes)
Hours	**THURSDAY, 16 NOVEMBER**	PARTICIPANTS
9:30-11:00	**Technology transfer and R&D commercialisation (the roundtable of the main bridging institutions representatives)**	The STP, CTT's, The IBNGR, The CASE, CoATs representatives, PTPs, RIPs, Technology and Academic incubators, enterprises
11:00-11:20	**COFFEE BREAK**	
11:20- 13:00	**Innovation in regions (Regional Innovation Strategies, Regional Operational Programmes)**	ME's representatives (Gulda, Lubos) MSHE's representatives (Drewniak, Gryzik, Wielec), The MRD's representatives (Kapciak, Żuber) ROPs, RIS representatives (Lower Silesia, Upper Silesia, Greater Poland).
13:00-14:00	**LUNCH**	
14:00-15:50	**Support for innovation**	Visit to the PAED
15:50-16:10	**BREAK**	
16:10- 18:00	**Summary**	

Polish acronyms:

1. ME – Ministry of Economy
2. MSHE – Ministry of Science and Higher Education
3. MRD – Ministry of Regional Development
4. CS – The Council of Science
5. CRDS CS – The Committee on Research for the Development of Science of the Council of Science
6. CRDE CS – The Committee on Research for the Development of Economy the Council of Science
7. CA CS – The Group of Appeal of the Council of Science
8. GCHE – The General Council for Higher Education
9. CRAS – The Conference of Rectors of Academic Schools in Poland (KRASP),
10. CRN-UHEIs – The Conference of Rectors of Non-University HEIs in Poland (KRePSZ)
11. CRPTU – The Conference of Rectors of Polish Technical Universities – (KRPUT – Konferencja Rektorów Polskich Uczelni Technicznych)
12. CRPPHEIs – The conference of Rectors of Polish Private HEIs (KRUN – Konferencja Rektórów Uczelni Niepaństwowych)
13. CCADT – The Central Commission for Academic Degrees and Titles
14. SAC – The State Accreditation Committee
15. PAN – The Polish Academy of Science
16. MCRDU – The Main Council of Research and Development Units
17. PFEA – NOT – The Polish Federation of Engineering Associations - NOT
18. IPC – The Information Processing Centre (OPI)
19. FPS – The Foundation for the Polish Science
20. NCP EU – The National Contact Point of EU Research Programmes
21. PAED - The Polish Agency for Enterprises Development
22. IDA – The Industrial Development Agency
23. CoE – Centers of Excellences
24. CoAT – Centers of Advanced Technologies
25. CTT – The Centers of Technology Transfer
26. CPE – The Confederation of Polish Employers (the KPP)
27. PCC – The Polish Chamber of Commerce (KIG)
28. CASE – The Centre for Social and Economic Research CASE
29. PO RP – The Patent Office of the Republic of Poland
30. BGK – The National Economy Development Bank (Bank Gospodarstwa Krajowego)
31. PPEA – The Polish Private Equity Association
32. NCD – The National Capital Fund
33. PBICA – The Polish Business and Innovation Centres Association (SOOIPP)
34. KSU – The National SMEs Services Network (KSU)
35. STP – The Polish Science and Technology Park
36. PTP –The Polish Technology Platforms
37. RIP – The Regional Industrial Parks
38. IBNGR – The Gdańsk Institute or Market Economics
39. ROP – Regional Operational Programmes
40. RIS – Regional Innovation Strategies