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Analysis of policy mixes to foster R&D investment and to contribute to the ERA

Poland

Jacek Walendowski

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ERAWATCH Network – Technopolis Group, Belgium

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Executive Summary

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. This report aims at supporting the mutual learning process and the monitoring of Member States efforts. Its main objective is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The report builds on the analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

The latest available statistics confirm Poland's poor performance in mobilisation of both public and private R&D investment. Despite a rapid (three-fold) increase of gross expenditure on research and development (GERD) during the period 1995-2007, its level in 2007 was estimated at 0.57% of GDP. In comparison, business expenditure on research and development (BERD) is estimated in 2007 at 0.17% of GDP, which is only higher by 1 percentage point than in 1995.

On the one hand, **structural problems**, which are summarised below are the major barriers to increasing R&D investments.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Polish system is heavily reliant on publicly-funded research	Opportunities: Concentration on the best performing research institutes to consolidate research efforts and promote excellence in a small number of selected areas. Risks: Delays in the adoption and implementation of new principles of science funding. This naturally means maintaining the present system, which is characterised by equal distribution of funding to all research areas mainly through the statutory funding.
Extent of socio-economic challenges	Opportunities: R&D related investments have positive impacts on economic growth and jobs. Risks: The earmarked funding does not generate expected results, which in turn might affect decisions to increase public R&D funding.
Limited absorptive capacity of SMEs	Opportunities: More companies investing and/or undertaking RTDI activities. Risks: Administrative barriers in the implementation of programmes and dependency on grants.
Little pressure from the society and economy	Opportunities: Stimulating the demand of economic actors and citizens to purchase new technologies developed based on recent R&D results. Risks: Associated with R&D projects, i.e. long duration of projects and a degree of uncertainty involved in research projects.
Frequent changes introduced to the legal framework	Opportunities: Introduce a clear, comprehensive and stable framework conditions conducive to R&D activities. Risks: Due to complexity of research system and extent of ongoing legislative revisions, there might be a need to introduce further changes, shortly after new provisions enter into force.

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Few large companies are the main R&D performers	Opportunities: Encourage the SMEs to undertake R&D activities, if relevant. Risks: Creating the dependency on subsidies.
Fragmentation of research efforts	Opportunities: Instruments mutually reinforcing the ongoing structural changes/reforms. In particular, the opportunity is to consolidate R&D efforts and set out strategic areas on which funding will be concentrated. Risks: After the formulation stage is completed, potential problems might be encountered during the actual implementation due to lack of institutional capacity and/or coordination mechanisms.
Mismatch between the skills and jobs requirements	Opportunities: Developing skills matching the needs to job market. Risks: Brain drain.
Intellectual property rights protection	Opportunities: Provide support to better manage IP issues. Risks: Low interest due to low awareness among the potential beneficiaries.
Low attractiveness of Polish market to attract VC funds	Opportunities: Addressing the funding gap through attracting the VC funds, creating investment culture and accompanying, in particular SMEs in the process of increasing their readiness for investment. Risks: Associated with setting up the VC funds.
Linear logic in the planning and design of support measures	Opportunity: Change towards systemic planning. Risks: Limited impact of independent evaluations.

On the other hand, there are also other **specific problems**, which have had negative impact on increasing R&D investments. For example, the incentives introduced by the Act on Some forms of support for innovation activities of 29 July 2005, notably the Status of R&D Centre (PL_77) and the tax incentive (PL_34) have not proved to be so effective as it had been initially planned. In practice, these instruments have not attracted a lot attention among the potential beneficiaries, precisely because they have not been recognised as particularly interesting instruments for undertaking and intensifying R&D activities. In context of contributions of national policies to the realisation of the European Research Area (ERA), the emerging finding is that the biggest focus in financial terms is on supporting the development of infrastructure research. That is why the present report argues that it is very important to introduce 'smart' mechanisms into the infrastructure measures with a view of triggering science-industry co-operation. While the policies in the domain of labour market for researchers are at the early-stage of development, opening-up research projects has received little policy attention.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	• This is relatively a new area, which has received considerable policy attention. • Despite the existing barriers and obstacles to mobility of researchers, mobility is generally not rewarded.	• The recent actions are concentrated on improving the career development model of researchers.
Governance of research infrastructures	• By the most recent count, it is estimated that more than 8% of the 2008 Science budget was allocated to this type of investments. • The significant financial resources have been also allocated in the Operational Programme Innovative Economy, 2007-2013. • Developing the Roadmap of the Polish research infrastructure projects has been identified as one of the tasks of the National Reform Programme 2008-2011.	• The focus of the OP-IE is on supporting the development of infrastructure of research centres, which are characterised by high-potential; establishment of joint infrastructure of several research institutes; as well as IT infrastructure.

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Autonomy of research institutions	• The higher education institutions are autonomous in all areas of their activities, although the Minister of Science and Higher Education has control function.	• While the recently proposed changes aim at increasing the autonomy of higher education institutions (e.g. financial decisions require the agreement from the Ministry of Treasure if it involves the amount exceeding €250,000), there are several examples of new obligations for higher education institutions (e.g. a new obligation would be that HEIs have to develop and adopt guidelines concerning IP management and principles of commercialisation).
Opening up of national research programmes	• So far, this action has received little policy attention. There are just few programmes encouraging international collaboration, which will be implemented by the Polish Science Foundation in the framework of the OP-IE 2007-2013.	• Projects undertaken by leading foreign scientists in Polish research institutes (Programme Welcome); support to institutions collaborating with a foreign partner on the realisation of doctoral programmes (International Doctoral Programme); and support to research projects with an involvement of students, Phd students and post-docs (Programme Team).

The key conclusions emerging from this report can be summarised as follows:

- The adopted policies have not yield the expected results.
- Several structural barriers and specific problems have undoubtedly had negative effect on achieving better R&D investment results.
- The policies aimed at improving the academic career development model and creating more student-friendly and effective higher education system have only recently gained momentum.
- Despite the lack of the Research infrastructure strategy, significant funding has been earmarked for research infrastructure projects.
- So far, opening up the national research programmes has received little policy attention.

The directions of ongoing reform can be considered as steps in the right direction, although the timing (five legal acts under review, plus two other drafts submitted as a parliamentary initiative and public consultation of proposals concerning the higher education sector) raises questions whether the changes are not taking place too rapidly. The experience has shown that unstable legal framework will negatively affect the efforts of increasing R&D investments.

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1 Introduction

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are thus at the heart of the Lisbon Strategy. This is reflected in guideline No. 7 of the Integrated Guidelines for Growth and Jobs.[1] This advocates increasing and improving investment in research and development (R&D), with a particular focus on the private sector. For the period 2008 to 2010, this focus is confirmed as main policy challenge and the need for more rapid progress towards establishing the European Research Area, including meeting the collective EU target of raising research investment to 3% of GDP, is emphasised.

A central task of ERAWATCH is the production of analytical country reports to support the mutual learning process and the monitoring of Member States' efforts in the context of the Lisbon Strategy and the ambition to develop the European Research Area (ERA). The first series of these reports was produced in 2008 and focused on characterising and assessing the performance of national research systems and related policies in a comparable manner. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures which a research system has to cope with. The analysis of the ERA dimension still remained exploratory.

The country reports 2009 build and extend on this analysis by focusing on policy mixes. Research policies can be a lever for economic growth, if they are tailored to the needs of a knowledge-based economy suited to the country and appropriately co-ordinated with other knowledge triangle policies. The policy focus is threefold:

- An updated analysis and assessment of recent research policies
- An analysis and assessment of the evolution of national policy mixes towards Lisbon R&D investment goals. Particular attention is paid to policies fostering private R&D and addressing its barriers.
- An analysis and assessment of the contribution of national policies to the realisation of the ERA. Beyond contributing to national policy goals, which remains an important policy context, ERA-related policies can contribute to a better European level performance by fostering, in various ways, efficient resource allocation in Europe.

[1] COM(2007) 803 final, "INTEGRATED GUIDELINES FOR GROWTH AND JOBS (2008-2010)", http://ec.europa.eu/growthandjobs/pdf/european-dimension-200712-annual-progress-report/200712-annual-report-integrated-guidelines_en.pdf

2 Characteristics of the national research system and assessment of recent policy changes

2.1 Structure of the national research system and its governance

Poland is the largest new EU Member State and one of the six largest EU countries in terms of population. According to the most recent available data (Eurostat), the total Poland's population was estimated in 2009 at 38.1m inhabitants. In 2007, the gross domestic expenditures on R&D (GERD) was estimated at roughly about €1.8b and increased by 13.2% compared to 2006, contributing around 0.7% of total EU27 R&D expenditures. However, at 0.57% (GERD as a percentage of GDP in 2007) Polish R&D intensity is significantly lower than the EU 27 average of 1.84%. This performance is equal to that one of Greece and only better than Bulgaria, Cyprus, Romania and Slovakia.

Main actors and institutions in research governance

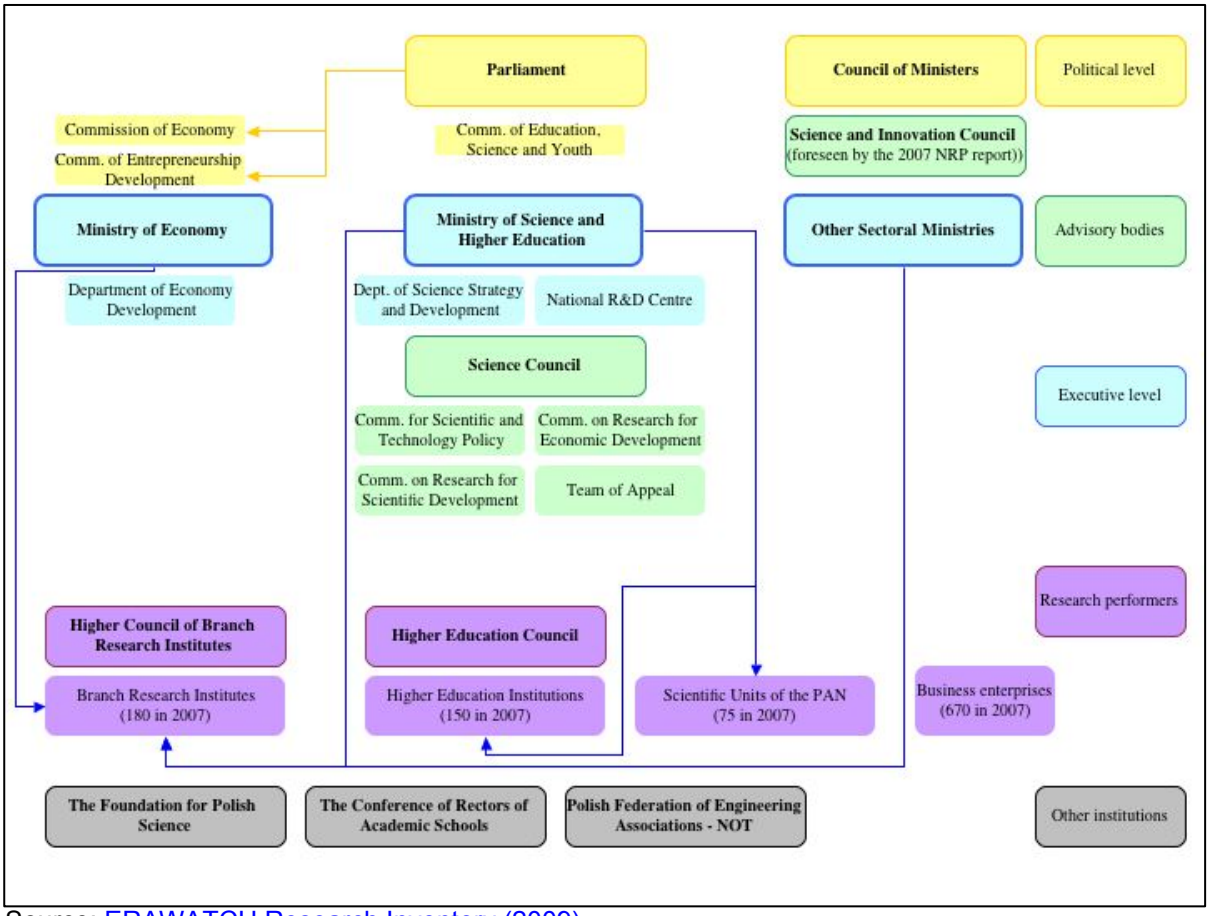
The main actor responsible for the design and implementation of national R&D policy is the Ministry of Science and Higher Education. The Science Council – established by the Act on Principles of financing science of 8 October 2004 – constitutes a formal representation of research community and plays an advisory role to the Minister, who has a decision-making role in the field of science policy and funding of R&D activities. The Minister issues a decision concerning the financial allocations on the basis of delivered opinion by the relevant Commissions (ERAWATCH Research Inventory 2009).

The year 2007 marked the creation of the National R&D Centre, the mission of which is to manage and fund large R&D projects of strategic importance and on competitive basis. There are also plans to establish the National Science Centre to shift the responsibilities over the fundamental research funding from the Ministry of Science and Higher Education to an independent institution.

The Ministry of Economy is responsible for innovation policy. The underlying difference in Poland's research system is that the Minister of Science and Higher Education grants funding to all the branch research institutes (JBRs), while the Minister of Economy is responsible for more than a half of such institutes.

The Parliament plays a decisive role in research policy making as initiatives in this area are usually introduced in the form of laws. During September 2008, the Ministry of Science and Higher Education presented the package, known as "Building upon knowledge" setting out the directions of planned reforms. The objective is to amend four legislative acts on the Polish Academy of Science, Research Institutes, National R&D Centre and Principles of funding science, as well as establish legal framework and create the National Science Centre. Officially, the reform package was adopted by the Council of Ministers on 2 December 2008. This decision, together with the plans to increase the science budget by 20%, shows strong commitment of the government to introduce structural changes into Poland's research system (ERAWATCH Research Inventory 2009).

Figure 1: Overview of the governance structure of the Poland's research system



Source: ERAWATCH Research Inventory (2009)

The institutional role of the regions in research governance

The influence of the 16 Polish regions on research policy process is still largely limited. However, the regional governments have been assigned significant resources from European Structural Funds for the implementation of RTDI policies. In the framework of the EU Structural Fund interventions 2007-2013, it is foreseen that the 16 Regional Operational Programmes will support in total 965 R&D projects, 686 science-industry interventions, and 14,536 investment grants for SMEs.

Main research performer groups

The major funding source of R&D activities is the State budget. It represents slightly less than three fifth (58.5%) of GERD in 2007 and in nominal terms is roughly about €1.07b (GUS, 2009). The business sector is the second largest source of funding for R&D activities accounting for 24.5% of total R&D expenditure, but it only reached the level of 0.17% of GDP in 2007 (GUS, 2009). The State budget is mainly distributed towards two types of institutions, notably HEIs (46.5%) and JBRs (32.2%), followed by the scientific units of PAN (18.1%), whereas a significant part of total business funding (€108m) goes to the JBRs (66.9%) and higher education institutions (24.6%). At 4.7% (2007) the share of GERD financed from abroad is still not very significant and remains below the EU average, but has been increasing rapidly since 2000.

2.2 Summary of strengths and weaknesses of the research system

The analysis in this section is based on the ERAWATCH Analytical Country Reports 2008, which characterised and assessed the performance of the national research systems. In order to do so, the system analysis focused on key processes relevant for system performance. Four policy-relevant domains of the research system have been distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The analysis within each domain has been guided by a set of generic "challenges", common to all research systems, which reflect possible bottlenecks, system failures and market failures a research system has to cope with. The Analytical Country Report for the specific country can be found on the ERAWATCH web site.

Poland's society and economy have undergone a profound transformation over the last two decades. For a long time, transforming the Polish research system was not a priority for either political or private actors in this process, and this was reflected in a low and shrinking R&D intensity as well as a low societal pressure for stronger resource mobilisation for research. Since 2004, Poland has been intensively working towards adjusting and reformulating the entire the research system. In particular, 2008 can be considered as a year on intensification of work, which has led to the formulation of strategic directions of the ongoing reform.

The recent changes introduced to the legal framework have not produced desired effects, especially in terms of mobilisation of financial resources. It can be argued that more R&D funding could have been realised, if frequent legal changes were avoided. The outcomes of securing long-term investment will largely depend on the implementation of strategic research programmes, which will be managed by the newly created National R&D Centre. So far, there are few large companies performing R&D activities and the challenge is to mobilise more private R&D funding. Despite the fact that the availability of specialists is not perceived as a huge problem, the challenge remains to develop inter-disciplinary profiles of skills to respond to the industry needs.

The knowledge demand is constrained by the low- and medium-tech sectoral specialisations and there has been no systematic approach to monitor how the demand is evolving. Some actions that aim at mapping out the demand and supply will be supported through the EU Structural Fund interventions.

In the knowledge production domain, there have been recently some attempts to introduce changes to the career development model of researchers. Also increasing funding can be considered as a positive development. As for the exploitation of knowledge is concerned, the main weakness of current policies is that they tend to encourage the researchers to publish rather than develop working relations with the industry, although this situation is slowly changing.

Despite some recent initiatives, there has been no significant policy attention in the area of encouraging trans-national mobility of researchers. Mobility is affected by legal conditions, but also by the cultural determinants, meaning working for the same organisation is considered more positively than the actual mobility.

The Table 1 summarises the ways in which Poland can build on existing strengths in this process and which weaknesses remain relevant.

Table 1: Summary assessment of strengths and weaknesses of the national research system

Domain	Challenge	Assessment of strengths and weaknesses
Resource mobilisation	Justifying resource provision for research activities	• Resource mobilisation has not been high on the policy agenda but there are signs that this is slowly changing. There is greater recognition of a need to invest in R&D. This is reflected in a decision of increasing the 2009 Science budget by 20%.
	Securing long-term investment in research	• R&D expenditures remain very low for several years (in particular BERD), although considerable steps have been undertaken to increase the funding. The Act on Principles of funding science among other acts is under review and additional funding from the Structural Funds can be considered as developments that can have positive influence on securing long-term investment in research. During the financial perspective 2007-2013, €2.6b has been earmarked within the Operational Programme Innovative Economy for two specific R&D related priorities.
	Dealing with barriers to private R&D investment	• Private actors still face difficulties in coping with the risk of R&D investment due to long-term investment and unexpected results. The Structural Funds may considerably contribute to overcoming these problems.
	Providing qualified human resources	• Financial incentives for graduates and young researchers are relatively new initiatives. • Lack of inter-disciplinary profile of skills.
Knowledge demand	Identifying the drivers of knowledge demand	• Knowledge demand constrained by the low- and medium-tech profile of the production.
	Co-ordination and channelling knowledge demands	• There has been no systematic approach to monitoring of knowledge demand.
	Monitoring of demand fulfilment	• There has been no systematic approach to monitor the demand.
Knowledge production	Ensuring quality and excellence of knowledge production	• Examples of leading scientific institutions (e.g. medicine, physics and programming). • Inefficient career development model of researchers. • Increased funding for this type of actions, mainly through the EU Structural Funds.
	Ensuring exploitability of knowledge	• Current policies encourage the research teams to publish their research results rather than support them to reach the market. • Shortage of specialist knowledge with the right management skills. • The majority of higher education institutions have not developed the rules for managing the IP protection. • Establishment of National R&D Centre can become a potential strength in the nearest future.
Knowledge circulation	Facilitating circulation between university, PRO and business sectors	• Low mobility due to legal barriers and cultural specific determinants
	Profiting from international knowledge	• Some recent initiatives adopted to encourage trans-national mobility of researchers, e.g. through the implementation of the Measure 1.2 of the OP-IE (PL_87)
	Enhancing absorptive capacity of knowledge users	• Main focus on fostering science-industry linkages.

2.3 Analysis of recent policy changes since 2008

The contribution of research and research policies to Lisbon goals (as well as to other societal objectives) goes beyond the fostering of R&D investment. It is therefore important to also analyse how other remaining shortcomings or weaknesses of the research system are addressed by the research policy mix. The focus of the section is on the analysis of main recent policy changes, which may have a relevant impact on the four policy-related domains.

2.3.1 Resource mobilisation

The mobilisation of resources for research has not been the top policy priority. However, since joining the European Union more emphasis is given to increase the spending for R&D as well as to raise the public awareness of the direct link between research and innovation on one side and economic growth and social development on the other.

The main change in the dimension of resources mobilisation is a draft of the new Act on the Principles of funding science. The objective of the Act is to consolidate the system of funding, organise its structure in institutional terms and secure long-term funding with the focus on leading research centres. The new system will be based on three organisational pillars. The first one remains the Ministry of Science and Higher Education, which will be responsible for overall financial planning of R&D activities, statutory activity, large R&D infrastructure and international scientific collaboration.

The second pillar is the National Science Centre, which includes competencies in financing of the basic research and supporting of scientific personnel, especially young scientists. The important feature of the National Science Centre is the independence of political changes. This solution has already been successfully applied in many European countries. The third pillar is embodied in National Research and Development Centre which should be responsible for stimulation of innovativeness of the Polish economy, i.e. co-financing of applied projects carried out by companies and other entrepreneurs as well as support to raise the funds from the sources different than the public ones. Moreover, the Centre will manage and implement strategic research programmes and development projects within the National Scientific Research and Development Programme adopted on 30 October 2008.

Private actors in Poland still have difficulties coping with the risks of R&D investment. So far, there are no specialised sectoral venture capital funds, which would address the needs of innovative companies. The improvement of this situation may be achieved by the funding from two Operational Programmes (Structural Funds), especially Innovative Economy (OP-IE) and Human Capital (OP-HC), which include research-related issues.

Table 2: Main policy changes in the resource mobilisation domain

Challenges	Main Policy Changes
Justifying resource provision for research activities	• Adoption by the Council a draft of the new Act on the Principles of funding science, which is under review at the Parliament.
Securing long term investments in research	• The National Scientific Research and Development Programme adopted on 30 October 2008.
Dealing with uncertain returns and other barriers	• Launch of the Structural Funds.
Providing qualified human resources	• Launch of the Structural Funds.

2.3.2 Knowledge demand

Systemic instruments to identify drivers of knowledge demand have been introduced recently. As for methods to set out the research priorities the main instrument is the National Foresight Programme. In February 2009 scenarios for research in area of security, sustainable development of Poland and information and telecommunications technologies were presented. The newly presented concept is to establish the regions of knowledge. This requires the introduction of competitive-based funding and promotion of active involvement of the private sector in the development of skills agendas.

Private demand for R&D is constrained by the sectoral structure of the Polish economy, which primarily focuses on low- and medium-low-tech activities. For that reason, the knowledge demand is mainly driven by publicly funded programmes. The JBRs are expected to play an important role as intermediaries between the traditional industries and science. The draft of a new Act on R&D institutes envisages a new role for the institutes, which will be restructured, and carry out R&D activity for the Polish economy. Only, the best institutes will be maintained and the funds will be assigned on competitive basis.

Knowledge demand will be driven by new programmes and projects managed and funded by National Science Centre and National Research and Development Centre. These institutions, as mentioned in the previous chapter, will coordinate and channel the activities with respect to fundamental and applied research respectively. There is also support foreseen to strengthen the capacities of institutions responsible for monitoring the labour market with the support of the EU Structural Fund interventions, notably the Operational Programme Human Capital Development 2007-2013.

Table 3: Main policy changes in the knowledge demand domain

Challenges	Main Policy Changes
Identifying the drivers of knowledge demand	• National Foresight Programme – new results • Integration of universities with regional socio-economic environment: regions of knowledge. • Restructured research institutes as intermediaries for knowledge demands from Polish industry
Co-ordinating and channelling knowledge demands	• New role for National Science Centre and National Research and Development Centre – drafts of new Act sent to the Parliament.
Monitoring demand fulfilment	• Support to monitoring of labour market demand in a forward-looking perspective.

2.3.3 Knowledge production

In January 2009, the Ministry of Science and Higher Education presented the first reform package, known as "Partnership for Knowledge: Reform of studies and students' rights". In the light of improving quality and excellence of knowledge production, it is proposed to reward the best students and PhD students through special forms of support.

In February 2009, the Ministry launched the consultation process regarding the second reform package, known as "Partnership for Knowledge: New model of academic career", the main objectives of which are to remove the barriers for the development of scientists, accelerate the procedure of promotion, while guaranteeing higher quality of Poland's science. In particular, the proposed changes, which are currently subject to the public consultation and relevant for the topic under review should lead to: increasing the quality of PhD, shortening the habilitation procedure, improving the human resources' policies within the higher education institutions and scientific research institutions.

More recently, the Ministry of Science Education launched in March 2009 public consultation on the reform package, known as "Partnership for knowledge: New model of managing the higher education institutions". In summary, the proposed changes regarding the functioning of higher education institutions, which are relevant for the knowledge production aim at: creating the mechanisms of selecting the leading scientific research entities, achieving better utilisation of existing research and academic potential, improving the quality of education.

Table 4: Main policy changes in the knowledge production domain

Challenges	Main Policy Changes
Improving quality and excellence of knowledge production	• Launched of the reform packages, known as known as "Partnership for knowledge" in the first quarter of 2009. • Progress in implementation of relevant EU Structural Fund interventions.
Ensuring exploitability of knowledge production	

2.3.4 Knowledge circulation

With the view of promoting the knowledge circulation, the reform package, known as "Partnership for Knowledge: Reform of studies and students' rights", proposed to take a series of actions, in order to promote internationalisation and strengthen linkages between the skills and the market needs. Besides that, second reform package, known as "Partnership for Knowledge: New model of academic career" proposed to open up the higher education institutions to leading foreign researchers. In addition to this, the reform package, known as "Partnership for knowledge: New model of managing the higher education institutions" identified integration of higher education institutions with the socio-economic environment as one of the priorities. The Polish Science Foundation has continued in 2009 the implementation of the Measure 1.2 (PL_87) of the OP-IE.

Table 5: Main policy changes in the knowledge circulation domain

Challenges	Main Policy Changes
Facilitating knowledge circulation between university, PRO and business sectors	• Launched of the reform packages in the first quarter of 2009. • Progress in implementation of relevant EU Structural Fund interventions.
Profiting from access to international knowledge	
Absorptive capacity of knowledge users	

In summary, the National Reform Programme 2008-2011 has made an explicit reference to the majority of policy instruments that has been discussed above. More precisely, the objective of reforming the research system is planned to be realised through the implementation of the following activities including: (1) elaboration and implementation of the 2015 Science Strategy; (2) revision of five legislative acts relating to research system; (3) elaboration of the road map of the Polish research infrastructure projects; and (4) implementation of the National Foresight Programme 2020. This actually means that only the recent developments regarding the higher education system have not been included in the 2008-2011 National Reform Programme.

2.4 Policy opportunities and risks related to knowledge demand and knowledge production: an assessment

Following the analysis in the previous section, this section assesses whether the recent policy changes respond to identified system weaknesses and take into account identified strengths.

Several changes taking place at the same time raise concerns regarding increased risks of errors that would in turn require additional amendments to the legal framework. There is also limited administrative capacity to handle these changes. The strategic departments involved in the actual policy making are relatively small, whereas the outflow of specialists to the departments responsible for the implementation of the EU Structural Funds has been a reality, precisely the latter can offer better employment conditions thanks to financial support from technical assistance.

The reform package, known as "Building upon knowledge", which consists of five legal acts is currently debated at the Parliament. Four of these acts are subject to major revisions. In general, they will introduce changes into the organisation and functioning of the Polish Academy of Sciences, the Research institutes, the National R&D Centre and above all to the principles of financing the science sector. The remaining act is set out to establish an independent agency to oversee the implementation of basic research projects. So far, only the first reading in the Parliament has taken place at the beginning of March 2009. Next, the proposals of specifics acts will be submitted to special parliamentary commissions for further discussions. On the top on this, the Ministry of Science and Higher education has also launched the initiative, known as "Partnership for knowledge" which set to introduce changes in three areas, such as the management of higher education institutions, scientific career and reform of studies and students' right. Such structural changes clearly require available and experienced personnel.

As for knowledge demand and production, a limited uptake of measure designed to

support RTDI project (due low absorptive capacity of SMEs) is the main risk in the current 2007-2013 programming period.

While there are also some initiatives to stimulate knowledge circulation, the risk is that other systemic changes will be considered as more important than the mobility of researchers.

Table 6: Summary of main policy related opportunities and risks

Domain	Main policy related opportunities	Main policy-related risks
Resource mobilisation	• Increased R&D investments, in particular from private sector	• Too many changes are taking place at the same time which requires available administrative capacity to handle these changes.
Knowledge demand	• First results of Foresight are provided	• Low absorptive capacity of SMEs.
Knowledge production	• Consolidation of research efforts • Establishment of competitive-based funding	• The same as in the domain of resource mobilisation.
Knowledge circulation	• Overcoming legal and cultural barriers to mobility of researchers (international, sectoral)	• Possibility that other proposed systemic changes will overshadow the actions related to knowledge circulation.

3 National policy mixes towards R&D investment goals

The aim of this chapter is to deepen the analysis of national policy mixes with a focus on public and in particular **private R&D investment**. The Lisbon strategy emphasises an EU overall **resource mobilisation objective** for 2010 of 3% of GDP of which two thirds should come from private investment. R&D investment is seen as important yardstick for the capacity of an economy to turn the results of science and research into the commercially viable production of goods and services and hence knowledge into growth. Corresponding investment policies are mainly pursued at national level and determined with a national focus.

The chapter is structured around five questions:

1. What are the specific barriers in the country that prevent reaching the Lisbon goal? What barriers exist in the country to prevent reaching the specific targets, particularly related to the private sector R&D investments?
2. Given the above, what are the policy objectives and goals of the government that aim to tackle these barriers?
3. What Policy Mix routes are chosen to address the barriers and which specific instruments and programmes are in operation to implement these policies?
4. What have been the achievements in reaching the above-mentioned R&D investment objectives and goals?
5. What are the reasons for not reaching the objectives, adaptation of the goals?

The chapter aims to capture the main dimensions of the national policies with an emphasis on private R&D investment. The chosen perspective of looking at investments in R&D is the concept of Policy Mixes. The analysis and assessment follows a stepwise approach following the five questions mentioned above.

3.1 Barriers in the research system for the achievement of R&D investment objectives

The R&D investment objective set out in the working document, known as the "2015 Science Strategy", is to increase the share of GERD and BERD to the level of 2% and 0.8% of GDP by 2015. Achieving these ambitious targets will be influenced by a series of factors. Firstly, the dependence of the Polish research sector on block funding represents one of the major setbacks preventing to reach the Lisbon goals (Górzyński, M. and Jakubiak M., 2009). Secondly, it is difficult to significantly increase the financial allocations for research due to the existing socio-economic challenges. The recent data shows that the share of public financial allocations for Science budget has not changed in recent years. In 2007, it represented just 1.5% of total budgetary expenditures. Thirdly, there is still limited absorptive capacity of SMEs (TrendChart, 2008) and relatively low demand coming from the society for more R&D intensive products (Górzyński, M. and Jakubiak M., 2009).

Another barrier preventing reaching the research targets is that almost three quarter of total R&D expenditure in the manufacturing sector (public and private) is incurred by few large companies with more than 499 employees and more than that in the service sector. Within the context of increasing the investments in the service sector it is expect that R&D expenditures will grow, although for the moment the industrial sector is spending almost twice as much as the service sector on R&D related activities (GUS, 2008/2009).

The fragmentation of research efforts and slow progress of reforms constitutes another drawback of the research system. The sector of JBRs actually illustrates to what extent it has been difficult to introduce and implement concrete actions that would lead to achieving the desired results and impacts. Yet the actual challenge of reforming the JBRs involves not only reducing the number of these institutes and cutting the level of employment, but primarily requires the consolidation of research efforts by rewarding and tailoring the support to the best performing units.

In addition to this, the Polish market is characterised by low attractiveness. The average size of innovative projects is too small and there are too few projects (Górzyński, M. and Jakubiak M., 2009). Despite the recent attempts to establish the fund-of-funds in Poland, so far there are no specialised sectoral venture capital funds, which would address the needs of innovative companies.

It has to be also remembered that reaching the Lisbon goals requires a series of mutually reinforcing support measures. Designing an optimal policy mix with the support of the 2007-2013 EU Structural Fund interventions represents a great challenge. In particular, it would be strongly recommended to re-think the use of fiscal incentives and draw lessons from the implementation of both past and ongoing policy measures. In conclusion, this implies that adequate response has to go beyond the domain of resource mobilisation.

3.2 Policy objectives addressing R&D investment and barriers

The main objectives set out by the 2015 draft Science Strategy are to: (1) improve the level and effectiveness of Polish science, (2) better use science potential with a view of stimulating socio-economic development, (3) increase the innovativeness of the Polish economy, and (4) establish closer co-operation within the European Research Area (Ministerstwo Nauki i Szkolnictwa Wyższego, 2008). The main changes will be directed at promoting the areas, such as biotechnology (application

in medicine, agriculture, and environment protection), nanotechnology, materials and information technologies. The National Scientific Research and Development Programme adopted on 30 October 2008 defined these areas (ERAWATCH Research Inventory, 2009).

Moreover, the 2015 Science Strategy defines actions to be taken in order to increase effectiveness of research personnel. In the first step, it will be necessary to adjust the career development path for researchers. It is also planned to introduce open competitions for professors, executive and managerial positions in higher education institutions, Polish Academy of Science and JBRs.

Significant changes are also planned in the way the science system is organised and managed. One of the objectives is to increase the competitive-based funding is considered as another objective. It has been recognised that the level of funding should depend of the effectiveness of individual research institutions. In particular, it is proposed to introduce changes to the criteria used in the performance assessment.

The Higher Education Council, which is the formal representation body of the higher education institutions, considered that the proposed changes formulated in the 2015 Science Strategy constitute the basis for the implementation of concrete actions. Nonetheless, it pointed out that the proposed changes were going towards the establishment of central model of managing science and higher education institutions, and suggested the use of performance contracts. (Rada Główna Szkolnictwa Wyższego, 2008).

The Higher Council of Branch Research Institutions emphasised that the statutory funding should be provided by the relevant ministries, whereas research funding should be provided by the Ministry of Science and Higher Education. In the opinion of the Council, the Strategy does not formulate clear target of increasing the research funding. It draws the attention that statutory funding for JBRs in the last two years has dropped from €143m to €121m, and its further decrease can lead to the worsening in the quality of research conducted by these institutes (Rada Główna Jednostek Badawczo Rozwojowych 2008).

Despite the information about the creation of the long-term strategy for the development of science (Górzyński, M. and Jakubiak M., 2009), the process of finalising the strategy after the intergovernmental and public consultation has not been completed. The adoption of five legislative acts that are currently under review is certainly a great challenge for the forthcoming months. This is mainly because of a degree of complexity and the fact that the process has just started. The future will show whether all the legislative acts will enter into force on 1 January 2010.

3.3 Characteristics of the policy mix to foster R&D investment

This section is about the characterisation and governance of the national policy and instrument mix chosen to foster public and private R&D investment. While policy goals are often stated at a general level, the policy mix has a focus on how these policy goals are implemented in practice. The question is what tools and instruments have been set up and are in operation to achieve the policy goals? The following sections will each try to tackle a number of these dimensions.

3.3.1 Overall funding mechanisms

The main form of support for undertaking R&D activities comes from the institutional funding (the so-called 'statutory funding', infrastructure and own research projects). It is estimated that this type of funding accounts for slightly more than a half of the total 2009 Science budget (54.7%). The 2015 Science Strategy that is currently being discussed in the Parliament proposed to limit the share of this type of funding to 30-40% of total R&D funding (Ministerstwo Nauki i Szkolnictwa Wyższego, 2008) in the perspective of next four years.

As regards the thematic instruments, the National Programme of Scientific Research and Development (established on 30 October 2008) identified priority research areas, such as: (1) society in conditions of secure, accelerated and sustainable socio-economic development, (2) dynamic and sustainable socio-economic development, (3) health, (4) energy and infrastructure, (5) new technologies for the economy, (6) environment and agriculture. Starting from 2008, the National R&D Centre will be responsible for the realisation of the two research programmes of Advanced technologies for energy production and Interactive system of science and technology information. From 2009 onwards, the Centre will administer the remaining programmes.

The establishment of the National R&D Centre can be considered as a shift towards 'competitive' funding, while the recently revised Act on the JBRs of 5 July 2007, and measures of the OP-IE can be viewed as an attempt to reform the public research base institutions and support for more collaborative research.

3.3.2 Policy Mix Routes

The "Policy Mix Project" identified the following six 'routes' to stimulate R&D investment:

1. promoting the establishment of new indigenous R&D performing firms;
2. stimulating greater R&D investment in R&D performing firms;
3. stimulating firms that do not perform R&D yet;
4. attracting R&D-performing firms from abroad;
5. increasing extramural R&D carried out in cooperation with the public sector or other firms;
6. increasing R&D in the public sector.

The routes cover the major ways of increasing public and private R&D expenditures in a country. Each route is associated with a different target group, though there are overlaps across routes. The routes are not mutually exclusive as, for example, competitiveness poles of cluster strategies aim to act on several routes at a time. Within one 'route', the policy portfolio varies from country to country and region to region depending to policy traditions, specific needs of the system etc.

Route 1: Promoting the establishment of new indigenous R&D performing firms

Previous research has found that the year 2007 marked a shift from general measures promoting the establishment of incubators (infrastructure projects) to more sophisticated interventions, the aim of which is to support the entrepreneurs in assessing their novel ideas, provide pre-incubation services, and ultimately give

financial backing to the most innovative initiatives (TrendChart 2008). It also explained that the Measure 1.3 (PL_21) of the Sectoral Operational Programme Increasing the Competitiveness of Enterprises (SOP-ICE) aimed at improving business environment by financing investments related to industrial parks, science and technology parks and technology incubators, however, noted that a small fraction of available funding was used to finance soft type interventions.

Building upon the experience of the pilot initiative, known as Technostarters Programme (PL_36), the Measure 3.1 of the OP-IE (PL_41) was designed to extend this type of support. The latter is addressed to incubators, including academic entrepreneurship incubators, centres of technology transfer and innovation, technology accelerators, science and technology parks. In summary, the support will be available for projects, such as, identification and assessment of innovative ideas of potential entrepreneurs, pre-incubation services and capital investment. This is in line with the findings of recent evaluation, which has recommended to focus the support to the newly created/developed institutions, in order to ensure their sustainability (PAG Uniconsult, 2008). Currently, the Measure 3.1 of the OP-IE (PL_41) is the main instrument promoting the establishment of new indigenous R&D performing firms.

Another measure that fits into the overall policy in the area of promoting the establishment of new indigenous R&D performing firms is the Innovator Programme (PL_76), the main objective of which is to support commercialisation of research results and provide the young scientists with knowledge about market mechanisms and principles of business activities. The programme is directed to young scientists under 35, i.e. doctoral researchers and young scientists holding PhD degree engaged in any field of science.

Route 2: Stimulating greater R&D investment in R&D performing firms

One of the three measures introduced by the Act on Some forms of support for innovation activities adopted on 29 July 2005 was the Status of R&D Centre (PL_77), which gives exemption from certain taxes and grants tax allowance. Such allowance is calculated on annual basis from the capital accumulated on the Innovation Fund on monthly basis not more than 20% of monthly turnover. The tax incentive is the second measure (PL_34) allowing the companies to deduct their expenditure relating to the acquisition of new technologies (R&D results) up 50% of their estimated value.

It is also worthwhile mentioning the Technological Initiative launched by the Ministry of Science and Higher Education in 2007, the objective of which is to provide funding for applied research projects and pre-commercialisation phase (PL_39). This measure was incorporated into the mainstream of EU funding, notably to the Measure 4.1 (PL_44) of the OP-IE. The aspects related to the implementation of this measure are discussed in the 2008 TrendChart report.

Until 2007, goal-oriented projects supported only “research” phase. The new programme will provide financial support to both phases, i.e. “research” and “commercialisation” through Measure 1.4 of the OP-IE and 4.1 (PL_40, and PL_44).

During the 2007-1013 programming period the Measure 4.2 of the OP-IE (PL_45) will support companies in conducting R&D activities and design. Besides that, this measure will also support companies changing to the Status of R&D Centre.

Another measures that can be considered as relevant for stimulating greater R&D investment in R&D performing firms is the Measure 3.2 of the OP-IE (PL_42), the aim

of which is to establish 20 new venture capital funds. It is expected that they will invest in about 160 innovative start-ups on average €1.5m per start-up. This measure can be considered as a follow-up to Measure 1.2 of SOP-ICE (PL_29), which was implemented by the PAED during the 2004 – 2006 programming period.

Route 3: Stimulating firms that do not perform R&D yet

One of the main instruments aimed at stimulating firms that do not perform R&D yet is the measure, known as the Technology credits (PL_32). It basically provides funding for the purchase of new technologies, defined as especially R&D results which are not implemented on the world market more than 5 years.

The measure 2.3 of the SOP-ICE (PL_24), was the most popular measure among the entrepreneurs. The support was granted especially to following types of projects, such as implementation of modernisation projects in SMEs; implementation of joint investment projects undertaken by enterprises; purchase of R&D results and/or industrial property rights by enterprises, etc.

The Measure 2.2.1 of the SOP-ICE (PL_22) supported entrepreneurs undertaking initial investments. These investments should relate to the acquisition of tangible and legal assets, such as buildings, structures, machines and appliances as well as intangible assets, consisting in obtaining a patent, purchase of a licence or non-patented technical and technological knowledge in the area of organisation and management.

The Measure 4.3 of OP-IE (PL_46) can be considered as a relevant instrument to stimulate firms that do not perform R&D yet. The companies will be able to obtain loans from commercial banks to purchase new technology, which is defined as technology knowledge (in particular R&D results) and is not implemented in the world markets in more than 5 years. The companies will be also able to obtain technology credits (max. €1.1m), if they commercialise new products/services developed on the basis of new technology. The discussion about the potential problems regarding the implementation of this measure was presented in the 2008 TrendChart report.

Route 4: Attracting R&D-performing firms from abroad

Apart from the Economic Free Zones, which were officially established by the Act of 20 October 1994, there are practically no other measures designed to attract R&D performing firms from abroad. Despite an attempt to encourage foreign companies to locate their R&D centres by establishing the Status of R&D Centre, the measure has proved to be inefficient (TrendChart 2008). The functioning of all special economic zones will last until the end of 2020. Until June 2008, the entrepreneurs undertaking activities in these zones invested more than €10b and employ more than 197,000 persons. The fiscal form of support is considered as suitable and safe for the State budget, because the support is spread for several years and is given after launching the activities and gaining the income. The proposed changes are going in the direction of supporting innovative undertakings in the strategic investments in the following sectors, such as automotive, aerospace, electronics, machinery, biotechnology, chemical industries, R&D, modern services, renewable sources of energy and equipment for the production of fuel (Ministry of Economy, 2009).

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

The Measure 1.4.1 sub-measure of the SOP-ICE (PL_27), the aim of which was to support applied research projects realised as joint co-operation between large companies and science sector. The results of implementation of that measure were presented in the 2008 TrendChart Annual Report.

During 2007-2013, fostering science-industry co-operation will be realised through the implementation of the Measure 1.1 of the OP-IE (PL_86), which will co-finance strategic research programmes and the Measure 1.3 (PL_88), the objective of which is to support R&D applied research undertaken by research institutions for the firms.

Route 6: Increasing R&D in the public sector

The OP-IE has two R&D specific priorities. While Priority 1 Research and development of new technologies was designed to support various initiatives ranging from foresight initiatives, R&D projects, initiatives encouraging the students to pursue scientific career, projects relating to improvement of professional qualifications of the academics and researchers and IP protection, Priority 2 basically provides financing for R&D infrastructure projects. The total EU funding earmarked for these two priorities is estimated at about €2.2b (€1.1b each), representing roughly 3% of total planned spending of the EU Structural Funds interventions. There is special support foreseen for the support to the centres of excellence and centres of advanced technology in the framework of the OP-IE.

The importance of education and innovation policies

Considering that the focus of innovation policy has been since 2005 on supporting technological innovations, it can be concluded that the innovation policy has interacted positively with R&D instruments. In the area of education policy, there is only one specific measure included in the OP-IE specifically dedicated to human resources. This is the Measure 1.2 of the OP-IE (PL_87), which aims at strengthening human resources potential in the science sector. Besides that, there are other measures foreseen in the OP-HC, notably Measure 4.1 and Measure 4.2 (PL_92 and PL_93), the objective of which is to strengthen potential of higher education institutions, increase the number of S&E graduates and develop skills of R&D personnel, in order to enhance science-industry cooperation. Among the national initiatives, Science Festivals can be considered as a good example of stimulating the interest of general public in explorations of the different facets of science and potentially attracting young pupils in pursuing science careers in the future.

Assessment of the importance of policy mix routes and their balance

Table 7: Importance of routes in the national policy and recent changes

Route	Short assessment of the importance of the route in the national policy	Main policy changes since 2008
1	In particular, small companies lack in-house capacity, but also financial support via public support programmes to carry out robust and reliable feasibility assessments of their novel ideas. Since 2002, the Foundation for Innovations, Restructuring and Entrepreneurship, known as, the FIRE Foundation has been supporting the establishment and development of innovative start-ups, although there is no publicly available information about its achievements in that area. Starting from 2007, there has been increased policy attention in promoting the establishment of new indigenous R&D performing firms.	• Launch of the Measure 3.1 of OP-IE (PL_41) • At the beginning of 2008, the Minister of Science and Higher Education confirmed that the public sector entities, such as, higher education institutions, branch research centres, the Polish Academy of Sciences, etc. were allowed to acquire company shares or stocks and bonds issued by entities other than the State Treasure.
2	So far, the two measures introduced by the Act on Some forms of support for innovation activities adopted on 29 July 2005 have proved to be not so effective. Considerable problems have been encountered in the implementation of the first round of Technological initiative, due to the delays in signing the contracts with the successful tenderers.	• Several different types of measures will be implemented in the framework of the OP-IE.
3	In particular, the Technology Credits scheme can be recognised as an example of good practice. To increase the number of loans, it was decided in 2007 that Commercial banks would grant loans, while the National Bank of Economy would pay the technology credits. In order to obtain the credit the company has to present the paid invoices of new products/services, which contain new technologies financed by the technology loan as well as submit an independent opinion from a research organisation certifying that the products/services actually were developed with the use of new technologies.	• Launch of the measure in the framework of the OP-IE.
4	Apart from the Economic Free Zones, which were officially established by the Act of 20 October 1994, there are practically no other measures designed to attract R&D performing firms from abroad. The Status of R&D Centre introduced by the Act on Some forms of support for innovation activities (29 July 2005) has not produced expected results in terms of attracting foreign companies.	• The development of the new Concept of Special Economic Zones by the team of experts from the Ministry of Economy.
5	Fostering science-industry co-operation has not been seen as the key priority that would be reflected in policy measures. Recently, this situation has been improving.	• Launch of new measures in the framework of the OP-IE.
6	Whilst the ongoing reform aims at concentrating the funding on the best performing research entities, considerable financial resources are planned to be used for infrastructure and research projects.	• Launch of new measures in the framework of the OP-IE.

3.4 Progress towards national R&D investment targets

The National Development Programme (2004-2006) set the targets of increasing GERD to 1.5% of GDP by 2006, which from the beginning was considered as a target that will be difficult to reach. In retrospect, several reasons affected the mobilisation of financial resources.

Firstly, there have not been significant support instruments that would help in increasing the R&D investments. Secondly, several problems were encountered in the implementation of existing measures (e.g., PL_27). Thirdly, the two measures introduced by the Act on Some forms of support for innovation activities (i.e. Status of R&D Centre, PL_77, and fiscal incentives PL_34) have not proved to be so effective. The delay of signing the contracts in the framework of the Technological initiative has been another factor. Besides that, the launch of strategic research centres foreseen in the Act on National R&D Centres of 15 June 2007 has not been realised due to lack of the National Scientific Research and Development Programme, which was adopted on 30 October 2008. Finally, the structural problems in the public research sector (currently five legislative acts are under review!) have undoubtedly had negative effect on reaching better R&D investment results.

Table 8: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
Polish system is heavily reliant on publicly-funded research	Opportunities: Concentration on the best performing research institutes Risks: Delays in the adoption and implementation of new principles of science funding
Extent of socio-economic challenges	Opportunities: Improvement of the situation in general. Risks: The earmarked funding does not generate expected results, which in turn might affect decisions to increase State R&D funding.
Limited absorptive capacity of SMEs	Opportunities: More companies investing and/or undertaking RTDI activities (important to build upon the existing strengths) Risks: Administrative barriers in the implementation and dependency on grants.
Little pressure from the society and economy	Opportunities: Changing that situation in general. Risks: Associated with R&D projects.
Frequent changes introduced to the legal framework	Opportunities: not relevant. Risks: not relevant.
Few large companies are the main R&D performance	Opportunities: Encourage the SMEs to undertake R&D activities, if relevant. Risks: Creating the dependency on subsidies.
Fragmentation of research efforts	Opportunities: Instruments mutually reinforcing the ongoing structural changes/reforms. Risks: Lack of co-ordination between the policy-making and implementation.
Mismatch between the skills and jobs requirements	Opportunities: Developing skills matching the needs to job market. Risks: Brain drain.
Intellectual property rights protection	Opportunities: Provide support to better manage IP issues Risks: Low interest due to low awareness among the potential beneficiaries.
Low attractiveness of Polish market to attract VC funds	Opportunities: Addressing the funding gap. Risks: Associated with setting up the VC funds.
Linear logic in the planning and design of support measures	Opportunity: Change towards systemic planning. Risks: Limited impact of independent evaluations.

4 Contributions of national policies to the European Research Area

ERAWATCH country reports 2008 provide a succinct and concise analysis of the ERA dimension in the national R&D system of the country. This Chapter further develops this analysis and provides a more thorough discussion of the national contributions to the realisation of the European Research Area (ERA). An important background policy document for the definition of ERA policies is the Green paper on ERA[2] which comprises six policy dimensions, the so-called six pillars of ERA. Based on the Green Paper and complementing other ongoing studies and activities, this chapter investigates the main national policy activities contributing to the following four dimensions/pillars of ERA:

- Developing a European labour market of researchers facilitating mobility and promoting researcher careers
- Building world-class infrastructures accessible to research teams from across Europe and the world
- Modernising research organisations, in particular universities, with the aim to promote scientific excellence and effective knowledge sharing
- Opening up and co-ordination of national research programmes

In the ERA dimension, the *wider context of internationalization of R&D policies* is also an issue related to all ERA policy pillars and is normally present in the dynamics of national ERA-relevant policies in many countries.

4.1 Towards a European labour market for researchers

The recent statistics show that after the upward trend in the number of PhD graduates during the period 1991-2006 (four fold increase), the number of PhD graduates dropped to 5,616, i.e. 7.5% lower than in the previous year for which the data is available (GUS, 2009).

The results of recently completed evaluation pointed out the lack of specialists with technical profiles and noted that the demand for such goes beyond the traditional definition of technical skills (e.g. ecological engineering, mechatronics in agriculture, technology of combustion and environment protection, etc.) Another research has indicated that until 2013 there will be a shortage of some 47,000 engineers in industry and 23,000 in service sectors (Sedlak, 2008).

Despite the fact that the R&D investment has been growing in recent years, the salary of young researcher is several times lower compared to the private sector. By international standards, the average remuneration is one of the lowest in the EU (i.e. roughly about €11,000 compared to almost €35,000 in Spain (Carsa, 2007).

Beyond the financial aspects, the limited positions in the universities and low demand from the business sector remain the disincentives for starting a research career position, which was confirmed by the last year assessment (Górzyński, M. and Jakubiak M., 2009).

[2] Commission of the European Communities: Green paper: The European Research Area: New perspectives. Brussels 4.4.2007, COM(2007) 161final
(see http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf).

The other aspect concerns the career development of researchers, which consists of three stages, i.e. a PhD, "Habilitated Doctor" status, and subsequently the academic title of Professor. As reported last year, the majority of the research community, in particular young researchers, are calling for the abolition of the habilitation, while its defenders support the present system as a quality assurance mechanism (Górzyński, M. and Jakubiak M., 2009).

In this context, it is also worthwhile mentioning that an earlier proposals setting the principles of reforming science and higher education system elaborated by the expert team commissioned by the Minister of Science and Higher Education at the beginning of 2008, advocated to facilitate the development career for researches by removing the habilitation requirement. The figures speak for themselves. It is estimated that in 14% of cases habilitation is obtained before the age of 40, but in the majority of cases 55% between 40-50. As a result of the consultation process, it was finally agreed that this requirement would be maintained, although the procedure would be further streamlined. The main reason for maintaining the habilitation procedure was precisely because the majority of stakeholders of science and higher education community consider that the level of PhD is not sufficiently high.

4.1.1 Policies for opening up the national labour market for researchers

One of the most important milestones regarding the improvement of labour market of researchers is the recently launched consultation process by the Ministry of Science and Higher Education aimed at collecting as well as validating the ideas for the improvement of the existing academic career development model (Reform package, known as Partnership for knowledge: New model for academic career, February 2009).

With the view of improving the quality of researchers, the Ministry plans a series of actions, notably to introduce the competition procedure for the publicly-funded PhD studies, increase funding for leading PhD studies, introduce the requirement that PhD advisors are those scientifically active who have at least PhD habilitation, introduce a requirement to open PhD by publishing at least one article in a national scientific magazine, increasing the participation of foreign peers, introducing a possibility to present and defend PhD thesis in English, etc.

Significant changes are also planned regarding the habilitation procedures. Specially, the three key proposed changes are to: limit the role of faculty councils or science councils in the habilitation procedure, establish the assessment of research achievements as a pre-condition to start the habilitation procedure, and remove the requirement of defending the habilitation dissertation.

As regards opening-up up the higher education institutions to leading foreign researchers, it is planned that the Rector (Director of scientific research entity) will not need to consult the Central Commission of Degrees and Titles about the appointment of foreigners for the position of professor ‘extraordinarius’, who obtained the title of doctor and Polish citizens with the same title who in the last five years worked as independent research staff and have obtained considerable research results.

The other main proposed changes are to introduce into the legislation a principle of open competitions for the position of researchers and academic staff, limitation of multiple employments as well as a proof of professional experience (i.e. scientific title) in the case of appointment through a nomination.

Given the low level of salaries, the researchers start carrying out their activities in several institutions at the same time, which leads to limited availability and deterioration of quality of teaching. To respond to this challenge, it is proposed that the researcher has to obtain permission for employment in two different entities from the rector.

The above-presented changes will be reflected in the revised Act on Higher Education Institutions and Act on Scientific degrees and titles and other executive acts issued by the Minister of Science and Higher Education.

The reform certainly goes beyond the aspects related to the national framework of qualifications and aims also at creating more student-friendly higher education system. According to the reform package, known as "Partnership for education: Reform of studies and student' rights" (January 2009), the following actions will be carried out:

- Establishment of special form of support for the outstanding students and PhD students;
- Protection of students' rights and closer partnership (e.g. obligatory assessment of academic staff by students, which will be used as one of the criteria for evaluating the academic staff);
- Reduction of administrative barriers (e.g. a possibility to give up the index as a form of reporting the achievements of students);
- Internationalisation of education (e.g. regulation of aspects related to contract with foreign science institutions to conduct joint doctoral projects, definition of the national qualifications framework); and
- Better preparation of graduates of higher education institutions to the industry needs and labour market.

The recent research has pointed out that working in the same institutions starting as a student to the position of professor is accepted as a model of typical career development, thus the mobility is not rewarded (Zespol Interdyscyplinarny ds. Mobilnosci i karier naukowych 2007)

To increase mobility of researchers, the Ministry of Science and Higher Education launched in the fall of 2006 the first round of the competition 'Support to international mobility of researchers' to support the participation of Polish researchers in projects undertaken in international research institutes. Another currently implemented intervention in the scope of the OP-IE is Measure 1.2 (PL 87), which well into the policy of opening up the national labour market for researchers.

4.1.2 Policies enhancing the attractiveness of research careers in Europe

The signatories of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers include the Conference of Rectors of Academic Schools in Poland, the Independent Academic Forum and the Polish Academy of Sciences. These are practically the main research representative bodies in Poland. Besides that, the Aeronautics Institute (member of the Association of European Research Establishments in Aeronautics, signatory of the C&C) has organised a conference with the participation of the representatives of the Ministry of Science and Higher Education to promote the C&C in the Polish research institutions.

Generally speaking, the executive of the Ministry of Science and Higher Education supports the initiatives of the EU Commission, in particular those relating to the mobility of researchers and development of research infrastructure initiatives. Recently, it has launched the public consultation on the career development model, which is in line with the recently launched initiatives, known as the European Partnership for Researchers (European Commission 2008).

During the period 2000-2007, the share of women obtaining a title of professor has remained at the level of roughly about 26-27%. In the same period the share of women habilitated doctors increased from 29% to 32%. Also, the share of doctor's degrees obtained by women increased from 41% to 49% (GUS, 2009). The year of 2009 has also marked the 8th edition of the competition organised by l'Oréal with the support of the Polish Committee of UNESCO to reward women conducting biological-medical research (Sprawy Nauki, 2008), although there is lack of incentives aiming at the mobilisation of the potential of women, even if this problem is officially recognised.

4.2 Governing research infrastructures

The degree of utilisation of scientific-research equipment is estimated at about 75% and during the recent years the upward trend can be observed (GUS, 2009). For comparison that rate back in 2000 was 69%. According to the latest available figures slightly more than 8% of the 2008 Science budget was allocated for infrastructure-related investments, which is roughly about €94m. In addition to this, €11m is spent on the maintenance of research equipment. In recent years, the share of this type of investment has slightly changed. For example, in 2005 infrastructure investments were estimated at 10% of the science budget for that year, which was almost €77m.

On the top on that annual investment in research infrastructure there is about €10m spent on research infrastructure projects from the Polish Fund of Science and Technology. It was established in 1996 and its funding is equivalent to 2% of income from the privatisation and interest rates. According to the Act of that Fund, the financial sources can be used for objectives related to the development of science and technology, especially strategic directions of scientific research and development activities, support to the investment necessary for conducting these activities and promotion of science. For example, in 2007 there were 33 projects which received financial support.

The role of the EU Structural Fund interventions has been considerable, especially the current programming period offers a lot of new opportunities. The significant financial resources have been allocated in the OP-IE. More specifically speaking, the funding earmarked for the Priority 2 of that programme is estimated for the entire programming period at almost €1.3b and is specifically designed to support financing the research investment type of projects. To give a sense of proportion, it is worthwhile mentioning that the same amount of financial resources has been committed for the actual research-related activities.

The Priority 2 consists of three measures, notably the Measure 2.1 (PL_89) support the development of infrastructure of research centres, which are characterised by high-potential, specialised research labs, and projects realised in the framework of the Polish Roadmap of large research infrastructure. The funding will be eligible for the purchase and production of research equipment considered as fixed-assets, real estate investment and purchase of buildings. The objective of the Measure 2.2

(PL_90) is to support the development of research infrastructure necessary for the establishment of better co-operation between the national research institutes. The projects funded by the measure should result in the establishment of joint infrastructure of several research institutes. The third recently launched instrument is the Measure 2.3 (PL_91), the objective of which is to ensure access to advanced IT infrastructure.

Besides competitive-based projects, the OP-IE will finance the individual projects, which are considered as investments of strategic importance. These projects will be selected on the basis of assessment criteria; however, will not follow the standard selection procedure. There are currently 10 projects on that list relating to the projects aimed at developing the research infrastructure in leading institutions. The total funding is estimated at €321m for the entire programming period. In addition to this, three projects were selected for the support of joint research infrastructure. The total funding is estimated at almost €203m. The largest projects in each type of interventions are: Lower Silesia Centre of Materials and Bio-materials: Centre of Advanced Materials and Technologies (€359m) and Wroclaw's Research Centre (EIT+; €503m) (Ministerstwo Rozwoju Regionalnego, 2009).

So far, Poland has participated in ten projects in the framework of pan-European research infrastructures roadmap, ERA-NET schemes and the Joint Technology Initiative (e.g. ENIAC, ARTEMIS, Clean Sky, IMI) and art. 169 instrument (e.g. AAL, Eurostars). The National R&D Centre established by the Act of 15 June 2007 is the Polish co-ordinator of these initiatives. With regards to the infrastructure projects, elaborating an appropriate strategy integrating both national and regional projects that will be co-financed by the EU Structural Fund interventions (2007-2013) into a broader framework of European research infrastructure constitutes a major challenge.

The 2015 Science Strategy that is currently under review has pointed out that it is necessary to take actions, including direct investments, consolidating the dispersed research infrastructure, and increasing the effectiveness of such infrastructure. It suggested that the National R&D Centre should be co-ordinating these activities. One of the relevant actions identified by the National Reform Programme 2008-2011 is to elaborate the strategy of building powerful domestic research infrastructure.

4.3 Research organisations

According to the Act on Higher Education of 27 July 2005, higher education institutions are autonomous in all areas of their activities. This means, for example, that a higher education institution, can undertake economic activities, which are separated from its core areas of responsibility, including the preparation of students to begin professional careers, realisation of scientific research and development activities, training of scientific staff, etc. Besides that, the Ministry gave clear guidelines back in February 2008, clarifying that higher education institutions, branch research centres, the Polish Academy of Sciences, etc. were to acquire company shares or stocks and bonds issued by entities other than the State Treasure (TrendChart, 2008).

The University main authorities are the Rector and Senate. It is, however, the Minister of Science and Higher Education has control function. For example, the Minister has a right to request information/explanation as well as undertake a control.

The candidate for the position of a Rector has to fulfil the following requirements, notably has to be an academic lecturer holding the scientific title of professor or doctoral habilitation. As far as private universities are concerned, the candidates for the position of a Rector should have at least a doctoral degree.

The existing institutional mechanism for assessing the performance of public research institutions, known as "parametric assessments" is carried out every four years by the Ministry of Science and Higher Education on the basis of annually submitted reports by the concerned entities. The objective of this assessment is to establish a ranking of public research institutions on a scale from 1 to 5 (1 being the highest), the results of which are used in the division of block funding for research activities. The currently bidding Ministerial degree regulating the allocation of block funding is the one adopted on 17 October 2007. The decision about the allocation of funding is based on the assessment of publication efforts, rights for granting the doctoral and doctoral habilitation degrees, as well as application results. During the preparatory phase, the JBRs Council considered the proposed changes as a step back compared to the previous version of ministerial decree. In particular, it pointed out that the criteria regarding the joint co-operation with other research institutes and enterprises were undervalued (Rada Główna Jednostek Badawczo Rozwojowych, 2007).

With a view of introducing structural changes to the research system and increasing the effectiveness of research funding, it is proposed in a draft of the Act on Principles of funding science to introduce a new ranking, notably A - leading institutions at the national level, B - acceptable level subject to improvements of research activities, C - unsatisfactory level of performance. More importantly, it is proposed that the research institutions considered as category C would not be eligible for the State budget funding for statutory activities, whereas non-allocated funding could be used for competitive-based projects administered by the National R&D Centre.

As far as the role of users and stakeholders in teaching, research and innovation is concerned, it is important to point out that the current legislation allows establishing a special advisory body consisting of the representatives of regional, local authorities, enterprises and financial institutions, however, there are still only few universities using this possibility (TrendChart 2008).

In the Partnership for knowledge: New model of managing the higher education institutions", the two major changes planned are:

- select leading national scientific institutions through competitive-based procedure and allocation of €3m for the five year period; and
- use competitive-based procedure to reward the integration of higher education institutions into the regional socio-economic context.

4.4 Opening up national research programmes

The general rule is that the proposals are eligible for the tenderers that have the legal address in Poland and it should be also the place where the projects are implemented. The Programme Team, which is managed by the Polish Science Foundation in the framework of the Measure 1.2 of the OP-IE requires that project manager organises an open competition to select team members from the national and foreign candidates. The same procedure applies for the Welcome and Doctoral International Studies. The purchase of research service and technical and financial

expertise from foreign entities is eligible for funding under a condition that these are necessary for the execution of the project.

4.5 National ERA-related policies - a summary

Table 9: Importance of the ERA pillars in the ERA policy mix and key characteristics

	Short assessment of its importance in the ERA policy mix	Key characteristics of policies
Labour market for researchers	• This is relatively a new area, which has received considerable policy attention. • Despite the existing barriers and obstacles to mobility of researchers, mobility is generally not rewarded.	• The recent actions are concentrated on improving the career development model of researchers
Governance of research infrastructures	• By the most recent count, it is estimated that more than 8% of the 2008 Science budget was allocated to this type of investments. • The significant financial resources have been also allocated in the Operational Programme Innovative Economy, 2007-2013. • Developing the Roadmap of the Polish research infrastructure projects has been identified as one of the tasks of the National Reform Programme 2008-2011.	• The focus of the OP-IE is on supporting the development of infrastructure of research centres, which are characterised by high-potential; establishment of joint infrastructure of several research institutes; as well as IT infrastructure.
Autonomy of research institutions	• The higher education institutions are autonomous in all areas of their activities, although the Minister of Science and Higher Education has control function.	• While the recently proposed changes aim at increasing the autonomy of managing the assets up to €250,000 there are several examples of new obligations for higher education institutions.
Opening up of national research programmes	• So far, this action has received little policy attention. There are just few programmes encouraging international collaboration, which will be implemented by the Polish Science Foundation in the framework of the OP-IE 2007-2013.	• Support to the projects undertaken by leading foreign scientists in Polish research institutes (Programme Welcome); support to institution collaborating with a foreign partner on the realisation of doctoral programmes (International Doctoral Programme); and support to research projects with an involvement of students, PhD students and post-docs (Programme Team).

5 Conclusions and open questions

5.1 Policy mix towards national R&D investment goals

The adopted policies have not yield the expected results and this is not only due to unrealistic targets that set out to increase GERD from 0.64 to 1.5% of GDP within two-year period.

Primarily, this is because until 2007 there have been no significant financial allocations earmarked for R&D activities. Within this context, it is worthwhile pointing out that since 2002 the science budget commitments have not passed the threshold of 1.5% of GDP and several problems were encountered in the implementation of RTDI measures during the 2004-2006 programming period of the EU Structural Fund interventions.

More importantly, the incentives introduces by the Act on Some forms of support for innovation activities (except Technology Credits) have not provided expected results. The most recent available data shows that by the end of 2007, only 19 corporate income tax payers used the tax incentives, whereas eight entities received favourable opinions and were granted the status of R&D Centre. There were also significant delays in signing the contracts with successful tenderers of the Technological initiative, while the launch of the strategic research and development projects has been postponed due to lack of the National Scientific Research and Development Programme that was finally adopted in October 2008.

In addition, several other structural problems have undoubtedly had negative effect on achieving better R&D investment results. Firstly, R&D funding distribution mechanism does not reward sufficiently well performing entities. Instead, the funding is dispersed among too many entities, which lead to fragmentation of R&D efforts. Secondly, socio-economic challenges have not allowed significant increase of public R&D funding. Thirdly, R&D activities are mainly undertaken by large companies. Next, there is neither sufficient IP protection within SMEs due to relatively high costs, nor comprehensive guidelines adopted by the majority of higher education institutions. Moreover, Polish market due to its size is not particularly attractive to attract VC funds, and there is also a deficit of mutually reinforcing measures to introduce systemic changes.

5.2 ERA-related policies

The policies that are aimed at improving the academic career development model and creating more student-friendly and effective higher education system have only recently gained momentum.

The key proposed changes, which are planned in the reform packages, known as “Partnership for knowledge: New model of academic career” (February 2009) are concentrated, among other aspects, on revision of the habilitation procedures, increasing funding for leading PhD programmes and opening-up higher education institutions to leading foreign researchers.

Besides that, the reform package, known as “Partnership for knowledge: Reform of studies and student’s rights (January 2009) set out different actions, among the most

important and relevant are: establishment of special form of support for the outstanding students and PhD students Internationalisation of education (e.g. regulation of aspects related to contract with foreign science institutions to conduct joint doctoral projects, definition of the national qualifications framework), and better preparation of graduates of higher education institutions to the industry needs and labour market.

Despite the lack of the Research infrastructure strategy, significant funding has been earmarked for research infrastructure projects.

The funding earmarked for the Priority 2 of the OP-IE is estimated for the entire programming period at almost €1.3b and is specifically designed to support financing the research investment type of projects. To give a sense of proportion, it is important to underline that the same amount of financial resources has been committed for the actual research-related activities.

So far, opening up the national research programmes has received little policy attention.

This is not surprising, since the ongoing reform is concentrated on re-designing the system towards greater consolidation of national R&D efforts. Besides that, there are practically no measures except the Economic Free Zones to attract R&D performing firms from abroad.

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List of Abbreviations

BERD	Business expenditure on R&D
ERA	European Research Area
GBAORD	Government budget appropriations or outlays on research and development
GDP	Gross domestic product
GERD	Gross expenditure on research and development
HEIs	Higher Education Institutions
IP	Intellectual property
OP-IE	Operational Programme Innovative Economy 2007-2013 (Program Operacyjny Innowacyjna Gospodarka)
OP-HC	Operational Programme Human Capital 2007-2013 (Program Operacyjny Kapitał Ludzki)
RTDI	Research, technology, development and innovation
SOP-ICE	Sectoral Operational Programme Increasing the Competitiveness of Enterprises 2004-2006 (Sectorowy Program Operacyjny Wzrost Konkurencyjności Przedsiębiorstw)
JBRs	Branch research institutes (Jednostki Badawczo-Rozwojowe)
PAN	Polish Academy of Sciences (Polska Akademia Nauk)
PARP	Polish Agency for Enterprises Development (Polska Agencja Rozwoju Przedsiębiorczości)

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Abstract

The main objective of the ERAWATCH Policy Mix Country reports 2009 is to characterise and assess in a structured manner the evolution of the national policy mixes in the perspective of the Lisbon goals, with a particular focus on the national R&D investments targets and on the realisation and better governance of the European Research Area. The reports were produced for all EU Member State and six Associated States to support the mutual learning process and the monitoring of Member and Associated States' efforts by DG-RTD in the context of the Lisbon Strategy and the European Research Area. The country reports 2009 build and extend on the analysis provided by analytical country reports 2008 and on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.

This report encompasses an analysis of the research system and policies in Poland.

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