RETURN ON INVESTMENT of Public Support to SMEs and Innovation in Poland
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SUMMARY REPORT
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# Abbreviations and Acronyms

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>BERD</td>
<td>Business enterprise expenditure on R&amp;D</td>
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<td>BGK</td>
<td>Bank Gospodarstwa Krajowego (State Development Bank of Poland)</td>
</tr>
<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ERDF</td>
<td>European Regional Development Fund</td>
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<tr>
<td>ESIF</td>
<td>European Structural and Investment Funds</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>MNiSW</td>
<td>Ministry of Science and Higher Education</td>
</tr>
<tr>
<td>MPIT DDI</td>
<td>International Cooperation Department of the Ministry of Entrepreneurship and Technology</td>
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<tr>
<td>MPIT DIN</td>
<td>Innovation Department of the Ministry of Entrepreneurship and Technology</td>
</tr>
<tr>
<td>NCBR</td>
<td>National Center for Research and Development</td>
</tr>
<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>OPI</td>
<td>National Information Processing Institute</td>
</tr>
<tr>
<td>PARP</td>
<td>Polish Agency for Enterprise Development</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>Polish Development Fund Ventures</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>ROI</td>
<td>Return on Investment</td>
</tr>
<tr>
<td>ROP</td>
<td>Regional Operational Program</td>
</tr>
<tr>
<td>SMEs</td>
<td>Small and Medium Enterprises</td>
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<tr>
<td>STI</td>
<td>Science, Technology, and Innovation</td>
</tr>
<tr>
<td>TFP</td>
<td>Total Factor Productivity</td>
</tr>
<tr>
<td>TFPR</td>
<td>Revenue-Based Total Factor Productivity</td>
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<td>WBG</td>
<td>World Bank Group</td>
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A “Smarter Europe” is a top priority of the European Union (EU), the core of which is innovation, economic transformation, and more competitive small and medium enterprises (SMEs). These themes account for a huge part of EU spending in the past, present, and (likely) future programming periods. Despite high expenditures, impacts on the economy often appear modest or are not well understood. EU, national, and regional policymakers want to know where and how to invest to get the highest return on investment (ROI).

This report responds to a request from the European Commission to develop and pilot methodologies to measure and improve innovation and SME support instruments. Poland was selected as the pilot country, since it is the largest recipient of EU funding, and has a rich set of support measures and implementing bodies. Drawing on the World Bank’s framework for Public Expenditure Reviews in Science, Technology, and Innovation, the report starts by examining the inputs to the innovation ecosystem, including economic priorities, government policies, and support instruments. It then analyzes the functioning of the support instruments, and ultimately the impacts on firm performance (that is, the return on investment / effectiveness). A combined understanding of these different dimensions gives public authorities a view into where and how innovation and SME support mechanisms can be improved.

1. Needs assessment and portfolio mapping analysis

A brief overview of Poland’s innovation ecosystem was prepared to understand the country’s needs and policy priorities. This “needs assessment” highlights the main weaknesses in innovation-related outcomes and challenges in Poland compared to its peers. Productivity growth has contributed moderately to overall GDP growth, and high TFP-growth can be often found among low-technology sectors. The sophistication of Polish manufacturing in the years 2008–2015 decreased, unlike in peer countries. The share of high-tech products in manufacturing exports has been growing slowly and is substantially below the Czech Republic and Hungary. New firms make limited contributions to productivity growth relative to incumbents, and R&D expenditures are lower than most peer countries. Weak linkages between small and large firms and gap in managerial skills also impede Poland’s innovation performance.

The characteristics of all the current (2014–2020) innovation and SME-related EU and nationally funded support instruments were then mapped. At the national and regional levels, 182 support instruments — corresponding to about €21 billion — were mapped across 14 dimensions, including: objectives, beneficiary types, support mechanisms, implementing bodies, and others. The most common objectives are business R&D and R&D-based innovation, non-R&D innovation, R&D infrastructure, and technology transfer/science-industry collaboration. The 11 largest instruments account for half of all funding, most of which are matching grants supporting business R&D. The remaining half is split between

1. The term instrument is used to describe individual interventions, defined in the EU documentation as measure (in Polish, działanie) or sub-measure (pol. poddziałanie). The term program denotes a group of instruments managed by the same institution, defined in the EU documentation as operational programme (pol. program operacyjny).
171 instruments. Support for management and export capabilities is limited, as are interventions targeting young firms. National and regional instruments support similar objectives (except R&D infrastructure, which is financed mostly at the regional level), and target companies with similar characteristics. The combination of the needs assessment and the portfolio mapping permitted an analysis of the “policy mix”. The policy mix analysis compares whether the current set of support instruments is aligned with Poland’s innovation-related and strategic needs and priorities, and seeks to identify potential gaps and overlaps. Conclusions from the policy mix analysis are described below.

2. Functional analysis

The functional analysis examines how the design, implementation, and governance of selected support instruments in the current EU financing perspective compare to international best practices. It aims to identify how the functionality of support instruments could be adjusted to increase the return on investment of public support. Through a documentation review and semi-structured interviews with the managers of 21 support instruments (primarily at the regional level), detailed information on 31 dimensions of instrument design, implementation, and governance was obtained. Each interview was performed jointly by at least two interviewers and lasted, on average, two to three hours per instrument. After the interview, members of the World Bank team assigned scores from one to five based on a scoring matrix adapted to the EU and Polish context, where five corresponds to international best practices.

During the interviews, numerous examples of good performance were identified. For example, in instrument design, the identification of products and outputs and the consideration of relevant stakeholders was close to best practice. However, the majority of analyzed instruments originated in response to EU requirements and were not always based on robust diagnostics. With respect to instrument implementation, agencies excel at efficiently managing application and selection processes. Challenges in the implementation stage are often linked to external regulations. For example, the lack of formalized staff incentive systems, especially linked to the performance of specific instruments, is often due to the general human resources rules of regional governments. Overall, the functionality of the two national instruments, which were included in the functional analysis, appears somewhat better than the regional ones covered by the study.

3. Effectiveness analysis

An ex post impact evaluation of the 2007–2013 EU-funded innovation and SME-related support instruments was undertaken. In partnership with Statistics Poland, the direct impact of the support was estimated using firm-level data and a difference-in-differences with propensity score matching approach. Indirect/spillover effects were estimated as well. Multiple estimation models were used to make the analysis as robust as possible. The analysis provides evidence on the impact of different types of support on: firm revenues, profits, exports, value added, research and development (R&D), and productivity as well as, ultimately, on the return on investment of public support.

The analysis found strong positive impacts of EU-funded innovation and SME-related support programs on firm employment, sales, value added, and exports. However, there was little to no impact on wages, R&D expenditures, and investments. The impact on productivity was mixed, depending on the productivity measure used—labor productivity versus revenue-based total factor productivity (TFPR)—and
beneficiary characteristics. For instance, productivity impacts were higher for manufacturing firms and younger firms. The productivity results are not surprising given that investments and R&D did not increase. Rather than transforming business operations, it appears that public support was used to hire more workers to scale-up output. This was likely beneficial for the Polish economy, as it worked to counter the negative effects of the global financial crisis. Going forward, an increased focus on boosting productivity will be critical.

The estimated impact from the support measures translates to an estimated average cost per job gain that compares favorably to available estimates from programs in other countries. Support measures emphasizing R&D, innovation, exports, and access to markets appear significantly more cost-effective in job creation than programs with small capital grants or those focusing on access to finance.

4. Conclusions and recommendations

The concluding section of this Summary Report brings together the findings from the different pieces of the analysis. It aims to provide insights on where and how innovation support mechanisms could be adjusted to improve the return on investment during the upcoming EU financial perspective (2021–2027). It also offers some considerations for the application of the public expenditure review methodology used in this report in the future, both in Poland and other countries. Recommendations relate to:

Designing and targeting instruments to maximize impact and boost productivity

• **Young firms.** Young firms may deserve increased attention in the upcoming perspective. The 2007–2013 effectiveness analysis found that the employment impact of support instruments on firms less than three years old is 20 percentage points higher than the impact on older firms. The impact of support on TFP and labor productivity are also better for young firms. On the other hand, the needs assessment found that new firms (net entry) contribute little to overall TFP growth in Poland. This suggests that there is room to better support young firms to leverage their productivity potential. The portfolio mapping found that while some current instruments focus on seed funding and startups, most instruments have a more general focus on SMEs and mature firms.

• **Exports.** Increasing the sophistication of exports is another vehicle for productivity growth. The effectiveness analysis found that 2007–2013 instruments supporting exports and access to markets had some of the best ROI, meaning the lowest cost per job created. Based on the portfolio mapping, there are some instruments supporting export promotion, but they are relatively small compared to the R&D instruments. For the next perspective, an increased focus could be placed on supporting high-technology exports, including linkages to global value chains.

• **Small firms.** The effectiveness analysis found that the impact of the 2007–2013 support on smaller firms is lower, especially for productivity. Using the TFPR (revenue productivity) measure, support programs increased productivity for large firms by eight percent, whereas they decreased productivity for micro and small firms by 13 percent. The impact on employment was slightly lower for smaller firms. On the other hand, the needs assessment highlighted the fact that foreign and large firms are responsible for a disproportionately high share of value added, R&D expenditures, exports, and investment. There could be scope to better leverage large and foreign firms to boost
SMEs’ performance. For the next perspective, policymakers could consider increasing support for linkages between SMEs and large/foreign firms, for instance, through supplier development programs, matchmaking, and facilitating links to global value chains.

- **Firm capabilities.** There is a growing body of international evidence on the importance of management practices and firm capabilities for firm competitiveness and innovation. The needs assessment showed that Poland has some room for improvement in management quality scores. Yet, the portfolio mapping showed that relatively few current instruments are dedicated to improving management practices. Going forward, policymakers could focus more on designing and adequately funding support to upgrading firm capabilities and management practices. This could help firms better manage technology adoption and innovation, move up in value chains, and increase their productivity.

- **Instrument design based on needs assessments.** The functional analysis found that the designs of the current instruments are often not based on robust assessments of firms’ needs and market failures. Ex ante assessments tend to be done at the program, rather than the instrument level, particularly for regional programs. The exception were financial instruments, which designed based on the ex-ante assessments including analysis of the financial gap. Ideally, the needs assessments would take potential alternative instruments into consideration, especially looking beyond grants. Often, the binding constraint for firms to innovate is the lack of knowledge or collaboration networks, rather than money. As described in the functional analysis section, an Innovation and Productivity Excellence Center (or similar entity) could help pilot more robust needs assessments for selected instruments.

- **Flexibility and targeting.** Flexibility to make adjustments to support instruments, particularly based on updated needs assessments, could be increased. Targeting mechanisms could also be piloted, such as using a staged approach to award financing to firms (where the beneficiaries would only receive additional funding after successfully completing an initial low-cost task).

Reducing fragmentation and overlap

The portfolio mapping highlighted considerable fragmentation of the current support instruments. It also showed that the duplication of support between the national and regional agencies is highly probable and most objectives are covered by many instruments. The instrument managers interviewed as part of the functional analysis also highlighted the overlap, including the challenges for the regions to compete with the national programs. The fragmentation and overlap lead to inefficiencies. For the next perspective, policymakers could consider limiting the overlap and increasing the specialization of the implementing bodies.

Improving coordination and learning

The functional analysis found room for improvement in inter-agency coordination. Among other things, improved coordination could facilitate the exchange of good practices, particularly from the national to the regional level, as well as between regions. An Innovation and Productivity Excellence Center could be a platform to improve the coordination and exchange good practices.

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2. The obligation to prepare ex-ante assessment of financial instruments, together with information on its scope, is specified in Article 37(2) and Annex IV of Regulation (EU) 1303/2013.
1. **INTRODUCTION**
The objective of the project was to:

- Develop a methodology to calculate the return to public investment in research and innovation, including direct and indirect (spillover) effects on firm performance
- Use methodology to conduct an evaluation of the 2007–2013 European Structural and Investment Funds (ESIF) support to innovation
- Develop and pilot tools to assess and improve current research and innovation support instruments

Why look at returns to innovation-related expenditures? A ‘Smarter Europe’ is a top priority of the European Union (EU), the core of which is innovation, economic transformation, and more competitive small and medium enterprises (SMEs). These themes account for a huge part of the EU spending in the past (2007–2013), present (2014–2020), and likely future (2021–2027) programming periods. For instance, in the 2014–2020 period, Thematic Objective 1 (Strengthening research, technological development and innovation) and Thematic Objective 3 (Enhancing the competitiveness of SMEs) are responsible for 40 percent of European Regional Development Fund (ERDF) spending. Despite high expenditures, impacts on the economy often appear modest or are not well understood. EU, national, and regional policymakers want to know where and how to invest to obtain the highest return on investment (ROI).

Why Poland? Poland was selected as a pilot country to develop and test the methodologies for the following reasons. First, Poland is the largest recipient of EU funding, including for innovation and entrepreneurship support. Over 2007–2013, Poland received €8.3 billion for the Innovative Economy Operational Program. A substantial amount of the regional operational programs (ROPs) and parts of other operational programs also relate to innovation. For 2014–2020, nearly €21 billion is allocated for innovation-related expenditures, of which 97 percent is through EU-funded instruments. Second, among the new EU member states, Poland has possibly one of the most sophisticated and efficient approaches to instrument design and implementation. This expertise suggests that there are good practices that other member states can learn from ahead of the next EU programming period (2021–2027). Third, Poland has a rich set of managing authorities, implementing bodies, and support instruments at the national and regional levels. This developed management structure offers an opportunity to understand the instruments’ impact and functionality in diverse contexts. Finally, there appears to be room for improvement in translating spending into impact, as Poland scores near the bottom of the EU Innovation Scoreboard (see Figure 1).

Figure 1. Poland scores near the bottom of the EU Innovation Scoreboard

Source: European Innovation Scoreboard 2018
Note: EU Innovation Scoreboard is an index of innovation performance enabling comparative analysis of innovation ecosystems across 40 countries. The index is composed of 27 indicators grouped in 4 pillars. Information about the index can be found at: http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en
Why the World Bank Group? The EC partnered with the WBG to develop and pilot the ROI methodologies based on the WBG’s extensive EU and global experience designing, funding, and evaluating innovation and competitiveness strategies and support instruments. Moreover, the work builds on and expands the WBG’s framework for Public Expenditure Reviews in Science, Technology, and Innovation. The work also allowed the WBG to continue helping the government of Poland strengthen its national innovation ecosystem, building on past technical assistance on enterprise innovation (2013), the Smart Growth Operational Program (2014), the National Center for Research and Development (NCBR) instruments (2013–2017), the Entrepreneurial Discovery Process (2014–2016), and other programs and efforts. The WBG also benefited from the opportunity to develop cutting-edge analytical tools to help the EU and national governments improve their innovation expenditures. And it enabled the WBG to learn from good practices in Poland that could then be shared with other countries around the world.

The analytical framework contains the four dimensions shown in Figure 2, moving from inputs (left side) to impacts (right side). It starts by examining the inputs to the innovation ecosystem, including economic priorities, government policies, and support instruments. The framework then analyzes the functioning of support instruments, how efficiently inputs are translated into outputs, and ultimately the impacts on firm performance (that is, ROI or effectiveness). A combined understanding of the different dimensions gives public authorities a view into where and how innovation support mechanisms can be improved. The paragraphs below briefly explain how each step was implemented in Poland. The efficiency analysis was not conducted due to the lack of available data.

Figure 2. Dimensions of ROI framework

1. Portfolio mapping and policy mix analysis. First, a brief overview of Poland’s innovation ecosystem was prepared to understand the country’s needs and policy priorities. This needs assessment highlights the main weaknesses in innovation-related outcomes, and the challenges in Poland to improve upon them, compared to its regional and aspirational peers. Second, the characteristics of all current innovation-related EU and nationally funded instruments were mapped. The combination of the needs assessment and the portfolio mapping permitted an analysis of the policy mix. The policy mix analysis compares whether the current set of support instruments is aligned with Poland’s innovation-related and strategic needs.
and priorities and seeks to identify potential gaps and overlaps. Portfolio mapping also provides insights into whether resources in the current financing perspective are appropriately allocated to themes and forms of support that are expected to yield higher productivity gains.

2. Functional analysis. Functional analysis examines how the design, implementation, and governance of selected support instruments in the current EU financing perspective compare to international best practices. It aims to identify how the functionality of the support instruments could be adjusted to increase the return on investment of public support.

3. Return on investment / effectiveness analysis. An ex post impact evaluation of the 2007–2013 EU-funded innovation-related support instruments was undertaken. In partnership with Statistics Poland, the direct impact of the support was estimated using firm-level data and a difference-in-differences with propensity score matching approach. Indirect/spillover effects were estimated as well. The analysis provides evidence on the impact of different types of support on firms: revenues, profits, exports, value added, R&D, and productivity, and, ultimately, on the return on investment (ROI) of public support.

What will this contribute to Polish and EU policymakers? Expected benefits include:

- **Evidence for future program and instrument design.** Taken together, all three dimensions provide information on where and how future public support to innovation can be channeled to increase the impact and help Poland achieve its development priorities. They also provide evidence for policymakers at the EU, national, and regional level to guide future innovation expenditure targeting, as well as to improve the enabling environment.

- **Replicable methodology.** The analysis provides a model for replicating all or parts of the methodology in the future. For instance, functional analyses could be done on a periodic basis by the managing authorities and implementing bodies in Poland to track improvements over time. The methodology could be applied in other EU member states interested in improving their public expenditures.

- **Good practices from Poland.** The managing authorities and implementing bodies in Poland and other countries can learn from the range of identified good practices in Poland.

The remainder of the document is organized as follows. Section 2 summarizes the assessment of the needs of the Polish ecosystem, along with the portfolio mapping and policy mix analysis. Section 3 summarizes the functional analysis methodology and findings. Section 4 describes the ROI/effectiveness methodology and findings. And Section 5 offers conclusions and recommendations based on the combined analyses.
2. PORTFOLIO MAPPING AND POLICY MIX ANALYSIS
Introduction

The policy mix analysis combines an assessment of Poland’s innovation-related challenges and a mapping of the portfolio of science, technology, and innovation (STI) instruments available to firms. The needs assessment highlights the main challenges in the innovation environment and benchmarks Poland against a group of regional and aspirational peers. The analysis assesses outcomes and outputs, such as the productivity and sophistication of production, against input determinants and conditions, such as firm capabilities, the enabling environment, the supply of knowledge, and competitive pressures. The assessment seeks to understand Poland’s needs for STI, as well as business support policies and the challenges linked to achieving the desired results. It also examines how the needs are reflected in strategic priorities and the gaps that need to be bridged to improve the policy mix.

The portfolio mapping catalogs all existing business support instruments and their characteristics relating to resource allocations (for example, the size of support), managing authorities and implementing bodies, objectives, types of beneficiaries, types of instruments, and so on. The analysis of the mapping identifies overlaps between instruments and gaps in STI support. An assessment of the needs of the innovation ecosystem helps identify areas where public support could be enhanced to support key economic objectives. The portfolio mapping provides a picture of whether resources in the current (2014–2020) financing perspective are being directed to the themes and types of beneficiaries with the highest ROI during the 2007–2013 perspective. While many operational changes occurred between the previous and current perspectives (for example, the shift from capital investment toward business R&D, the wider use of financial instruments, and the limited financing of new infrastructure), similar objectives are supported across both perspectives, (for instance, R&D grants for SMEs). The combination of the above inputs provides a more evidence-based foundation for STI policy. A complete description of the methodology and results can be found in the Portfolio Mapping and Needs Assessment Technical Note.

Needs Assessment

The needs assessment looks at four dimensions: 1) Outcomes—observed performance; 2) Inputs that influence the observed outcomes—firm-level investments and capabilities; 3) Local framework conditions; and 4) External factors (Figure 3).

The results of the country needs assessment presented below focus on economic outcomes and identified gaps in the innovation-related outcomes of the Polish economy. The analytical approach compares Poland’s performance to regional and aspirational peers, using secondary data. The regional peers were selected based on geography and proximity, as well as similarity in economic characteristics. Korea and Germany were selected as aspirational peers. The EU-28 average is also used as an aspirational benchmark.
Figure 3. Analytical framework to assess demand for innovation – Country needs assessment


Note: Examples of indicators to measure outcomes include high-tech exports as a % of manufacturing exports, high-tech patent applications to European Patent Office per million inhabitants, total factor productivity growth, Economic Complexity Index (from Harvard/MIT Observatory of Economic Complexity), etc.
Outcomes that matter:
Some stylized facts on Poland’s growth and productivity dynamics

“Productivity isn’t everything, but in the long run it is almost everything”

Paul Krugman

1. Poland was one of the fastest growing economies during 1992 – 2017, with capital accumulation contributing the most to this growth

Poland has experienced one of the fastest gross domestic product (GDP) per capita growth rates in the world over the last 25 years (see Figure 4). Capital has been the largest contributor to GDP growth between 2010 – 2017, similar to Poland’s regional peers (see Figure 5). The contribution of labor has been positive due to decreasing unemployment, large labor cohorts entering the market, and improvements in workforce educational attainment. Total factor productivity (TFP) contributions were similar to labor. The fast catch-up helped eliminate the gap in GDP per capita with Hungary, increased the lead over Romania, and narrowed the gap with all the other peers. However, Poland is still lagging behind Slovakia and the Czech Republic in GDP per capita. With an aging society, productivity improvements will be crucial for maintaining growth.

2. New firms make limited contributions to productivity growth relative to incumbents, while high TFP growth is not necessarily limited to the high-tech sector

New firms have a negligible contribution to productivity growth relative to incumbents. For most sectors, the main contributors to productivity growth are existing firms that increase their productivity (within), closely followed by productive firms gaining market share (between). Looking across sectors: for the typically low-tech sectors, productivity growth was more frequently through the ‘between’ channel (for example, leather, textiles, wood, and food); whereas for the high-tech sectors, the ‘within’ channel is more important (for example, computers, electronic equipment, and machinery). The fastest TFP growth was observed among several low-technology industries, such as furniture, wearing apparel, textiles and leather,
in addition to the typically high-technology industries, such as computers and vehicles. At the same time, some typically high-tech industries, such as pharmaceuticals and chemicals, had the slowest TFP growth.

**Figure 6.** TFP growth across selected industries in Poland, 2006 - 2014

![TFP growth across selected industries in Poland, 2006 - 2014](image)

Source: Albinowski, Hagemejer, Lovo, Varela (2015).

### 3. Foreign firms and large firms make disproportionally large contributions to the economy

The share of micro and small enterprises in Poland is similar to most of its peers. Over 95 percent of entities are micro firms, which represent 40 percent of employment and generate 16 percent of value added. Only two out of 1,000 firms are large, but they employ a third of the workforce, and produce half of the value added of the Polish economy (see Figure 7). Large companies account for over 60% of investment and R&D expenditures. Moreover, they invest disproportionally more on R&D per employee: five times more than microenterprises, three times more than small enterprises, and 70% more than medium enterprises. The same pattern can be observed for business expenditures on R&D (see Figure 8).

**Figure 7.** Contribution to the Polish economy by firm size, 2017

![Contribution to the Polish economy by firm size, 2017](image)

Source: Statistics Poland

**Figure 8.** Business expenditures on R&D per person employed by firm size, 2017

![Business expenditures on R&D per person employed by firm size, 2017](image)

Source: Eurostat
Overall only 0.5 percent of all companies are owned by foreigners. Nonetheless, 17 percent of firms with at least 10 employees (that is, small, medium and large firms) have foreign ownership. While foreign companies account for one-third of total employment, they generate 40–45 percent of total revenue, profits, and R&D expenditures (see Figure 9 and Figure 10). Foreign firms are also the driving force behind Poland’s international trade, accounting for two-thirds of all exports. Additionally, foreign companies account for most of the production value in a few high-technology industries: transport equipment, computer products, and electronic equipment.

**4. The sophistication of production and exports could be elevated**

In the long run, the sophistication of production and the ability to upgrade technology, regardless of the sector, can drive productivity growth. Compared to its regional peers, the share of high-technology and medium high-technology manufacturing in Poland is low (see Figure 11). Moreover, among the comparators, Poland is the only country in the group to decrease the share of high-technology and medium high-technology manufacturing production since 2008, which indicates that the technology intensity in manufacturing production is growing more slowly than the whole economy.

The structure of the Polish economy is also reflected in the composition of its exports. The share of high-technology exports in Poland is similar to that in Romania, but behind other regional and aspirational peers (see Figure 12).
Gaps in Polish innovation: Inputs that influence outcomes

1. Poland is not doing as well as its peers in innovation

The innovation ecosystem in Poland is one of the least developed in the EU. During the last few years, Poland has occupied the fourth-to-last place on the European Innovation Ranking, ahead of Romania, Bulgaria and Croatia. According to the European Innovation Scoreboard, Poland exhibits the most significant challenges in the areas of the intensity of innovation activities (only a small number of innovative firms, and only rudimentary cooperation on R&D projects) and framework conditions (despite one of the highest shares of population that completed tertiary education among the EU member states).

At the same time, enterprises in Poland do not report higher barriers to innovation than its peers (European Commission Community Innovation Survey, 2016). A lack of good ideas and high costs related to innovation are the main reasons prohibiting firms from engagement in R&D projects. Almost one in four
Enterprises in Poland considered undertaking innovative activities, but chose not to do so, due to the high barriers. Similar problems are reported by other Central and Eastern European countries, except that respondents in Hungary, Romania, and Slovakia report low market demand as the most important barrier.

Although general conditions for entrepreneurial activity in Poland are more favorable than among its regional peers, some distance remains to achieve the activity levels of Germany and Korea (2019 Ease of Doing Business Ranking). The biggest deficiencies persist in starting a business and enforcing contracts, which are particularly important for the development of innovative enterprises. In recent years, performance in these categories has improved, but the pace of change has been slow.

2. Lower commercialization of innovation activity

The number of patents per million inhabitants in Poland is higher than among regional peers, but the applicability of patents is low. Polish scientists and companies register 12 patents per million inhabitants in the European Patent Office, more than Hungary, Slovakia and Romania, but less than the Czech Republic, Germany, and South Korea (see Figure 13). However, the implied suitability of patents for business applications is limited: the number of patents registered in the European, U.S., and Japanese patent offices (the so-called ‘triadic’ patent families, which indicates high applicability of the patent) is smaller than all its peers except for Romania. The distance to the aspirational peers is also higher for triadic patents. One of the reasons for the low patenting activity might be the limited cooperation between science and industry. According to data from the Global Competitiveness Index, the intensity of university-firm collaboration in Poland is lower than among all its peers except Romania (see Figure 14).

3. Lower firm capabilities, low rates of technology adoption

Polish enterprises report low adoption and readiness for new technologies. According to the Technological Readiness Index, which takes into account the level of technological adoption and ICT use, Polish companies perform below its regional and aspirational peers. Moreover, Poland ranks sixth out of 12 EU member states included in the World Management Survey assessment of managerial capabilities. On average,
the managerial capabilities in Poland are not far from the frontier, but the distribution of management scores across Polish firms is spread out, pointing to a large number of companies with management practices that are significantly below average (see Figure 15).

**Figure 15.** Distribution of management scores, 2008 – 2010

<table>
<thead>
<tr>
<th>Country</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>0 to 30</td>
</tr>
<tr>
<td>Romania</td>
<td>-4 to 2</td>
</tr>
<tr>
<td>Germany</td>
<td>-4 to 2</td>
</tr>
</tbody>
</table>

*Source: European Bank for Reconstruction and Development (EBRD) Management, Organization and Innovation Survey (building on the work of Bloom and Van Reenen).*

**Needs assessment summary and recommendations**

Despite impressive growth in GDP per capita in the last 25 years, Poland is still lagging behind both the Czech Republic and the Slovak Republic, as its productivity growth makes only limited contributions to overall growth. Moreover, production in the Polish economy remains much less sophisticated relative to its regional and aspirational peers. The share of high-technology exports in manufactured exports is the lowest among the comparator countries (along with Romania). Expenditures on R&D, cooperation between science and business, and commercialization of research are all low. As a result, Poland is near the bottom of the EU-28 Innovation Scoreboard ranking, ahead of only Romania, Bulgaria and Croatia. Firm capabilities that can help enhance managerial skills and technology adoption could help improve innovation-related outcomes.

With an aging society, the importance of productivity for maintaining growth will increase. Suggestions for boosting productivity include:

1. Strengthen linkages between small or young firms and foreign or large companies
2. Support activities that help firms improve the sophistication of their production and exports
3. Facilitate the participation of young firms in support programs
4. Improve firm capabilities, especially management and technology adoption skills
**Portfolio Mapping**

The portfolio mapping catalogs support instruments and budget allocations and identifies responsible institutions (points 1.2 and 1.3 in Figure 3). It provides the basis for analyzing the alignment between the demand for innovation (the country’s needs) and the portfolio of support instruments and helps identify potential overlaps and gaps.

The analysis includes information about all public instruments that support firm development financed from domestic and European sources related to Thematic Objectives 1 (R&D and innovation) and 3 (SMEs). The unit of analysis is an individual support instrument, which is defined as a measure (Polish: działanie) or, if available, a submeasure (Polish: poddziałanie). Data on 14 dimensions were collected for each of the 182 identified instruments, resulting in over 15,200 data points. Data was sourced from program documentation, which was supplemented by a review of EU and national regulations. The final portfolio mapping matrix was validated by the relevant managing authorities to ensure the accuracy of the collected information.

**Institutions responsible for support to SMEs and innovation**

In the years 2014–2020, the value of public support for innovation and SME instruments for enterprises in Poland is almost €21 billion. Two-thirds of this budget is invested through country-wide ‘national’ (that is, EU-co-financed) and ‘domestic’ (that is, Polish government-financed) programs, with the remainder managed at the regional level (see Figure 16). The national programs, with budgets of over €13 billion, are implemented by seven agencies under the EU co-financed Smart Growth and Eastern Poland operational programs. Entirely state-budget financed domestic instruments worth €0.7 billion are managed by the Ministry of Science and Higher Education. Additionally, the 16 top-level administrative regions, called voivodeships (NUTS2 level), invest jointly €7 billion (34 percent of the total for Poland) through regional operational programs (ROPs).

Over half of the budget for country-wide interventions is implemented by the National Center of Research and Development (NCBiR) through 10 national instruments. Another 25 percent of the budget of the country-wide interventions is invested by the Polish Agency for Enterprise Development (PARP), with the remaining implementing bodies each responsible for 4–6 percent of the budget. Additionally, 10 domestic instruments managed by the Ministry of Science and Higher Education (MNiSW) constitute a total of 5 percent of the budget of country-wide support (see Figure 17).

Each of the 16 Polish regions manages its own regional operational program covering 10 out of 11 thematic objectives (interventions in the area of Thematic Objective 11—Enhancing institutional capacity of public authorities and stakeholders and efficient public administration are implemented only on the national level. Thematic Objective 1 (R&D and innovation) and Thematic Objective 3 (SMEs) account for, on average, 19 percent of the total budget of regional programs (see Table 1). Each managing institution allocates financing between policy areas based on ex ante evaluations carried out by external consultants, and negotiations

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4. Not all measures are further broken down to submeasures. The decision on dividing interventions into measures and submeasures depends on the managing authority. This breakdown affects the count of the total number of instruments, but it has limited impact when the characteristics of instruments are analysed.
5. List of analyzed instruments is presented in Annex I of the Portfolio Mapping and Needs Assessment Technical Note.
6. Except for Smart Growth Operational Program 3.3.2 — Promotion of Polish brands — that accounts for 0.3 percent of total country-wide spending. This instrument is implemented by the International Cooperation Department of the Ministry of Entrepreneurship and Technology (MPIT DDI) due to its expertise in initiating foreign trade relations.
with the European Commission and the Ministry of Investment and Economic Development (henceforth, ‘the Ministry’). As a result, the share of ROPs dedicated to Thematic Objective 1 (TO1) and Thematic Objective 3 (TO3) varies significantly between regions and constitutes from 15 – 26 percent of ROP budgets.

Figure 16. Value distribution of instruments per national, regional, and domestic instruments

Figure 17. Value distribution of national and domestic instruments per implementing body (regional programs excluded)

Table 1. Share of STI policy in total budget managed by national and regional agencies

<table>
<thead>
<tr>
<th>Region</th>
<th>TO1 Innovation</th>
<th>TO3 SMEs</th>
<th>Total STI policy</th>
<th>Total value (EUR millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National programs</td>
<td>16%</td>
<td>7%</td>
<td>24%</td>
<td>13,091</td>
</tr>
<tr>
<td>Mazowieckie</td>
<td>14%</td>
<td>8%</td>
<td>23%</td>
<td>632</td>
</tr>
<tr>
<td>Opolskie</td>
<td>14%</td>
<td>10%</td>
<td>24%</td>
<td>206</td>
</tr>
<tr>
<td>Kujawsko-Pomorskie</td>
<td>10%</td>
<td>16%</td>
<td>26%</td>
<td>635</td>
</tr>
<tr>
<td>Śląskie</td>
<td>10%</td>
<td>11%</td>
<td>21%</td>
<td>940</td>
</tr>
<tr>
<td>Podlaskie</td>
<td>9%</td>
<td>11%</td>
<td>20%</td>
<td>300</td>
</tr>
<tr>
<td>Regional average</td>
<td>8%</td>
<td>11%</td>
<td>19%</td>
<td>443</td>
</tr>
<tr>
<td>Małopolskie</td>
<td>8%</td>
<td>6%</td>
<td>14%</td>
<td>489</td>
</tr>
<tr>
<td>Łódzkie</td>
<td>8%</td>
<td>11%</td>
<td>19%</td>
<td>497</td>
</tr>
<tr>
<td>Pomorskie</td>
<td>8%</td>
<td>7%</td>
<td>14%</td>
<td>306</td>
</tr>
<tr>
<td>Wielkopolskie</td>
<td>7%</td>
<td>10%</td>
<td>17%</td>
<td>591</td>
</tr>
<tr>
<td>Świętokrzyskie</td>
<td>7%</td>
<td>12%</td>
<td>19%</td>
<td>297</td>
</tr>
</tbody>
</table>
The size of regional STI budgets depends on two factors. First, the general financial allocation for all policy objectives is decided by the EU, based on the population of the region and its level of economic development. Second, each regional Marshal’s Office designs its ROP distribution among investment priorities in compliance with EU regulations. The biggest regional SME and innovation budget is €940 million in the Śląskie Region (covering 12 percent of the population). The smallest is €206 million in the Opolskie Region (covering three percent of the population).

Support is fragmented, as there are 182 SME and innovation instruments, including 10 domestic, 36 national, and 136 regional instruments. The number of regional instruments is a consequence of Poland’s administrative division into 16 regions and the decision to channel financing closer to the final recipient. Budget allocations across institutions and the fragmentation of support create substantial differences between the size of instruments at the national and regional levels. An average national instrument has a budget of €364 million, whereas the averages for the domestic and regional instruments are €69 million.
and €32 million respectively. The budget of the 11 largest instruments (six percent of all instruments) represents over half of the budget of all the SME and innovation interventions in Poland. The other half is dispersed across 171 instruments (see Figure 18).

Regions independently divide allocated budgets into individual interventions. Even though the number of instruments varies from four to sixteen between regions, the scope of interventions is similar because instruments can cover one or multiple objectives. Usually all related instruments in a region are managed and implemented by the same group of people, so decisions about the fragmentation of individual instruments do not significantly impact their functionality.

**Support instrument objectives**

Instruments were categorized based on SME and innovation-related objectives (see Figure 19). Most objectives are covered by many instruments. Instruments at all levels of governance focus on business R&D and R&D-based innovation (91 out of 182 instruments) and technology transfer/science-industry collaboration (58 instruments). Multiple regional and national instruments cover non-R&D innovation (73). R&D infrastructure is the most frequent objective for regional instruments (59 regional instruments and 63 in total). On average, there are three to four regional instruments for each of the most widely documented objectives, in addition to the national instruments available in each region. A beneficiary from an average region can select from a total of six R&D infrastructure instruments, 14 technology transfer instruments, and 28 R&D-based or 22 non-R&D innovation interventions.

**Figure 19. Distribution of national, regional and domestic instruments per objective (by number)**

Over 60 percent of instruments cover multiple objectives. Eighty-two percent of R&D infrastructure instruments have an additional objective, which is more likely to be technology transfer, non-R&D, and R&D infrastructure. Only three instruments focus solely on technology transfer, whereas 72 percent of the instruments that cover technology transfer also cover business R&D, and 48 percent of them cover R&D infrastructure. Export promotion instruments are the most focused, with over half supporting only this particular objective. There are 22 instruments supporting management practices, of which two focus on this objective only, and most are linked with non-R&D innovation.
Types of firms that are eligible for support

Firm eligibility can be based on size, sector of activity, and stage of development. With respect to firm size, most instruments are open to micro, small, and medium applicants. Approximately one-third of national and regional instruments are available also for large companies, which is a result of the Common Provisions Regulation (CPR), which limits provision of support under Thematic Objective 3 to SMEs. Domestic instruments are not subject to the CPR and some other EU regulations; thus, they are less restrictive in terms of enterprise size.

The sectoral orientation of EU co-financed instruments is determined by European regulations. Interventions implemented under Thematic Objective 1 (Research and innovation) are limited to companies that fall within national or regional smart specializations. Under Thematic Objective 3 (SME development) some interventions are open to all SMEs, regardless of the sector of activity. All NCBR instruments focus on firms within smart specializations, as do 11 out of the 16 PARP instruments. Six out of the 10 domestic instruments (which are not bound by the Common Provisions Regulation) have a narrower sectoral focus.

With respect to the stage of business development, the highest number of instruments is available for mature companies (see Figure 20). Out of 182 instruments, 146 are open for mature firms, with 108 intended only for this type of enterprise. The focus on mature firms is higher at the regional level compared to national interventions. The portfolio of national instruments is more complementary, aimed at supporting newly established companies from their infancy. Some regions also have instruments or dedicated solicitations for young companies that have been operating for less than 24 months. However, there are only 25 instruments that are explicitly intended for non-mature firms. Of these 25 instruments, three are solely focused on pre-seed, another three on startups, and 19 support multiple early stages. All domestic instruments focus on mature companies.

![Figure 20. Distribution of instruments per stage of business development (by number)](image)


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7. Smart specializations are strategic areas for intervention based on an analysis of the strengths and potential of the economy and an Entrepreneurial Discovery Process (EDP) with wide stakeholder involvement. In Poland, smart specializations were identified in each of the 16 regions, as well as on the national level. More information on smart specializations are available at: http://s3platform.jrc.ec.europa.eu/


9. The Common Provisions Regulation generally prohibits the implementation of narrow sectoral programs co-financed from European Structural and Investment Funds (ESIF).

10. The stage of development denotes the intended target group of the instrument. Regulations usually do not prohibit young companies from applying, but the selection criteria may make them unlikely to succeed.
Support mechanisms

Over three-fourths of all the instruments use grants, and about eight percent use vouchers (see Figure 21). Other forms of financial support include equity finance and credit guarantees (offered mostly by central institutions). Non-financial support is limited to invitations to business services and public R&D infrastructure (with the latter offered almost exclusively by regions, through financing university laboratories that are available for firms for business R&D). Compared to the 2007–2013 financial perspective, the role of repayable (for example, credit/loan and equity) instruments has increased significantly.

In terms of value, grants and vouchers comprise more than 85 percent of the total budget. The budget for repayable instruments represents 15 percent of total support, half of which is allocated to risk capital implemented by Polish Development Fund (PFR) Ventures. The diversity of instrument types on the regional level is reflected in the financial distribution. Some forms of support are offered mainly by the regions (for example, credit guarantees or investments in public R&D infrastructure). The scale of some interventions on the regional level is very small. The average regional risk capital instrument is only €12 million, compared to €252 million at the national level.

Policy mix recommendations

Reduce fragmentation and overlap. There is a need for increased coordination between the national and regional authorities to reduce the proliferation of instruments and avoid unnecessary overlaps. The overlaps of objectives, beneficiaries, and support mechanisms could be investigated, and instruments with similar characteristics potentially consolidated. Reducing fragmentation lowers administrative costs as well as the costs for beneficiaries, as the proliferation of instruments can create confusion among beneficiaries and increase their costs for searching and applying. Reducing fragmentation could also help address the issue of minimum impact scale, given that smaller instruments may have difficulty serving a critical mass of beneficiaries and achieving systemic change. On the other hand, smaller instruments could allow for piloting or more responsiveness to local needs. Finding the right balance between efficiency and context alignment requires appropriate analytical capacity, which could

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11. Vouchers are generally small grants allocated to non-innovative SMEs to purchase services from external knowledge providers and stimulate future collaboration between them.
12. Initially, 10 regions also planned to include credit guarantees instruments in respective ROPS. However, competition with the de minimis guarantees implemented by the BGK contributed to closure of six of them (as of December 23, 2019).
13. There is only one credit guarantee instrument on the national level (SG OP 3.2.3 Guarantee Fund) and one instrument funding public R&D infrastructure (SG OP 4.2 Development of the Modern Research Infrastructure of the Science Sector).
14. Further recommendations on increasing coordination are included in the Functional Analysis section.
be a challenge, particularly at the regional level. One of the areas where overlaps are particularly proliferated are regional returnable instruments, analyzed in the Section 2.3.5 of the Portfolio Mapping and Needs Assessment Technical Note.

Consider narrowing the focus of regional instruments. One way to address the fragmentation, overlap, and minimum impact scale issues is to focus the regional instruments more on identified regional needs (taking into account that national instruments will still be available to the firms in the region). Cirera and Maloney (2017) developed a hierarchy of the sophistication of instruments to strengthen firm capabilities along a ‘capabilities escalator’. The hierarchy matches the complexity of instruments with the needs of firms and their ability to benefit from the instruments, as well as the ability of public institutions to deliver these programs. For example, if firms in lagging regions struggle with the adoption of basic managerial and organizational practices, as well as machinery upgrading, and undertake little-to-no formal R&D, the capabilities escalator approach suggests a focus on encouraging firms to adopt existing technology and invest in simple organizational changes rather than incentivize advanced research. Thus, there is a case that regional instruments ought to be designed to adapt to local conditions. This may also allow for specializations across regional and national implementing bodies, which would also be helpful in refining the choice of instruments and avoiding overlaps.

Improve support for management and export capabilities, and young firms. Extensive work by Bloom and co-authors, as well as Iacovone and Pereira-Lopez (2017), emphasize the importance of management practices for innovation. Likewise, Grover, Medvedev, and Olafsen (2019) show that firm growth and innovation is often associated with the so-called ‘internal characteristics’ of companies, such as export orientation and global linkages of firms, membership in networks, and the quality of managerial skills. While Poland has some instruments that support management practices, it would be worth examining further whether their size and quality is optimal. For export promotion, it would be useful to review whether eligible expenditures are adequate to achieve the objectives. Existing instruments mainly cover the costs of participating in international trade fairs, adjusting operations to the needs of international customers (such as, obtaining certifications), and market research. Boosting the quality and sophistication of exports may require more support, such as connecting domestic suppliers to global value chains, or facilitating linkages with foreign or larger companies that are innately more productive. Finally, the preponderance of support for mature firms raises the question of whether some support could be rebalanced toward young firms (which is discussed further below).

Use an evidence base when choosing support mechanisms. Although Poland has a strong track record of disbursing funds through matching grants, it is important that firms’ needs are matched with the choice of instrument. Cirera and Maloney (2017) show that innovation can be spurred using a wide range of instruments, and the efficacy of each instrument is contingent on the context in which it is applied. For instance, vouchers tend to be effective at stimulating behavior change, but evidence of sustained impact is mixed, suggesting that voucher programs are likely to work best as an initial step toward more complex support programs. More details on the importance of strong instrument justifications and the consideration of alternative instruments are included in the Functional Analysis section below.
3.

FUNCTIONAL ANALYSIS
Introduction

What makes some innovation support instruments more successful than others? Policymakers and academics around the world struggle with this question. One way to answer it is through functional analyses of support instruments. The World Bank has developed functional analyses to compare the design, implementation, and governance of instruments to international best practices, and identify areas for improvement. The functional analysis complements the other dimensions of the return on investment methodology by:

- Identifying systemic and idiosyncratic shortcomings in how instruments function
- Highlighting local and international best practices
- Identifying how the functionality and governance of support instruments could be adjusted to increase ROI and inform future instrument design
- Serving as a monitoring tool that managing authorities and implementing bodies can use periodically

This section provides an overview of the functional analysis methodology and summarizes the results from the reviews of selected innovation support instruments conducted during June–October 2018. *The Functional Analysis Technical Note* contains detailed information on the methodology and findings, including annexes (to which references are made in the text below).

Methodology

The unit of analysis is an individual support instrument, which is defined as a measure (Polish: działanie) or, if available, a submeasure (Polish: poddziałanie).\(^\text{15}\) The analysis covered 19 regional and two national instruments (see Figure 22). The instruments were chosen based on the portfolio mapping of all innovation-related support instruments in Poland. The selection aimed at obtaining a heterogenous sample covering a range of instrument types and geographies. Counterpart willingness to participate was also a factor in the selection.

Information was gathered from both secondary and primary sources. These include: instrument documentation (for example, detailed descriptions of priority axes, ex ante evaluations and analyses, strategic documents, and smart specialization documents); European and national regulations, and the EU-Poland Partnership Agreement; and interviews with representatives of the managing authorities and implementing bodies.

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\(^\text{15}\) Not all measures are further broken down to submeasures. The decision on dividing interventions into measures and submeasures depends on the managing authority.
of managing authorities and implementing bodies. Semi-structured face-to-face interviews were conducted by the WBG team with the managers and employees of the departments responsible for the design and implementation of selected instruments. Thirty-one areas of public management were analyzed along three dimensions: design, implementation, and governance (see Figure 23). The design dimension covers 14 areas, implementation 13, and governance, the remaining four areas.

**Figure 23. Subjects covered in the functional analysis**

List of analyzed instruments:

- National: *Fast Track* (1.1.1) implemented by NCBR and *Grants for pro-innovative services offered by Business Support Institutions* (2.3.1) implemented by PARP
- Dolnośląskie Region: *Innovative firms* (1.2) and *Product and services development in SME* (1.5)
- Kujawsko-Pomorskie Region: *Capital instruments for innovative SMES* (1.6.1)
- Łódzkie Region: *Enterprise R&D infrastructure* (1.2.1) and *Business R&D projects* (1.2.1)
- Lubelskie Region: *Support for targeted research* (1.2) and *R&D infrastructure in enterprises* (1.3)
- Lubuskie Region: *Research and innovation* (1.1) and *Development of entrepreneurship* (1.2)
- Podlaskie Region: *Business R&D projects and support of the transfer of knowledge, innovations, technologies and commercialization of results of R&D projects* (1.2) and *Voucher for research services* (1.3)
- Podkarpackie Region: *Industrial research, development works and their implementation* (1.2), and *Grants for SMES* (1.4)
- Pomorskie Region: *Expansion through innovation—financial instruments* (1.1.2), *Support for Business Support Institutions* (2.4.2/2.4.3)
- Świętokrzyskie Region: *Grants for organization of events promoting regional economy* (2.4), *Credits for general development of SMES* (2.6)
- Wielkopolskie Region: *Strengthening of the innovative potential of enterprises* (1.2), *Financial instruments for improvement of the competitiveness of the region* (1.5.1)
Each interview was performed jointly by at least two interviewers and lasted, on average, two to three hours per instrument. After the interview, members of the WBG team assigned grades for each of 31 categories independently, relying on a scoring matrix and a documentation review. Consolidated scores for each category were then discussed and agreed on by the interviewers, using a scale of one to five, with higher scores indicating closer proximity to international best practices. Scores in each category are based on the World Bank and academic research on good practices for science, technology, and innovation (STI) support instruments and public management. The framework builds on the WBG’s Public Expenditure Reviews in STI methodology, which was deepened and adapted to the Polish and EU context. Descriptions of the categories and grading details are included respectively in Table 1 and Annex 1 of the Functional Analysis Technical Note. For illustrative purposes, examples of grading guidelines for three of the 31 categories are provided below (see Table 2, Table 3, and Table 4).

**Instrument Justification (example from Design dimension)**

Instrument Justification focuses on the quality of the diagnosis underpinning an instrument and reference to market failures as a problem that justifies the creation of the instrument.

**Table 2. Scoring in Instrument Justification category**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No sound rationale for government intervention is given. It is mostly assumed.</td>
</tr>
<tr>
<td>2</td>
<td>An informal rationale that implicitly justifies government action exists, but it lacks articulation and evidence.</td>
</tr>
<tr>
<td>3</td>
<td>A diagnosis that refers to market failures exists, but it lacks sufficient evidence and does not address all dimensions of the problem.</td>
</tr>
<tr>
<td>4</td>
<td>There is a diagnosis and it covers the market failure, but the quality is not state-of-the-art.</td>
</tr>
<tr>
<td>5</td>
<td>A high-quality diagnosis that identifies the market failure using evidence and state-of-the-art techniques.</td>
</tr>
</tbody>
</table>


**Eligibility Criteria and Application Information (example from Implementation dimension)**

This category addresses the process by which eligibility criteria are implemented, how effective they are in reaching the target population, and what are the mechanisms for their ongoing modification. Additional considerations include the transparency of the criteria, and the public availability of information about the applicants (to the degree allowed by general privacy regulations).

**Table 3. Scoring in Eligibility Criteria and Application Information category**

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The criteria are not well suited to generating applications from the target population. The process lacks transparency and information on the applicants is not gathered. A process to disseminate information about successful applications is lacking.</td>
</tr>
<tr>
<td>2</td>
<td>There is a rudimentary articulation of eligibility with the features of the target population, focusing more on control requirements than in effecting the change intended by the instrument. Requirements are unclear and put a burden on the applicants.</td>
</tr>
</tbody>
</table>
3. FUNCTIONAL ANALYSIS

The criteria are coherent with the features of the target population, but they lack transparency in their implementation, and there is limited use of background information on potential applicants. The burden on applicants is lighter, but not optimal.

4. There is a transparent selection process, coherent with the target group, and information about the candidates is used to improve and adapt future selection criteria. Gathered data on financial decisions is not fully diffused. The burden is reduced, but higher than optimal.

5. There is a transparent selection process, coherent with the target group, and information on the candidates is used to improve and adapt future selection criteria. Additionally, data on financial decisions is publicly shared. The burden is within reasonable limits and generally does not demand additional resources to submit applications.


Interaction of Jurisdiction Rules and Regulations, External (example from the Governance dimension)

Jurisdiction interactions occur when the regulatory or legal framework have consequences for the operation of the instrument. The external aspect of jurisdiction interaction relates to the degree to which general legislation leverages or inhibits the impact of an instrument, and the possibilities for the modification of such obstacles.

Table 4. Scoring in the Interaction of Jurisdiction Rules and Regulations (External) category

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Legislation and/or regulations strongly inhibit instrument effectiveness and impact and are very difficult to change.</td>
</tr>
<tr>
<td>2</td>
<td>Legislation and/or regulations inhibit effectiveness, but do not completely defeat its purpose. The degree of difficulty of removal is high, but not impossible.</td>
</tr>
<tr>
<td>3</td>
<td>Jurisdiction interactions exist that create some impediments, but to some degree they are removable.</td>
</tr>
<tr>
<td>4</td>
<td>Some constraints exist that affect the effectiveness of the instrument only mildly, and/or the removal seems feasible but is not yet underway.</td>
</tr>
<tr>
<td>5</td>
<td>No external obstacles exist, or those that do exist are in the process of being removed.</td>
</tr>
</tbody>
</table>


Lessons learned for future applications of this approach in other countries include:

- Reviewing national and supranational regulations affecting management of STI support instruments is critical to understand the underpinnings of many of the categories of analysis.

- The relationships between the institutions engaged in innovation support should be mapped as a part of the preparation for meetings with the instrument managers.

- Extending the analysis to include interviews with the instrument beneficiaries could provide valuable insights into instrument functionality and corroborate the information collected from government officials.
Results

This section summarizes the results of the functional analysis. This exercise is not an impact evaluation, but a tool that helps to better interpret impact evaluation results and understand the connection between instrument functionalities and outcomes. More detailed information is presented in the Functional Analysis Technical Note. Figure 24 shows average scores in each of the 31 categories across all instruments. Average scores per dimension do not vary much: both design and governance scored 3.3 on average, and implementation scored 3.5. Five of the 31 categories have an average score above four (high performance), which indicates that nearly all instruments, both at the national and regional level, are close to best practices in these dimensions. Another five categories could be considered ‘good performance’, with the average above 3.7. Areas with the greatest need for improvement include some categories governed or affected by external regulations.

**Design**

Examples of good practices from the Design dimension include the identification of products and outputs, and the consideration of the relevant stakeholders. Products and outputs are clearly listed, and all agencies have created procedures for tracking indicators and establishing milestones. The list of stakeholders and consultation processes are identified at an early stage and include non-beneficiary parties, such as business associations or academia.

Among good performance categories (with an average score above 3.7 across all instruments), the process of instrument formation is well structured, but often leaves little room for adjustment to the local context. The majority of the analyzed instruments originated in response to EU requirements and were not always based on robust diagnostics. In terms of the portfolio and instruments relationship, instruments are designed to be complementary within interventions managed by the same authorities. However, awareness of the instruments implemented by other institutions varies between instruments, and the acknowledgement of overlapping instruments appears to be rudimentary.

Such a situation results in the duplication of instruments, which lowers efficiency. Future modification of the regulations could potentially incentivize the managers of grant instruments to consider alternative instruments to better address market failures (as they are obliged to do with repayable instruments...
Monitoring and evaluation systems are embedded in the design of all the instruments, but their usefulness for impact analysis can be limited. The effectiveness of the interventions is measured mostly at the program level (or the subset of interventions in a specific area), rather than at the instrument level. This method of measurement limits the information available to the managing authorities on whether instruments should be continued, revised, or closed. The quality of the monitoring and evaluation of the national instruments is higher than the regional ones. For example, PARP analyzes the impact of individual instruments for midterm evaluations and regularly gathers feedback through the ongoing *Barometr Innowacyjności* (Innovation Barometer) evaluation.

### Implementation

In the implementation stage, the application and selection process, and the project closure, are highly rated. The application and selection processes are agile and transparent, and usually follow best practices: use of expert panels, the possibility of introducing minor corrections to applications, and a clear mechanism for appeal and conflict resolution. Moreover, national instruments tend to have more streamlined procedures and put smaller burdens on applicants. A description of the categories with the biggest differences in results between the national and regional levels is presented in Annex 3 of the Technical Note. All instruments have a structured process for project and instrument closure. Actions undertaken in the above categories results mostly from the governmental and EU regulations, which reflect best international practices. More details on the identified national and regional best practices in the above areas are included in Annex 2 of the Technical Note. Budgets for interventions are disbursed based on a seven-year framework, which is an example of best practices, because it provides predictability of financing over time. On the other hand, financial resources in some regions exceed the feasible absorption levels by the beneficiaries (especially for business R&D). In some cases, the technical assistance budgets for the implementing bodies to hire an adequate number of employees and/or experts were considered insufficient.

Areas with the greatest need for improvement include some categories governed or affected by regulations. For example, the lack of formalized staff incentive systems, especially linked to the performance of specific instruments, is often due to the general rules of human resource management in the Marshals’ Offices. As a result, employee rotation, and the lack of applicants for job openings, pose serious challenges. The outcome indicators regulated by the EU are explicit and measurable, but they do not facilitate the connection of outcomes with the higher-level objectives. Data on indicators collected by the managing authorities seem mostly internal to the instruments themselves and support the fulfillment of controlling functions. The eligibility and selection criteria built into instrument design are clear, but they do not allow for the identification of a target population that could have the biggest impact on achieving the instrument objectives. The situation is similar across the board, except for the rudimentary provisions aimed at reaching the optimal applicants, such as the offer of a slight increase in co-financing levels for knowledge dissemination, or the cooperation between large firms and SMEs. Finally, process monitoring in most regional instruments is perceived only as a vehicle for compliance with the EU and national law, and present little or no potential for process improvement.

### Governance

The high score in the ‘Interaction (Internal)’ area indicates that both the managing authorities and the implementing bodies are aware of the internal and external rules and regulations governing the instruments and are able to navigate these constraints well. External regulations, such as competition rules
regarding state aid and public procurement laws, create significant constraints on the implementing bodies and the beneficiary firms and are likely to negatively affect instrument effectiveness. The significant burden of the external regulations is reflected in the low scores in the ‘Interaction (External)’ category.

In most cases, the relationship between the programs exhibit insufficient consideration of potential complementarities, as well as possible competition with other instruments. Complementarities seem to be managed informally rather than through explicit criteria and mechanisms. Only one region managed to analyze the relationship of its instruments with other programs based on a structured process, thereby also capturing interactions with the innovation support activities undertaken by private entities. Other agencies do not consider private actors in the innovation ecosystem, or do so in a provisional way. In general, there is competition rather than cooperation between the regional and the national programs regarding R&D support instruments. However, a few regions implement joint instruments with NCBR, which is an example of best practices in terms of regional-national cooperation.

**Systemic and idiosyncratic patterns of performance**

One of the objectives of the functional analysis is to identify systemic (that is, similar across all instruments) and idiosyncratic performance patterns. Despite the differences in the types of instruments and agencies, the results of the analysis are similar across the board in many categories. Two main reasons behind this situation were observed. First, the EU and national regulations leave limited space for discretionary decisions in many of the Design and Implementation categories. Second, the perceptions of the authorities engaged in EU co-financed firm support programs appear to be aligned on many topics. Categories that exhibit the most systemic performance across all the instruments are listed in Table 5. Improvement in these areas will likely require the modification of the regulations.

Several categories are characterized by a high differentiation in performance. Idiosyncratic performance categories include: Instrument Origin and Justification, Alternative Instruments, Learning and Adjustments, Solicitations, and Staff/Training. Top performing instruments in the idiosyncratic categories constitute a collection of best practices that could be used by the managers of other interventions to improve their performance. Details on the methodology of detecting patterns of systemic and idiosyncratic performance are described in Annex 10 of the Technical Note.
Systemic challenges

Coordination between national and regional programs. The relationship between the national and regional programs, especially regarding support for business R&D, is mostly characterized by competition rather than coordination. This is partly due to the lack of a clear ‘demarcation line’ defining boundaries between national and regional programs in the current perspective. This situation leads to inefficiencies, and is confusing for the applicants, because of the duplication of activities on both levels of governance (see the portfolio mapping section for information on instrument overlaps). As of April 2019, four regions have implemented joint instruments with the NCBR that target specific sectors at the regional level. While joint projects are an example of best practices in the Institutions Relationship category, in general, the coordination does not include strategic-level thinking. (The shortcomings of the present coordination bodies are listed in Annex 5 of the Technical Note).

Insufficient coordination also negatively affects the dissemination of best practices among the institutions in the innovation ecosystem. While the quality of the design and implementation of the instruments varies considerably between agencies, there is a significant scope to learn from the solutions developed by both the central and regional authorities (these are described in Annexes 2 and 3, respectively, of the Technical Note). For instance, the regional programs could learn from the national programs how to better reduce bureaucratic burdens on applicants. The higher burdens in the regional programs likely result from differences in the interpretation of regulations. This is an example of a ‘low-hanging fruit’ that could be seized relatively easily through the creation of a better platform for national-regional dialogue (see Annex 4 of the Technical Note).

Flexibility in designing and implementing instruments. In general, regions should have the flexibility to finance their regional objectives, as long as they are based on solid rationales and market failures (and are within EU thematic objectives). One challenge is the limited capacity of the managing authorities and implementing bodies to prepare evidence-based rationales for instrument adjustments and piloting. Another challenge is the limitations that result from external obligations. The regions reported difficulties in meeting the EC and ministerial requirements related to earmarking resources for business R&D support. Even when the regional authorities presented the results of analyses highlighting the limitations of regional innovative potential, they had to allocate more funds to Thematic Objective 1 (R&D), than are, in their opinion, optimal.

The perceived lack of flexibility also relates to the difficulties of shifting funds between thematic objectives, and the rigidities related to the public procurement rules for the selection of intermediaries for financial (that is, loan rather than grant) instruments. (The process of selecting financial intermediaries is described in Annex 7 of the Technical Note). The EC has proposed that there should be increased flexibility to design and implement support instruments in the new financial perspective. However, the scope of the changes will depend on the inclusion of specific provisions in the regulations, as well as their active implementation. Under the current rules, the thematic concentration thresholds apply to all funds designated for a given member state. Decisions on the distribution of funds in the individual regions is based on negotiations between the Ministry and the regions.

Justification and alignment with systemic change. The design of many of the instruments is based on a limited needs assessment, with an insufficient understanding of the underlying constraints and market failures. Ex ante assessment of the programs is intended to provide such knowledge, but its methodology and
execution have some shortcomings. Ex ante assessments are, in most cases, seen more as a ‘box-checking compliance exercise’, rather than a useful tool for instrument design. This is partly due to a shortage of analytical capacity in the managing authorities and in the market, as well as budgetary and time constraints. Additionally, ex ante assessments cover an entire operational program, not an individual instrument, nor a group of similar instruments. In the case of the regional operational programs, one document justifies interventions in all 11 thematic objectives. Apart from the repayable instruments, the consideration of alternative instruments tends to be very limited or nonexistent. This leads to a preference for grants, regardless of the intervention objectives, due to the high firm demand for grants.

Instrument objectives are not clearly linked with systemic change metrics. Rather, they focus on narrowly defined outputs and outcomes. Performance targets are often considered to be the ultimate objective. Although tracking the impact of individual instruments might be difficult, due to their (in some cases) relatively small size, the objectives of all the instruments should be logically connected with systemic changes. The ex ante assessment is supposed to make this connection, but, in practice, the connection is weak. Even when explicit logical frameworks are part of the documentation, they are rarely used by the policymakers or implementing bodies. There is a general tendency and pressure to focus on meeting disbursement targets, rather than achieving systemic change in the smartest way possible.

Operational planning. Currently, the targeting of interventions is based on smart specializations, which are broadly defined, and on firm size (for example, SMEs). This is due to a focus on complying with EU and national regulations and meeting disbursement targets. There is a lack of strategies to target firms where the return is likely to be the highest. In the area of supporting business R&D, some managing authorities struggle to obtain enough quality applications to absorb the current innovation funds, so there is little incentive to increase targeting. As of January 2019, the utilization rate for Thematic Objective 1 (Business R&D) was half that of Thematic Objective 3 (Support to SMEs). The piloting of new interventions is limited for similar reasons.

The efficiency of the support instruments could be increased by improving process and input cost monitoring. In some regions, process monitoring is perceived only as a vehicle for compliance with EU and national law. This perception prevents the managing authorities from obtaining information about the real costs of their instruments. It also limits the data available for detailed ROI calculations. One challenge is the high costs associated with IT system upgrades needed to incorporate input and process monitoring, especially given that some agencies still mainly use paper documents.

Functional analysis recommendations

Establish an Innovation and Productivity Excellence Center. One recommendation is to establish an ‘Innovation and Productivity Excellence Center’ (or similar entity) that plays both coordination and advisory roles. Such an institution could help address most of the systemic challenges identified above. Possible activities/functions for the center include, among others:

- Coordinate the mix of SME and innovation support instruments to reduce the overlap across national and regional programs (including all types of interventions, not only EU co-financed instruments)

Establish a repository of best practices related to instrument design and implementation, and disseminate them

Provide analytical inputs to instrument design and prepare non-binding opinions on the instrument design proposals. Support the managing authorities in conducting needs assessments

Analyze the effectiveness of the implemented support schemes (for example, research on smart specializations and targeting approaches), as well as the symptoms of innovation underperformance in each region

Support managing authorities and implementing bodies in linking the design and implementation of instruments to strategic-level objectives

Pilot innovative targeting mechanisms. For example: work with the representatives from selected smart specializations to tailor the instrument design, marketing, and application processes to their needs; test staged financing mechanisms, where the beneficiaries that are successful in an initial low-cost stage then receive additional funding, and so on

Further analysis and stakeholder consultations would be needed to determine the best institutional set-up for the proposed institution. An Innovation and Productivity Excellence Center could be a new, stand-alone entity, or could evolve out of an already existing coordination body.

**Reduce the rigidity of regulations.** Agencies face constraints from both the national and EU regulations. One of the most burdensome of the constraints, according to the managing authorities, is the competitiveness principles regarding state aid. These principles require the beneficiaries to select suppliers based on public tenders. They also require the managers of the funds to select the financial intermediaries through public tenders. There are also regulations related to implementation procedures (for example, the performance framework and the certification of funds) that lead to an excessive focus of the managing authorities on achieving disbursement targets. Modification of such rules would allow the agencies to better adapt the instruments to the local context and pilot new forms of support.

**Improve process monitoring infrastructure.** The introduction of instrument-level process and input cost monitoring systems would generate information on the efficiency of the implemented interventions. Such data could inform evidence-based decisions about the adaptation or discontinuation of support schemes. Such systems could be incorporated into the transition of some implementing bodies from paper to an electronic document flow.
4.

ROI / EFFECTIVENESS ANALYSIS
Introduction

The final dimension of the ROI framework is the effectiveness analysis. The aim is to measure the effectiveness of EU-funded innovation support measures during the 2007–2013 EU financial perspective, assess impact at the firm level, and derive relevant conclusions for future project design. The methodology used in this report may also serve as a guide for future analyses of public spending in Poland and other countries. A complete description of the methodology and results can be found in the ROI/Effectiveness Analysis Technical Note. To facilitate replicating the methodology, Annex 6 of the Technical Note contains a detailed description of the data cleaning and estimation procedures, including Stata statistical software codes.

The analysis aims to be comprehensive in the support instruments included in the evaluation. As the main interest is focused on support for innovation (broadly defined), competitiveness and innovation-related instruments were included in the analysis, based on a portfolio mapping exercise and consultations with the Polish government. During 2007–2013, the EU funds were used to create instruments within the Operational Program for Innovative Economy (OP IE) and the regional operational programs (ROPs) to boost the innovation of firms through, for instance, grants for capital equipment, R&D equipment, access to business services, and access to trade fairs. Thus, the evaluation was conducted for over 100 instruments during the 2007–2013 perspective, which have a variety of objectives and outcomes.

The wide variety of programs makes it challenging to conduct a rigorous impact evaluation. The analysis tested various estimation model specifications to ensure that the effects of the support measures on firms are consistent across the different models. In addition, the evaluation was comprehensive, as it used administrative firm-level data in Poland that covers the universe of firms (with at least 10 employees). Lastly, using the estimated impact on firm performance outcomes, and the costs of providing and administering the support measures, the report calculated the returns on investment.

The report is situated within three branches of the economic literature on program evaluation. The first branch examines how different government support programs on innovation, export promotion, or technology adoption have direct effects on firms. These studies examine how programs can improve firms’ performance in R&D activities, sales, exports, and productivity levels. The second branch examines spillover effects of the support to firms and research institutions. The third branch includes studies that examine the effects of the OP IE and ROPs on firm performance in Poland. Perhaps, the third branch of literature is the most relevant. Several studies examined the effects of the OP IE and ROP programs on firms in Poland, but they focus only on a subset of measures, do not use a comprehensive dataset, do not examine the full period when the programs were operational, or do not employ robust methodologies. The GUS (2015) study is noteworthy, as it is the closest in the coverage of the instruments and the methodology to the analysis in this report. While the study uses some similar methods as this report, it evaluates the effects from the national instruments individually, and the regional instruments as a group. GUS (2015) finds that the regional instruments increased employment and the fixed assets of some beneficiaries, but the effect is not present in all the regions. No significant impacts from the regional instruments are observed for profits, revenues, and R&D expenditure or exports. The study does not find any effect of the national instruments on net revenues or profits. However, there are some positive effects on employment, fixed assets, export activities, and R&D activities for firms receiving support from certain instruments. The findings in this report reinforce the GUS (2015) findings.
Empirical methodology and data

While there were improvements observed in many innovation and competitiveness indicators between 2007 and 2013, it is difficult to causally attribute the improvement to the operational programs without a proper evaluation. The improvements can be the result of a variety of reasons unrelated to the operational programs, such as a growing economy and an improvement in the quality of European research institutions. Many indicators relate to outputs, such as the amount of R&D expenditure, the introduction of business processes, and the use of intellectual property, but they do not reveal the impact of the programs on actual firm performance outcomes, such as product/market diversification, revenue, employment, and productivity. Figure 25 presents our theory of change. Under certain market imperfections, public support for innovation is expected to improve intermediate outputs, such as R&D activities, which, in turn, are expected to have an impact on firm survival, growth, and productivity—both directly and through spillover effects. Hence, the analysis considers both the direct effects of support measures on the beneficiary firms, as well as indirect/spillover effects on non-beneficiary firms.

Datasets. The analysis uses a census collected by Statistics Poland (GUS) of all Polish firms with at least 10 or more employees between 2006 - 2017. This dataset includes information on firm characteristics (size, age, sector, location, and so on) and other standard financial data on employment, output, assets, and profits. In addition, the firm census was merged with customs data to construct measures of firms’ export patterns. To identify beneficiaries from EU support, this data was merged with Poland’s SIMIK\(^\text{18}\) database, which lists the beneficiaries of the OP IE, ROPS, and related programs, using the taxpayer ID number. In addition, these two firm-level datasets were supplemented with other sector and regional level data required for the analysis. First, NACE\(^\text{19}\) two-digit level price deflators were used to calculate real values of output, materials, capital, and wages. Second, the 2009 input-output table was used to construct

\(^{18}\) Systemu Informatycznego Monitoringu I Kontroli (System for Information Monitoring and Control).

\(^{19}\) Nomenclature des Activités Économiques dans la Communauté Européenne (Statistical Classification of Economic Activities in the European Community)
measures of vertical linkages to capture spillovers effects. Given that the data from the firm census and customs are confidential, all the data processing, matching, and analysis were performed by GUS, with technical support from the World Bank.

**Direct effects: outcomes of interest.** Direct support instruments can affect firms’ performance in many ways. The grants and other financing instruments subsidize firm’s purchases of tangible or intangible assets, and other business services. If the recipient firms previously underinvested, due to constraints, such as access to finance or lack of information about available services or technologies, these measures should increase their investments in innovative activities, and consequently increase firms’ output, employment, and productivity. More specifically, the analysis focuses on both intermediate outputs and longer-term outcomes (see Figure 25 above). Most of these outcomes — employment, investment, sales, exports, value added, profits, value added per worker — can be derived directly from firm-level data, and total factor productivity can be calculated as well.

**Direct effects estimation methodology: matching and difference-in-differences.** There are two key challenges in identifying a causal relationship between access to grants/loans and firm performance. First, firms might self-select into applying for the grants based on their assessment of their needs and likelihood of success in getting the grant. Second, non-random allocation of the program measures might further select beneficiary firms that are systematically different from non-beneficiary firms. Therefore, any observed differences in performance may be due to inherent differences in the firms’ characteristics, rather than due to the impact of receiving support. This is likely to be the case if the aim of these measures is to select ‘better’ firms in the first place. Indeed, program data, as of 2011, indicates that applicants for R&D support are disproportionately in knowledge-intensive sector activities, while applicants to capital investment support are dominated by low and medium-technology manufacturing. As described above, the Polish implementing agencies do select firms based on a set of selection criteria, such as firm size and sector. There is some evidence suggesting that risk aversion during the application review process results in the bulk of R&D funding being channeled to large firms and low to medium-technology sectors (Kapil et al. 2013).

To mitigate concerns with the endogenous selection of firms in these policy measures, the analysis uses a propensity score matching (PSM) methodology to account for the observable differences in characteristics between the beneficiary (treated) and the non-beneficiary (untreated) firms. Intuitively, PSM is a process of replicating an experimental dataset by estimating a firm’s likelihood of receiving support (the treatment) based on their observed characteristics. Under the ‘unconfoundedness assumption’ — that is, after controlling for observable characteristics — treatment exposure is independent of firm outcomes. Under the ‘common support assumption’ — that is, given any values of observable characteristics — each firm has a non-zero probability of receiving a treatment. Therefore, controlling for the propensity score is sufficient to eliminate bias (Rosenbaum and Rubin, 1983). This means that non-treated firms with similar propensity scores can serve as a valid control group for the treated firms.

There are several advantages of using the PSM methodology in the case of Poland. First, we are interested in evaluating the impact of the overall innovation-related support, which involves over a hundred measures. The sheer number of measures renders selection on observables the most likely viable method. Second, rich firm-level data in Poland enables us to control for a large set of firm characteristics, making the unconfoundedness assumption more plausible.

20. As opposed to methods requiring detailed institutional knowledge of each program, such as Instrumental Variables or Regression Discontinuity Design.
Despite these advantages, there are multiple shortcomings with the standard \textsc{psm} method that we have attempted to mitigate. First, as there is extreme heterogeneity in the support measures, it is both difficult to establish a valid control group with only one treatment group, as well as less useful in terms of identifying the effect of different support instruments. To account for this complication, the \textsc{psm} model can be extended to multivalued or multiple treatment cases to consider different grant amounts (Imbens, 2000; Lechner, 2001) or categories of measures (Joffe and Rosenbaum 1999, Imai and van Dyk 2004). In our case, the grant amount is only one dimension of the program heterogeneity. Given the very different objectives, financing instruments, and eligibility conditions of the different program measures, we categorized them into groups based on those conditions. Grouping based on these dimensions helps to avoid having a prohibitively large number of treatments, while preserving the critical heterogeneity across policy measures.

Finally, the methods described above only control for observable characteristics. Even with rich data, there likely exist unobservable firm characteristics that can influence both the treatment propensity and firm performance, violating the unconfoundedness assumption. To account for this possibility, we will combine matching with the difference-in-differences (\textsc{d\textsubscript{id}}) estimator to control for time-invariant characteristics, such as managerial capabilities, that may influence firm performance. More specifically, this amounts to defining a trimmed or matched sample for the treated firms, and estimating a \textsc{d\textsubscript{id}} model on that sample.

As the firms receive grants at different times throughout the period when the programs were operational, both matching procedures and \textsc{d\textsubscript{id}} specification account for the different timing at which firms receive the funding. The matching procedure is for each year of the programs (that is between 2007 - 2013), where we find controls for the firms who started receiving treatment in the same year, using pre-treatment firm characteristics.\textsuperscript{21} This approach has the advantage of allowing the program selection process to vary each year, which is robust to considerations, such as the rush at the end of the programs to disburse money. The matched \textsc{d\textsubscript{id}} specification was also modified to allow for heterogenous treatment effects (meaning different effects based on firm size, age, and sector), by including interactions with the treatment status.

\textbf{Indirect/spillover effects.} Beside the direct effects on the beneficiary firms, instruments that provide support at the firm level can also affect the non-beneficiary firms through their interactions with the beneficiaries. There are three channels through which these spillovers can happen. First, through \textit{geographical proximity}: firms located near the beneficiary firms can take advantage of knowledge spillovers through operating in a close environment and having repeated interactions. Second, through \textit{horizontal industry linkages}: similar to the ways that firms can learn through geographical proximity, firms in the same industries can also learn by operating in the same market, such as through employee turnover and industry association meetings. As a result, support in an industry can result in a positive impact on non-supported firms in the same industry.

On the other hand, there can be negative spillover effects if supported firms compete away demand from non-supported firms. The overall impact will depend on the strength of each effect, on the degree of market competition, and on the tradability of the sector. Since the programs support innovation and exports, it is expected that the demand substitution effects would be small, if the supported firms succeeded in accessing external markets, or in creating new product demand. Third, through \textit{vertical industry linkages}: The non-beneficiaries may also benefit as they purchase higher quality inputs.

\textsuperscript{21.} Examples of sample selection procedures are: (i) trimming to discard observations with extreme propensity scores, (ii) nearest-neighbor matching to restrict the control sample to those most observationally similar to the treated firms.
from the beneficiaries or sell more or higher quality output to the beneficiaries. To examine these spillover effects, the analysis estimates how the extent of the exposure of non-treated firms (firms that never received any direct support throughout the sample period) to treated firms—either spatially or through industrial linkages—affects performance.

**Return on investment.** To inform policy decisions on public spending for innovation in Poland and other countries, it is necessary to know not only the impact of the programs, but also ROI. To estimate ROI, first, aggregate impacts can be estimated using the (average) direct effects of the various instruments on firms. Overall cost effectiveness can then be estimated, where costs include both the grant/support provided for the firms and the administrative costs to manage the programs. The relevant outcomes include: costs per job gain, costs per unit profit gain, costs per unit value-added gain, and costs per percentage gain in productivity.

**Direct Effects on Firm Outcomes**

To estimate the direct effect of support measures on firm outcomes—including employment, sales, value added, exports, wages, and productivity—the analysis moves from simple to complicated models. The simple model assumes a one treatment effect model (meaning all the support measures are lumped together). ‘Heterogeneous effects’ are then introduced to this simple model to see how outcomes differ by firm age, size, and sector. The next step was to test a more complicated model with ‘multiple treatment groups’. Two types of instrument groupings were tested: one based on instrument objectives, and one based on expected instrument outcomes. For example, instruments that supported R&D were considered to be one treatment, instruments that supported exports were considered to be another treatment, and so on. This multiple treatment approach shows how effects on the firm outcomes differ by type of instrument.

**One treatment effect group**

Public support had positive effects on employment, output, exports, and value added. On average, the treatment effect across all of the year cohorts increases employment by 14.5 percent, value added by 19 percent, sales by 19 percent, and export value by 29 percent (see Figure 26). There is some positive treatment effect on average wages, especially for the firms receiving support toward the end of the program period (in 2012 and 2014). There is little-to-no treatment effect on fixed assets investments (tangible and intangible), R&D expenditure, and profits. Lastly, there are mixed results on firm productivity levels, depending on which productivity measure is used (see Figure 27). The two productivity measures—labor productivity and revenue-based total factor productivity (TFPR)—impose different assumptions and structure on the productivity calculations. For labor productivity, with the least amount of assumptions and structure, there is a positive treatment effect. On average, the treatment effect across all the year cohorts is a 2.7 percent increase in labor productivity. For TFPR, with the most structure and assumptions in the production function, there is a negative treatment effect. On average, TFPR decreases by six percent due to the treatment.

There are larger treatment effects experienced by large firms, young firms (less than three years old) and firms in the manufacturing sector. Heterogeneous impacts—meaning different impacts based on firm size, age, and sector—were examined for employment, TFPR, labor productivity, profits and R&D expenditure. There are minimal heterogenous effects for profits and R&D expenditures, so these results are omitted.
Large firms tend to benefit more from the innovation support. Large firms have a higher increase in employment, albeit the difference from small and micro firms is minimal, 0.9 percentage points (see Figure 28). The treatment effect on TFPR for large firms is positive and about six percentage points higher than medium firms, while it is negative for small and micro firms (see Figure 29). Labor productivity increases are also higher for large firms (see Figure 30). There is no treatment effect on labor productivity for small and micro firms.

Young firms—those that are three years old and younger—benefit more from the innovation support. Young firms experience a higher positive effect on employment, and the difference between young firms and older firms is large (see Figure 31). The treatment effect on TFPR for older firms is negative compared to no effect for young firms (see Figure 32). The increase in labor productivity is higher for young firms compared to older firms, with a difference of about 2.5 percentage points (see Figure 33).
Manufacturing firms enjoy more benefits from the innovation support. There are heterogeneous effects for firms in different sectors: manufacturing, trade (retail and wholesale), construction, and all other sectors (agriculture and other services). There are only heterogeneous effects for the productivity outcomes. There is a clear pattern for the sectoral heterogeneity of outcomes: there is a positive effect for firms in the manufacturing sector, and a negative effect for firms in the trade sector (see Figure 34 and Figure 35). There is minimal effect for firms in construction and the remaining sectors.

Lastly, the analysis finds a positive relationship between the grant amount and employment. The elasticity of employment to grant amount is 0.04: that is, a one percent increase in grant amount is associated with a 0.04% increase in employment. For comparison, moving from the 50th percentile to the 75th percentile in the co-financing amount among beneficiaries translates into a tripling in the co-financing amount. Doubling the grant amount (that is, a 100 percent increase) can translate to a 4.4 percent increase in employment. There is no heterogeneous treatment effect for productivity outcomes.

**Multiple treatment effects groups**

Moving away from a general treatment effect, the estimation considers multiple treatment effects by grouping support instruments based on their characteristics. The groupings need to balance two opposing issues: (i) creating enough categories to capture the different types of support across programs, while
(ii) minimizing the number of categories to ensure the feasibility of the estimation process. Based on a portfolio mapping of the instruments, two groups were constructed around the instrument objectives and expected outcomes. They are listed in Table 6.

**Table 6. Groupings for multiple treatment effects**

<table>
<thead>
<tr>
<th>Group 1: Instrument Objectives</th>
<th>Group 2: Expected Instrument Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Small capital (K) grants, low expected innovativeness</td>
<td>Increased innovation</td>
</tr>
<tr>
<td>2. Large capital (K) grants, high expected innovativeness</td>
<td>Better access to finance</td>
</tr>
<tr>
<td>3. Grants for R&amp;D work / implementation</td>
<td>Better access to services</td>
</tr>
<tr>
<td>4. Supporting exports</td>
<td>Better access to markets</td>
</tr>
<tr>
<td>5. N/A</td>
<td>Overall competitiveness (of the firms and environment)</td>
</tr>
</tbody>
</table>

The treatment effects of both groupings are consistent with the results of the one treatment effect. The general effects (positive, negative, and not significant) are presented in the diagrams below (see Table 7 and Table 8). There is a positive effect on employment, sales, value added, export participation, and export value. Similarly, the results for productivity are mixed, with positive effects for labor productivity and negative effects for TFPR.

**Table 7. Summary of results for Group 1**

<table>
<thead>
<tr>
<th>Outcome Variables</th>
<th>&quot;Type 1 Small K grants, low expected innovativeness&quot;</th>
<th>&quot;Type 2 Large K grants, high expected innovativeness&quot;</th>
<th>&quot;Type 3 Grants for R&amp;D work / implementation&quot;</th>
<th>&quot;Type 4 Supporting exports&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment (%)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Sales (%)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Value Added (%)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Exporting</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Export Value (%)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Average Wages (%)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Profits (thous zł)</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Labor Productivity (%)</td>
<td>+</td>
<td></td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>TFPR (%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>R&amp;D Expenditure</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Tangible Fixed Assets Investment (%)</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>


Note: Full results are presented in Annex 5 of the ROI/Effectiveness Analysis Technical Note. Positive coefficients are represented with ‘+’ in blue, negative coefficients are represented with ‘-’ in orange, and non-significant results are blank.
Indirect Effects

We estimate the indirect effects of support to two groups of beneficiaries: (i) firms receiving support (that is, firms included in the direct effects); and (ii) research institutions and business support institutes (BSIs). For the first group, we examine the indirect effects at the regional and industry level (that is, horizontal, backward and forward linkages). For the second group, we examine the indirect effects at the regional level. In both groups, we focus on how spillovers affected the non-beneficiary firms’ employment, sales, value-added, profits, TFPR, and labor productivity.

In general, we find that the programs have largely insignificant indirect effects on non-beneficiary firms and if they did, the effects are very small. First, there is no evidence of spillover effects through backward linkages, that is, through spillovers to suppliers of beneficiaries. However, there is a negative effect on non-beneficiary firms’ TFPR through forward linkages. That is, increasing support in upstream (selling) sectors has a small negative effect on non-beneficiary (downstream) firms. Similarly, there is a small negative effect on non-beneficiary firms’ labor productivity when there are more beneficiary firms in the same sector (horizontal spillovers). These negative indirect effects suggest that beneficiary firms are exerting some negative pressures on non-beneficiary firms they sell to or those in the same sector.

22. A PLN 1 million increase in support to upstream sectors can result in a decrease in 0.1 percent in TFPR for downstream firms.
23. A PLN 1 million increase in support to an industry can result in 0.01 percent decrease in labor productivity in the same industry.
The results are slightly stronger for the indirect effects of research institutions and BSIs receiving support. There are positive effects of support to research institutions and BSIs on non-beneficiary firms’ labor productivity, TFPR, and profits in the same region. However, similar to the previous results, the magnitude of effects may be minimal. An increase in PLN 1 million of financing to the research institutes and BSIs in the region can result in: 0.17 percent increase in average firm profits, 0.00053 percent increase in labor productivity, and 0.00049 percent increase in TFPR.

To summarize, these results suggest that there have been limited spillover impacts of the innovation support on other firms—either through geographical proximity, within industry interactions, or buyer-supplier linkages. Support to BSIs and research institutions appears beneficial, but still small in magnitude.

**Return on Investment Calculations**

Using the estimates from the one treatment effect, ROI for job creation is comparable to the international estimates of the effectiveness of job creation schemes. The cost effectiveness is highest for SMEs, that is, it costs less to create one job for each zloty of support to SMEs. The cost per job created is about PLN 85,000 (or $22,100) for large firms, and PLN 53,000 (or $13,800) for small and medium firms (see Figure 36). Few studies have examined the cost effectiveness of job creation programs, but estimates can range between $20,000 to $30,000 per job created. For example, World Bank estimates found that the cost of creating a job in Tunisia through a public investment program was around $30,000.24 A review in the U.S. of 240 tax subsidy packages for companies found that the average cost per job created was $465,000.25

The estimates from the multiple treatment effects show that there is a high cost effectiveness for instruments emphasizing R&D, innovation, and access to markets. When the impact is differentiated across instrument types, the cost per job gain can vary substantially between PLN 7,000 and over PLN 100,000. When the instruments were grouped by their objectives, the instruments that supported R&D, and those that supported exports, have the lowest costs per job created (see Figure 37). Similarly, for the instruments grouped according to their expected outcomes, the cost effectiveness is highest for instruments that aimed to increase innovation and improved access to markets (see Figure 38).

Lastly, the analysis finds that there is a sizeable ROI on value added. The ROI calculations for value added requires additional assumptions to be made on the persistence of impact of the value-added gains and the length of the gains. With different assumptions, PLN 100 of costs (related to the grant amount and administrative costs) can generate between 18 – 25 PLN of value added (see Figure 39).

In all ROI calculations, we take into account the direct effects only, given the minimal size of the indirect effects.

**Fiscal Impact**

We consider the fiscal implications of the increase in employment and wages due to the support programs. We focus on the potential increase in Personal Income Tax (PIT) revenue that can be generated through the increase in employment and wages. Since it is not possible to recover the full distribution of wages to determine which tax rate will apply, these calculations are based on a key simplifying assumption that all wages are taxable at the same average PIT rate of 8.7 percent, based on Poland’s average PIT rate in 2007–2013. Given the minimal indirect effects, the total gain in PIT revenue is calculated based on the direct impact on the average employment and wages in beneficiary firms only. In addition, we estimate the total PIT gain up until 2016 as the sum of PIT gain in each year following the treatment, where annual PIT gain is assumed to be constant over time. This follows from the assumption of a constant linear treatment effect used in the estimations above.

Our results suggest there has been a substantial benefit to fiscal revenue due to the increases in employment. The estimated annual tax revenue gain between 2008 and 2014 ranges approximately between PLN 80 – 280 million. To put this in perspective, the cumulative tax revenue gains for a given treatment year (up until 2016) cover between 13 percent to 35 percent of the cost of support for that treatment year. (The cumulative gains for more recent treatment years are naturally lower due to fewer years of available data.)
Conclusion

The ex post evaluation of Poland’s support programs over 2007–2013 finds that there are positive impacts on firm employment, sales, value added, and exports. This result is consistent across the different estimation models. In contrast, there is mixed evidence on the impact on productivity, depending on the productivity measure used. However, productivity impacts were higher for firms in the manufacturing sector. There is minimal evidence that the programs affected investments (either physical assets or R&D) and profits. These findings are broadly similar to earlier studies, such as GUS (2015), which examine the impact for a more limited set of programs or firms.

The estimated impact from the innovation support programs, in turn, translate to an estimated average cost per job gain that is comparable to available estimates of other programs in other countries. Programs emphasizing R&D, innovation, exports, and access to markets appear significantly more cost-effective in job creation than programs with small capital grants or those focusing on access to finance. Finally, evidence of the indirect effects of support on non-beneficiary firms is minimal, while the fiscal impact from increased employment and wages appears to be substantial.

The limited impact on investments in physical assets or R&D expenditure may be partially driven by a crowding-out effect, if firms lack the capacity to absorb capital efficiently. Instead of increasing investment, a firm may choose to redirect private funds toward other purposes (for example, increased hiring). In turn, the lack of impact on investment, and intangible assets in particular, could be one of the reasons for the muted (mixed) effect on productivity. A recent International Monetary Fund (IMF) study (2019) found that Polish firms with no or low investments in intangible assets have lower TFP growth than firms with the highest investments in intangible assets. A study on Southern Europe found that large capital inflows, in the short run, led to an increase in capital misallocation and a subsequent decline in productivity (Gopinath et al, 2017). Further investigating the reasons behind the mixed evidence on productivity, as well as efforts to boost productivity gains from support instruments going forward, could be key foci for future work.
OVERALL CONCLUSIONS, RECOMMENDATIONS, AND REPLICABILITY
This section brings together the findings from the different pieces of the ROI methodology summarized above. It aims to provide insights on where and how innovation support mechanisms could be adjusted to improve the return on investment during the upcoming EU financial perspective (2021 – 2027). It also offers some considerations for applying the methodology in the future, both in Poland and other countries.

**Designing and targeting instruments to maximize impact**

The effectiveness analysis (Section 4) found overall strong positive effects on employment, value added, revenue, and exports for the 2007 – 2013 innovation-related support programs. However, there was little- to-no impact on wages, R&D expenditures, and investments. The impact on productivity was mixed, although it was better for manufacturing firms and younger firms. Overall, this suggests that firms tended to use the support to scale up output and employment, which, in all likelihood, was beneficial for the Polish economy, as it worked to counter the negative effects of the global financial crisis.

Many of the support instruments were designed to boost investment and two interventions specifically aimed at increasing R&D activity, yet neither investment nor R&D increased. It appears that firms used the public funds for investments and R&D that they would have otherwise done with private funds (in the absence of public support). In other words, public funds crowded out private funds. Given that the beneficiary (that is, the treated) firms did not increase investment and R&D compared to similar non-beneficiary (that is, the control) firms, the mixed productivity results are not surprising. Moreover, the productivity results suggest that much of the public support was not used to transform business operations. Rather, it enabled the scale-up of business as usual.

For the 2014 – 2020 financial perspective, several adjustments (for example, the weighting of different themes and eligibility criteria) were made to improve instrument performance, compared to the 2007 – 2013 perspective. Repeating the effectiveness analysis after the 2014 – 2020 impacts show up in the firm-level data, for example in 2025, would provide an accurate picture of if and how the ROI of the public support improved. However, policymakers cannot wait that long. They need information now to inform decisions about the upcoming 2021 – 2027 programming period. Moreover, there is reason to suspect that the impacts may not be that different between 2007 – 2013 and 2014 – 2020. The objectives, types of beneficiaries (for example, R&D grants for SMEs), and implementing bodies are generally similar between the two periods.

In summary, it is safe to assume that boosting productivity will continue to be a key challenge for the 2021 – 2027 period. The needs assessment in Section 2 also highlighted the importance of boosting productivity, if Poland is to continue growing and reach the standards of living of its Western neighbors. An aging society makes improving productivity even more critical, as Poland cannot rely on an expanding the workforce to drive growth. The recommendations below are aimed at improving the impact of the 2021 – 2027 support measures on firm productivity.

**Young firms.** Young firms may deserve increased attention in the upcoming perspective. The 2007 – 2013 effectiveness analysis (Section 4) found that the employment impact of support instruments on firms less than three years old is 20 percentage points higher than the impact on older firms. The impact of support on TFP and labor productivity are also better for young firms. On the other hand, the needs assessment (Section 2) found that new firms (net entry) contribute very little to overall TFP growth in Poland. This suggests that there is room to better support young firms to leverage their productivity potential. The portfolio mapping (Section 2) found that while some current instruments focus on seed funding and startups, most instruments have a more general focus on SMEs and mature firms.
For the 2021–2027 perspective, additional mechanisms to support young firms could be considered. For example, younger firms could be given preference in the selection criteria for some instruments. Instrument application requirements could also be reviewed to reduce implicit barriers for younger firms. On the other hand, while support to younger firms could be increased at the margin, it would be important to avoid a massive shift and flood the market with excess funding for startups.

**Exports.** Increasing the sophistication of exports is another vehicle for productivity growth. While increasing high-technology exports is a key objective in the government’s Strategy for Responsible Development, there is much room for improvement. High-technology exports (as a percentage of manufactured exports) are lower in Poland than in most of its peer countries (see Section 2). The effectiveness analysis found that 2007–2013 instruments supporting exports and access to markets had some of the best ROI, meaning the lowest cost per job created. Based on the portfolio mapping, there are some instruments supporting export promotion, but they are relatively small compared to the R&D instruments.

For the next perspective, an increased focus could be placed on supporting high-technology exports, including linkages to global value chains. (Note: high-technology exports refer to the sophistication of the export product itself, rather than the sector of origin. In other words, high-technology exports can be present in traditionally low-technology sectors.) To better support high-technology exports, a more sophisticated understanding of potential exporter needs would be necessary to appropriately design support mechanisms and eligible expenditures. Firm needs would likely go beyond the typical export support measures, like subsidies for attending international trade fairs.

**Small firms.** The effectiveness analysis found that the impact of the 2007–2013 support on smaller firms is lower, especially for productivity. Using the TFPR (revenue productivity) measure, support programs increased productivity for large firms by eight percent, whereas they decreased productivity for micro and small firms by 13 percent. The impact on employment was slightly lower for smaller firms. On the other hand, the needs assessment highlighted the fact that foreign and large firms are responsible for a disproportionately high share of value added, R&D expenditures, exports, and investment. There could be scope to better leverage large and foreign firms to boost SMEs’ performance. For the next perspective, policymakers could consider increasing support for linkages between SMEs and large/foreign firms, for instance, through supplier development programs, matchmaking, and facilitating links to global value chains.

**Firm capabilities.** There is a growing body of international evidence on the importance of management practices and firm capabilities for firm competitiveness and innovation. 26 The needs assessment showed that Poland has some room for improvement in management quality scores. Yet, the portfolio mapping showed that relatively few current instruments are dedicated to improving management practices. Going forward, policymakers could focus more on designing and adequately funding support to upgrading firm capabilities and management practices. This could help firms better manage technology adoption and innovation, move up in value chains, and increase their productivity.

**Instrument design based on needs assessments.** The functional analysis (Section 3) found that the designs of the current instruments are often not based on robust assessments of firms’ needs and market failures. Ex ante assessments tend to be done at the program, rather than the instrument level, particularly for regional programs. Ideally, the needs assessments would take potential alternative instruments into consideration, especially looking beyond grants. Often, the binding constraint for firms to innovate is the

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26. See, for example, Cirera and Maloney (2017).
lack of knowledge or collaboration networks, rather than money. As described in the functional analysis section, an Innovation and Productivity Excellence Center (or similar entity) could help pilot more robust needs assessments for selected instruments.

Additional recommendations emerged from the functional analysis that could help maximize the impact of support instruments. One example is increasing flexibility to make adjustments to support instruments, particularly based on updated needs assessments. Another example is piloting improved targeting mechanisms, such as using a staged approach to award financing to firms (where the beneficiaries would only receive additional funding after successfully completing an initial low-cost task). Programs funded by the government budget (that is, domestic programs) might offer more opportunities for piloting, as they fall outside of EU regulations.

Future analysis. Questions were also raised that could be the subject of future analysis. Examples include:

- How to keep grants from substituting for private investment and R&D expenditures?
- Are there other potential explanations for the lack of productivity gains (especially outside of manufacturing) found in the 2007–2013 programs?
- How can the stronger productivity impacts on manufacturing firms be better leveraged?
- What else can be done to increase the impact of public support on firm productivity in the future?

Reducing inefficiencies and improving coordination and learning

Fragmentation and overlap. The portfolio mapping highlighted considerable fragmentation of the current support instruments. There are 182 instruments, but 50 percent of the total support value is concentrated in the 11 largest instruments. The portfolio mapping also showed that the duplication of support between the national and regional agencies is highly probable and most objectives are covered by many instruments. The instrument managers interviewed as part of the functional analysis also highlighted the overlap, including the challenges for the regions to compete with the national programs. The fragmentation and overlap lead to inefficiencies, as described in the portfolio mapping section. For the next perspective, policymakers could consider limiting the overlap and increasing the specialization of the implementing bodies.

Coordination and learning. The functional analysis found room for improvement in inter-agency coordination. Among other things, improved coordination could facilitate the exchange of good practices, particularly from the national to the regional level, as well as between regions. An Innovation and Productivity Excellence Center could be a platform to improve the coordination and exchange good practices.

Applying the ROI methodology in the future

In the future, all or parts of the ROI methodology could be applied in Poland, or in other countries. For instance:

- Portfolio mapping. The portfolio mapping could be performed during the design of the upcoming financial perspective to reduce the overlaps and fragmentation and ensure that the key objectives and target groups are covered. It could potentially be done by an Innovation and Productivity Excellence Center, or a similar entity.
5. OVERALL CONCLUSIONS, RECOMMENDATIONS, AND REPLICABILITY

- **Functional analysis.** The functional analysis could be repeated at the start of the next perspective, with a focus on instrument design. Shorter analyses focused on implementation could then be done after three to four years in order to track improvements. The analyses could be done by managing authorities and implementing bodies who are interested in using it as a learning tool (rather than a bureaucratic control mechanism).

- **Effectiveness analysis.** The ex post evaluation could be repeated periodically, for example, every three to four years, by an Innovation and Productivity Excellence Center (in collaboration with Statistics Poland). For instance, in 2023 initial impacts from the 2014–2020 perspective could be measured, as well as the persistence of impacts from the 2007–2013 period. In 2027, a more comprehensive measurement of the impact of the 2014–2020 programs could be undertaken (for example, using firm-level data up to 2025).

**Lessons learned**

Below are some lessons learned for the future application of the methodology.

**Data analysis.** The ex post evaluation (effectiveness analysis) relies on firm-level data normally collected by the national statistics agency. This data provides a time series of firm performance for both the beneficiaries (treatment) and non-beneficiaries (control group). Due to data privacy laws, access to such firm-level data is normally restricted. In some countries, researchers can directly access the data (for example, using computers within the statistics agency), with appropriate privacy controls to prevent firm-identifying information from being made public. In Poland, privacy laws prevented the World Bank from directly accessing the data. Hence, all the data preparation and analysis were done within Statistics Poland, while the World Bank prepared the STATA codes for the econometric analysis ‘at arm’s length’. This resulted in significant challenges, as frequent testing of the iterations of complex regression models was required. It would be much easier for the analysis to be replicated elsewhere, if the analysts were to have direct access to the firm-level data.

**Institutional arrangements.** For the government of Poland (or other countries) to be able to replicate the methodology ‘in-house’, there should be a central unit with strong analytical capacity. (This could be the Innovation and Productivity Excellence Center.) For the effectiveness (ex post) analysis, the unit could work closely with Statistics Poland and measure impacts and ROI at different levels of disaggregation (using the guidelines and STATA codes provided in Annex 6 of the ROI/Effectiveness Analysis Technical Note). For instance, the ex post analysis could be done separately for each individual region, and even for some individual instruments (provided there is a large enough pool of beneficiaries to generate statistically significant results). The central unit could then share the results with each region and help the region interpret the findings and generate policy implications. The central unit could also coordinate the portfolio mapping for the whole country.

Individual managing authorities and implementing bodies could potentially replicate the functional analysis on their own, if desired. The questions and scoring matrix are relatively self-explanatory and are included as annexes to the Functional Analysis Technical Note. Initially, technical assistance could be provided by the central unit to ensure consistency.

**Government ownership.** The success of the analysis depends on government openness to share data, participate in detailed interviews and feedback sessions, and learn from the exercise. The innovation support ecosystem normally has a variety of actors at both the national and the regional levels, and interest may vary by agency.
REFERENCES


GUS. (2015) *Ustalenie wartości wybranych wskaźników ekonomicznych dla beneficjentów Regionalnych Programów Operacyjnych, Programu Operacyjnego Innowacyjna Gospodarka oraz dla dobranych grup kontrolnych.* (Determining the value of selected economic indicators for the beneficiaries of Regional Operational Programs, the Innovative Economy Operational Program and selected control groups.)


