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Research and Innovation Observatory Country Report 2016 Estonia
The 2016 series of the RIO Country Report analyses and assesses the development and performance of the national research and innovation system of the EU-28 Member States and related policies.
It aims at monitoring and evaluating the EU policy implementation as well as facilitating policy learning in the Member States.

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Foreword

This report offers an analysis of the R&I system in Estonia for 2016, including relevant policies and funding, with a particular focus on topics of critical importance for EU policies. The report identifies the main challenges of the Estonian research and innovation system and assesses the policy responses implemented. It was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports and online publications. The quantitative data are, whenever possible, comparable across all EU Member State reports. Unless specifically referenced all data used in this report are based on Eurostat statistics available in January 2017. The report contents are partly based on the RIO Country Report 2015 (Ruttas-Küttim and Stamenov, 2016).

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HIGHLIGHTS

- The Estonian economy is small, has high level of openness and its structure has remained remarkably stable during the 2010-2015 period. Exports and value added are driven mostly by contract manufacturing of relatively complex products. SMEs dominate the non-financial business economy.
- Estonia has a very favourable business environment but it is faced with a short supply of highly qualified human resources due to ageing population, outward migration and lower attractiveness of research careers.
- An important aspect of the Estonian R&D system is its overwhelming reliance on competitive project-based policy measures, both in funding public universities and private companies.
- The overall level of GERD almost doubled in 2009-2011 (from 1.4% to 2.31%), but slid back to 1.45% in 2014. In 2015 it picked up slightly to 1.5%. Public allocation of R&D and R&D expenditure are above the EU average but the business investments (BERD) dropped significantly as the effect of the business R&D investments in an oil shale refinery by Eesti Energia ended.
- Estonia has been at the forefront of online public services for a few years now. However, other aspects of public sector innovation are far less developed, most notably user-centric service design, co-creation of services and similar areas.

MAIN R&I POLICY CHALLENGES

- **Addressing the asymmetry between the public and the private R&I efforts.** The Estonian science system follows very different specialisation from the business sector as it finances and supports mostly curiosity-driven basic research for which there is little immediate economic demand.
- **Promoting private investment in R&I by addressing the low pace of technological upgrading in industry.** Due to their contract manufacturing profile, most Estonian manufacturing companies are not very strong in design and development capacities, both in terms of in-house capabilities and networks they belong to, thus these companies have strong obstacles in climbing the value ladder.
- **Improving the unbalanced public sector innovation effort.** Public sector innovation efforts since early 2000s have been firmly focused on the development of e-government infrastructure (x-road architecture, e-ID card) and less on service development (via co-creation with the civil society) and public procurement for innovative solutions.

MAIN R&I POLICY DEVELOPMENTS IN 2016

- The Government decided to allocate additional funds for basic funding of universities.
- A task force on research funding and organization at the Government Office was formed to discuss consolidation, pooling of resources and changing the financing model of HEIs.
- The Government Office set up two tasks forces to strengthen its public sector innovation efforts: one on zero bureaucracy, the other on public sector innovation and social entrepreneurship.
- The creation of R&D officer positions in line ministries through the RITA programme was launched.
- The Estonian Development Fund was closed down and its investment function merged into KredEx, and its foresight and monitoring functions were transferred to the newly created Foresight Centre of the Estonian Parliament.

1. Main R&I Policy Developments in 2016

Additional basic funding allocated to universities	The Government decided to allocate additional funding for basic funding of universities from 2017 thereby increasing the level of baseline funding vis-à-vis project-based funding. By 2020 total government funding of R&D should increase to 1% of GDP.
Task force on research funding and organization (June 2016)	The "Report on the network and policies of Estonian universities and other R&D institutions and higher education institutions" led to the creation of a task force on research funding and organization at the Government Office. The task force will discuss further consolidation, pooling of resources and changing the financing model of HEIs and should present its main recommendations in the 3rd quarter of 2017.
Task forces to strengthen public sector innovation (Feb/March 2016)	Two task forces target the following areas: lower the administrative burden of reporting; strategic management of innovation and creativity in the public sector; co-creation practices and methodologies; supporting social entrepreneurship. 5 pilot projects (prototypes) will be generated during 2016 and 2017.
Creation of R&D officer positions in line ministries through the RITA program	The aim is to increase the role of the state in strategic management of research and the capacity of R&D institutions in carrying out socially relevant research.
Estonian Development fund closed down	The venture funding functions of the Estonian Development Fund are merged into KredEx and its foresight and monitoring functions were transferred to the newly created Foresight Centre of the Estonian Parliament.

1.1 Focus on National and Regional Smart Specialisation Strategies

Description and timing: Estonia does not have regional level RD&I policies; neither does it have a separate national R&I strategy on smart specialisation. Instead, the country's smart specialisation framework comprises the Entrepreneurship Growth Strategy (adopted by the government in October 2013) and the Research, Development and Innovation Strategy (adopted in January 2014), with a focus on shared priorities while further specialising in the thematic areas. There are three smart specialisation growth areas: ICT supporting other sectors (use of ICT in industry including automation and robotics, cyber security, software development); health technologies and services (biotechnology, e-health); resource efficiency (material science and industry, knowledge-based construction, health-promoting food industry, chemical industry). The process of selecting these areas was relatively top-down, driven by both key ministries in the R&D arena (MER, MEAC). The analytical part of the processes was implemented by the Estonian Development Fund, which has been closed down in 2016. The smart specialisation management and monitoring tasks were handed over from the Estonian Development Fund to joint management by the Ministry of Economic Affairs and Communications and by the Ministry of Education and Research. The overall process is co-ordinated and monitored by the inter-ministerial and institutional Smart Specialisation Steering Committee based on a quadruple helix model; the committee leadership rotates annually between the Ministry of Economic Affairs and Communications and the Ministry

of Education and Research. The budget for smart specialisation in 2014-2020 (including structural funds and state budget co-financing) is planned to be about €208m (RDI Strategy 2014-2020).

New developments: A new instrument, Support for applied research in the areas of smart specialisation (in Estonian, Rakendusuuringute toetamine nutika spetsialiseerumise kasvuvaldkondades (NUTIKAS), managed by the MER entered the policy mix in 2015. It will inject €26.6 million into supporting business R&D and cooperation between universities and the business sector.

Outstanding issues: The European Semester 2016 country report notes that "the smart specialisation areas could be narrowed down and their practicality increased for future international competitiveness. This could be done through a bottom-up process involving relevant stakeholders, in particular from the private sector."

2. Economic Context

After dropping to 1.4% in 2015 as a result of sharply reduced demand from neighbouring Russia and low international oil prices, which affect Estonia's oil shale sector, annual real GDP growth in Estonia slowed further in the first half of 2016, as imports grew significantly faster than exports.[1] Real GDP growth in Estonia is expected to be 1.1% this year but is forecast to recover to 2.3% in 2017 and 2.6% in 2018, as negative external shocks fade and investment picks up.[2] High tech exports increasingly offset contracting exports in transport, as transit trade with Russia collapsed.

The working age population has declined significantly over the past years due to ageing and emigration, but higher wages have raised the participation rate to historically high levels of 70%. The introduction of a 'work ability' reform in mid-2016 is gradually bringing work-incapacity pensioners back to the labour market. Due to the reform, employment is expected to continue growing in 2017-2018, while unemployment is also projected to rise from about 6.5% in 2016 to over 8% in 2018.[3]

While GDP growth remains moderate, its composition appears favourable to government revenue, especially labour and consumption taxes. As a result, after a surplus of 0.1% of GDP in 2015, 2016 is set to close with a general government surplus of 0.5% of GDP. An important contributor to the surplus is lower than planned expenditure on investment. However, in 2017 public investment is forecast to rebound as the bulk of EU funded projects from the new programming period take off.[4]

Estonia's government consolidated gross debt as % of GDP has always been the smallest in the EU28 and is still eight times smaller than the EU28 average (85.2% in 2015). Estonia's public debt is expected to stand below 10% of GDP in 2016-18.

Estonia's productivity lags behind the EU average - in 2015 labour productivity per hour worked was 70.7% of the EU28 average. This puts Estonia in the 6th lowest position within the EU28. One of the key factors behind low productivity growth is the low return on investments - while Estonia experienced the highest investment growth in the EU in 2014 (predominantly in the construction sector), its productivity growth is similar to other Baltic economies with lower levels of investment. While nominal unit labour costs increased in 2013 and 2014, the contribution of technological development (expressed

[1] ECFIN Autumn 2016 Economic Forecast, http://ec.europa.eu/economy_finance/eu/forecasts/2016_autumn/ee_en.pdf
[2] Ibid.
[3] Ibid.
[4] Ibid.

through total factor productivity) to nominal unit labour costs growth was very low in both years (European Semester Country Report 2016).

2.1 Structure of the economy

The structure of the Estonian economy has remained remarkably stable during the 2010-2015 period. The main fields of economic activity (as a % of total GDP) are manufacturing (16%), wholesale and retail trade (13%), real estate activities (10%). In the service sector (which accounts for 68% of total GDP), information and communication technologies provide about 5% and the professional, scientific and technical activities sector gives about 4% of GDP, as does agriculture (Statistics Estonia, 2016).

Exports and value added are driven by manufacturing. In exports, mineral oils, electronics, wood and wooden products dominate since mid-2000s (Karo et al 2014). Manufacturing exports are by 2015 mostly based on contract manufacturing of relatively complex products. However, at the same time many such products tend to be niche products and thus without significant potential for economies of scale. Electronics and other similar manufacturers of machinery import almost all of their inputs which shows weak domestic value chains (Karo et al 2014).

The Estonian economy has high levels of openness (trade is 155% of GDP in 2015 according to the World Bank Development Indicators) and integration with Western and particularly Nordic neighbours as evidenced by the high levels of foreign direct investments (both stocks and flows). One of the key and relatively unique structural features of the Estonian economy is the high share of foreign ownership in the banking sector: more than 90% of banking assets are foreign owned (Kattel 2010 & 2015). As throughout the 2000s, the leading sectors for foreign investments in 2015 were the financial and real estate sectors (Bank of Estonia, 2016).

In terms of firm organisation, 90% of enterprises in Estonia are micro enterprises with less than 10 employees.[5] SMEs dominate the 'non-financial business economy'. They provide approximately three quarters of value added and roughly 78% of employment.[6] This is 18 percentage points higher than the EU average for value added, and 11 percentage points higher than the EU average in terms of employment.

2.2 Business environment

Estonia has a high ranking (rank 16 out of 189 economies) in the World Bank Ease of Doing Business 2016 index which places it 1st among Central and Eastern European EU member states. Estonia is ranked among the 38 freest countries in the world in most indicators, except resolving insolvency (rank 40) and protecting minority investors (rank 81). In general, the rules for starting up and running a business are simple (rank 15) and the legal framework is transparent and up-to-date. The Tax Foundation ranks Estonia as number 1 globally in tax competitiveness in 2016 (Tax Foundation 2017).

In addition, Estonia's Small Business Act (SBA) profile is generally strong[7]. Estonia performs above the EU average in five SBA principles — it scores particularly well in responsive administration, access to finance, single market and internationalisation. Its scores for 'second chance' are below the EU average. The only issue for Estonia, therefore, is to work on faster insolvency procedures for a second chance for entrepreneurs who may have failed the first time around.

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[5] Statistics Estonia 2015, News http://www.stat.ee/78415/?highlight=teenindus

[6] European Commission, SBA Factsheet 2015 Estonia, http://ec.europa.eu/DocsRoom/documents/16344/

[7] Ibid.

2.3 Supply of human resources

A short supply of highly qualified human resources due to ageing population, outward migration and lower attractiveness of research careers has been a persisting bottleneck for Estonia (ERAC, 2012; European Commission DG EAC, 2015). The main reasons for the lower attractiveness of research careers are the short-term funding models (strong dominance of project-based funding) and lower than the EU average salary level. For highly qualified foreign researchers to settle in Estonia, the drawback is not only the salary level, which is not internationally competitive but also the fact that Estonia's research institutions are not sufficiently broadly known and the immigration rules for third country nationals are quite strict, making it difficult for local companies to attract qualified labour from outside Europe.

Nevertheless, Estonia has been active in addressing the human resources issue and some results are already visible. In the recent years a significant proportion of EU Structural Fund support has been directed to the development of human capital, entrepreneurship and vocational education. The Alien's Act was amended in 2015 to more easily allow foreign labour force to come in the country. The conditions have somewhat improved in the last few years and the number of new graduates in science, maths, computing, engineering, manufacturing, construction per 1000 population has slightly increased but remains below the EU average (1.88 per 1000 in 2014 vs 2.3 per 1000 for EU-28). The number of foreign researchers has also grown from 58 in 2004 to 393 in 2013 (Statistics Estonia, 2015). The number of doctoral graduates is fluctuating but is still below the EU average (0.7 per thousand population in 2014 vs 1.07 for EU-28 in 2013).

3. Main R&I actors

3.1 Government

The Organisation of Research and Development Act provides the framework for the structure of the Estonian research and innovation system. According to this law, the Government of the Republic prepares national R&D development plans, submits them to the Riigikogu (Parliament), approves national R&D programmes, ensures the cooperation between the ministries and enacts legislation.

Policy design and evaluation is carried out mainly by the **Ministry of Education and Research (MER)** which is in charge of national research and education policy and the **Ministry of Economic Affairs and Communications (MEAC)** which oversees technological development and innovation policy. **Other ministries** are also responsible for organising and financing R&D activities, drafting and implementing R&D programmes in their area of responsibility.

A permanent advisory body - the **Research Policy Committee** - provides advice to the Ministry of Education and Research and the **Innovation Policy Committee** advises the Ministry of Economic Affairs and Communications. The **Research and Development Council** is an expert consultative body that advises the Government on R&D and innovation matters – all policy documents have to pass the R&D Council prior to being submitted to the Government for approval.

At the operational level, both MEAC and MER have implementing agencies and intermediaries. The main implementing body under the Ministry of Economic Affairs and Communication is the **Enterprise Estonia** Foundation, which is responsible for managing business support, innovation and technology programmes. Foundation **KredEx**'s mission is to facilitate the increase of the competitive strength of Estonian

companies by improving the availability of financing and managing credit risks, and the improvement of the energy efficiency in the housing sector.

From the research policy perspective, the Ministry of Education and Research has three main agencies that among their other activities deliver funding and support: the **Archimedes** Foundation is implementing agency for structural support in the field of R&D and administers schemes for improving mobility and marketing Estonian higher education and research abroad. The **Estonian Research Council** was established in March 2012 to concentrate the funding of R&D and achieve better functioning of the financing systems. This body is the main funding organization of R&D, consolidating different grants and types of funding and giving research more visibility in the society. The **INNOVE** Foundation manages a range of programmes and support measures in the fields of lifelong learning and active labour market policies.

3.2 Academia

The main players of the Estonian research system are the six public universities (one private university is focused mostly on education, not research); out of these universities, Tartu University and Tallinn University of Technology dominate in terms of student and staff numbers, and public funding received. In 2015, the R&D expenditure in non-profit institutional sectors (higher education, government and non-profit private sectors) was €163m, of which 77% was performed by universities (Statistics Estonia 2016). From 19 positively evaluated R&D institutions 7 are universities (1 private and 6 public), 4 are private R&D institutions (3 in health services, 1 in ICT field) and 8 are public research organisations. Among the 8 positively evaluated PROs two are active in health, bio- and environmental sciences.

An important aspect of the Estonian R&D system is its overwhelming reliance on competitive project-based policy measures, both in funding public universities and private companies (Raudla et al 2015). This is particularly glaring in research where ca 80% of all funding is competitive (Raudla et al 2015). However, in 2016 the Government decided to allocate additional funding for basic funding of universities from 2017 thereby increasing the level of baseline funding vis-à-vis project-based funding; in detail, the baseline funding has evolved as follows: 2015 – €9.2 m; 2016 – €13.9 m and 2017 €16.9 m.

3.3 Business

According to the National Audit Office (2014), the structure of the Estonian economy is still dominated by small and medium-sized low-tech companies whose need for research and development is limited and therefore only a few of them are cooperating with universities. Private sector R&D is performed mostly in larger companies: around half of the private R&D investments are done by companies with more than 250 employees (Mürk and Kalvet 2014). Around 40% of private R&D expenditure is done by about 100 manufacturing companies (Mürk and Kalvet 2014). Overall, in 2015 there were 225 companies reporting R&D expenditure and this number has been quite stable over the past years (Statistics Estonia).

Estonian manufacturing is characterized by contract manufacturing as a prevalent business model (Kaarna et al 2015). Contract manufacturing means that there are relatively low levels of in-house competences for design and development. According to CIS data, contract manufacturing companies also have low access to external networks of competences (Kaarna et al 2015).

Multinational R&D organisations do not operate in Estonia.

3.4 Networks, clusters, platforms, linkages

Organizations aimed at creating and solidifying networks and linkages between various R&D system actors are rather poorly developed in Estonia. Most such networks have been created in late 2000s and early 2010s with the help of European structural funds via cluster, competence centre and similar programmes. Estonia has 22 technology clusters[8], 8 competence centres[9], 3 Science and Technology Parks (Tallinn Science Park Tehnopol, Tartu Science Park, Technopolis Ülemiste)[10].

In addition, the Estonian Intellectual Property and Technology Transfer Centre (EIPTTC) was founded by the Estonian Chamber of Commerce and the Ministry of Economic Affairs and Communication in 2013. EIPTTC offers a wide variety of intellectual property and technology transfer support services, training and education.

4. R&I trends

The overall level of R&D investments as a percentage of GDP (GERD) almost doubled in 2009-2011 (from 1.4% to 2.31%), but slid back to 2.11% in 2012 and dropped again below the EU28 average in 2013 (EU28: 2.03%; EE: 1.71%) as the effect of the R&D investments in an oil shale refinery by Eesti Energia ended. For 2014, GERD as a percentage of GDP dropped even further down to almost the same level it was in 2009 (1.44%) but in 2015 it picked up to 1.5% (Figure 1).

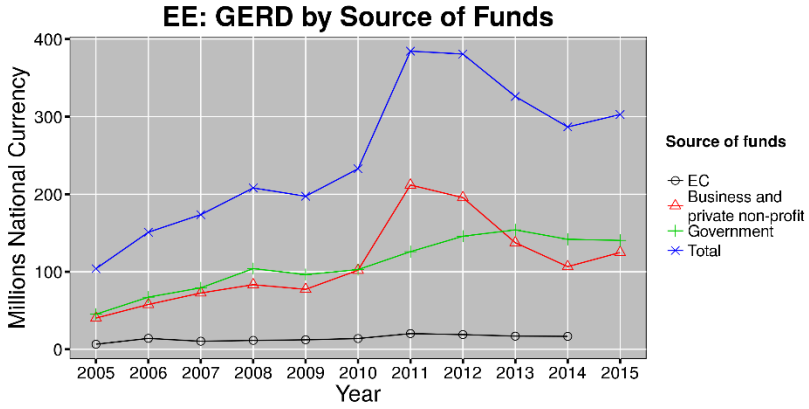

Figure 1 Development of government funding of the total GERD.

Data source: Eurostat, 2016.

4.1 Public allocation of R&D and R&D expenditure

The share of government sector investments as a percentage of GDP has been growing steadily in 2009-2013 (from 0.68% to 0.81%)[11], but declined in 2014 to 0.71% and remained at roughly the same level in 2015 (0.7%). This behaviour was caused by the remarkable growth of the share of EU Structural funds in government R&D budget from 2009 to 2011 (switch-in) and later by the decrease of payments from structural funds at the time of substitution of funding periods.[12] Still, GBAORD is above the EU average (0.64% in 2015) and as a share of general government expenditure it reached 2.12% in

[8] http://www.estonianclusters.ee/?lang=en
[9] http://researchinestonia.eu/science-scene/competence-centers/
[10] http://www.workinestonia.com/living-in-estonia/science-technology/#articleblock-Scienceparks
[11] The post-crisis fiscal adjustment process has not come to the expense of public support to the Estonian R&D (Ruttas-Küttim and Stamenov 2016).
[12] In Estonia EU Structural funds are included in the composition of State budget and treated accordingly in statistics as part of government funding, not funding from abroad.

2013 (EU28: 1.41%) but slid back to 1.87% in 2014 and further to 1.75% in 2015 (EU28: 1.36%). The higher education sector performed 41% of GERD in 2015 which is above the EU average (EU28: 23%).

During the period 2008-2015, external funding for the Estonian R&D activities accounts for 9-12% of the total GERD (which includes participation in the Framework Programmes but doesn't include Structural funds like in some other countries). In 2015, 12% of Estonian total GERD was funded from abroad. Overall, Estonian R&I funding is quite dependent on EU funds but not as much as in its neighbouring Baltic countries.

In the 2014-2020 period €665.8m (15.2% of total structural funds allocation) is allocated to thematic objective 1. Strengthening research, technological development and innovation (EC 2014). A significant amount of public RD&I funding is planned to be channelled into smart specialisation areas. The budget for Smart Specialisation in 2014-2020 (including structural funds and state budget co-financing) is planned to be about €208m. (RDI Strategy 2014-2020).

Unsurprisingly, the public sector is the main recipient of government funded GERD. Government support to private sector R&D has mainly been in the form of direct funding via competitive grants. However, a gradual shift towards increased use of financial instruments is being planned. Through the Estonian Entrepreneurship Growth Strategy, the government aims to shift to a more market-based approach to public support, with fewer direct grants and more financial instruments, including loans, loan guarantees and venture capital. As far as indirect public support to business R&D is concerned, Estonia has no tax incentives for R&D and innovation investments as its tax policy traditionally follows the rule of taxing everything similarly and allowing as few exemptions as possible.

4.2 Private R&D expenditure

The business sector is the main funder of the Estonian business sector investment and it has been the main driver of its changes. Business Expenditures on Research and Development (BERD) tripled between 2008 and 2011, and in 2011 it was 1.46% of GDP. The significant growth in BERD occurred mostly due to big one-off R&D investments in the oil shale refining industry by a single company (an Eesti Energia subsidiary). This effect faded and BERD declined to 0.82% in 2013 and to 0.63% in 2014, which is close to the pre-peak levels of 2009. However, in 2015 the trend reversed and an increase of private R&D spending is observable (0.69%). It is noteworthy that in 2014 public funding of BERD in Estonia (ca 10%) was much higher than the EU28 average (ca 6%).

In 2014, the highest BERD spenders are the ICT, manufacturing and energy sectors. In manufacturing the leading R&D expenditure product categories are computer, electronic and optical products, chemicals and refined petroleum products. The chemical sector has traditionally been an important one in Estonian manufacturing R&D. Several large-scale enterprises of the chemical industry are located in the industrial area of the North-Eastern Estonia and have found partners and markets abroad. Up to 85% of the chemical industry production is exported. [13] The electronics sector is also very internationally oriented with a handful of widely recognized multinational companies (such as ABB and Ericsson) and some smaller companies specialised in high quality contract manufacturing of niche products (see also section 2.3). The nature of the contract manufacturing business model implies that very few of those companies would use public support since the products they are producing change quite frequently and at best they would be interested in state support for acquiring machinery and improving infrastructure but not for longer-term R&D projects.

[13] http://www.keemia.ee/en/chemical-industry-in-estonia

In the business services sector ICT and professional, scientific and technical activities sectors are the top R&D spenders. ICT is one of the fields that has had the fastest growth in the last 10-15 years in Estonia, and was not severely affected by the economic crisis. The ICT sector witnesses the highest number of high growth innovative enterprises and the second highest number of employees among the most innovative sectors in the recent years. The number of ICT enterprises is quite big in Estonia (ca 3,000 in 2013), but most of them have less than 10 employees. In 2013, most of ICT enterprises provided services such as programming and consultations and only 2.4% of them were engaged in manufacturing (Statistics Estonia 2015).

4.3 Public sector innovation and civil society engagement

Estonia can be considered globally one of the leading countries in e-government services, characterized also by high share of individuals having contact with government over the internet (81% in 2015) and with a high rank in the UN's e-government development index (15th in 2014) and in the Digital Economy and Society Index (DESI) (7th in 2016). Estonia has been at the forefront of online public services for a few years now and is the best performing country in Europe in 2016 (DESI 2016). However, other aspects of public sector innovation are far less developed, most notably user-centric service design, co-creation of services and similar areas. The underlying reason for this is the generally weak engagement of civil society actors in public policy and public service design in particular.

There are two key offices in charge of public sector innovation activities: the Government Office (supports the government and the prime minister in day-to-day and strategic activities) and the Government's Chief Information Officer. In addition, the Ministry of Social Affairs created in 2015 a position for deputy secretary general for e-services and innovation. This is the first such position in Estonia, tasked to enhance innovation in e-health[14] and health policy and service delivery in general.

In 2016 the government proposed a new action plan for open government aimed at increasing participation of non-governmental sector and citizens in general in policy making (Government Office 2016). The Government Office has also introduced two key new task forces in 2016: Zero Bureaucracy task force, whose mission is to find ways to lower the administrative burden of reporting, and Public sector and social innovation task force, tasked with managing innovation and creativity in the public sector, initiating new co-creation practices and fostering social entrepreneurship. The latter task force will generate 5 pilot projects (prototypes) during 2016 and 2017.

However, in 2016 the most politically prioritized area of public sector modernization is the territorial local government reform that aims to diminish the number of local governments in Estonia quite drastically (http://haldusreform.fin.ee).

Civil society is rather poorly engaged with R&D and innovation activities in Estonia. There are three types of activities that are of importance here: first, urban regeneration efforts have galvanized particularly in Tallinn parts of civil society to engage with urban planning and, implicitly, with its impact on creativity and innovation (Tõnurist, Kattel, Lember 2015); second, policy efforts and institutions aimed at engaging school children with science and engineering (TV shows, museums, etc); and third, industry associations' slowly increasing role in policy making (e.g. Estonian Association of Information Technology and Telecommunications).

[14] A key e-health strategy was adopted in December 2015, as a result of the Government Office's task force on e-health.

5. Innovation challenges

5.1 Challenge 1: Address the asymmetry between the public and the private R&I efforts

Description

The need to address the weak cooperation between science and business is an "old" issue, identified as a major challenge of the Estonian R&I system in the Council Country Specific Recommendations (CSRs) for 2012, 2013, 2014 and 2015. There seems to be a mismatch between the needs of the business sector and the provision of knowledge from the public sector.

There are many quantitative indicators that signal that the level of applied research (in the form of both knowledge transfer and research commercialisation) is low in Estonia. The share of privately funded publicly performed R&D as a share of the total research spending (GERD), a proxy indicator for the collaboration between academia and business, was 1.96% of GERD in 2013 and 2.09% in 2014, below the EU-28 average. In addition, according to the Community Innovation Survey 2012 only 10.8% of the total sample of innovative companies cooperated with universities and HEIs (compared to almost 26% in neighbouring Finland). Finally, only 3.8% of public R&D is contracted by private enterprises (Kaarna et al 2015).

Comparing Estonia's private sector specialisation with European averages in terms of R&D investments and exports, it can be observed that Estonia specialises in knowledge intensive services (computer programming, consulting), manufacturing (electronics, wood) and energy (Karo et al 2014). However, neither knowledge intensive services, nor manufacturing, nor energy are reflected strongly in public R&D spending (Ukrainski, Kanep, Masso 2014).

Public R&D spending prioritises medical sciences and basic sciences such as physics where private investments are low. As far as participation in EU FPs is concerned, Estonia's share of EU FP7 contributions received between 2006 and 2014 (compared with FP6) is higher than the EU-13 average and is on par with the EU-15 countries (EC JRC-IPTS 2015). This signals that Estonian excellent researchers are actively participating in international consortia. However, while Estonian top scientists are well integrated internationally, this is not the case for the overall research community in Estonia (European Commission 2013). This is partially a result of the fact that Estonian RD&I policy-making has been overly concentrated on scientific excellence and high technologies, neglecting domestic economic structure. Thus, the Estonian science system follows very different specialisation from the business sector as it finances and supports mostly curiosity-driven basic research in fields such as physics, chemistry and earth sciences for which there is little immediate economic demand. This results in what can be called "enclavisation" of Estonia's relatively excellent research system (Karo et al 2014). In sum, excellence oriented domestic research does not have strong impact on domestic industrial upgrading (Karo et al 2014).

Policy response

As regards specific programmes promoting science-business cooperation and smart specialisation, the 2014-2020 Technological Development centres (formerly known as Competence centres) programme opened its new round in November 2014, continuing from the previous programming period with a budget of €40m. It aims to provide Estonia's entrepreneurs with opportunities for cooperation in the development of new technologies, products and services and to increase qualified staff in business-oriented R&D, and their movement between businesses and research institutions. Those centres

operate like private businesses. A recent success story is that one of the technological development centres was sold to an Indian pharmaceutical company.[15] Beyond a few success stories, a comprehensive evaluation of the programme in the 2007-2013 period is not yet available.

Estonia has also introduced innovation voucher grants for SMEs (maximum amount of the grant €4,000). It enables a small and medium-sized entrepreneur who is cooperating with a higher education institution, test laboratory, or intellectual property experts, to develop innovative solutions for development obstacles, carry out tests with new materials, gather knowledge on technologies, conduct studies in intellectual property databases etc. Last but not least, the Ministry of Education and Research launched the new activity Support for applied research in the areas of smart specialisation (NUTIKAS) in August 2015. The aim is to support enterprises tendering applied research or product development from Estonian public R&D institutions and about 1/3 of financing should come from enterprises.

Policy Assessment

The mismatch between the needs of the business sector and the provision of knowledge from the public sector is not simply a failure to commercialise scientific activity but also a result of the RD&I support system being focused on areas other than those that dominate Estonia's economy today (OECD 2013). Such asymmetries are, on the one hand, to be expected after the tumultuous structural changes that took place in the 1990s and the subsequent industry specialization into contract manufacturing for European production networks. This means that process innovations dominate over technology and science driven innovations. On the other hand, these asymmetries are also perplexing given that Estonia's economic policy in general and RD&I policies in particular have been rather focused on generic framework conditions and supply side mechanisms, i.e. there has been hardly any steering of specialisations.

However, as the asymmetries are persistent since early 2000s, it appears that the problems of mismatching specialisations in public and private R&D profiles are ingrained in respective governance structures. Estonia has particularly strong decentralisation culture between ministries (making coordination rather difficult) and also between ministries and their respective agencies. In the latter case, the establishment of special agencies to implement European structural funds played a particularly important role. These agencies are quite independent (they are foundations) and operate within EU guidelines (that is, they have specific administrative culture) which makes coordination between agencies complicated. Thus, Estonia has a quite strongly disjointed RD&I policy governance structure (Suurna and Kattel 2010; Karo and Kattel 2015). For instance, in evaluating research proposals at the Estonian Research Council there is no input from Enterprise Estonia, or from other outside agencies or industry associations. Such problems are endemic across the policy landscape. Also important is the general weakness of mediating or networking organisations, as well as civil society's role in R&D and innovation policy. This is particularly important for the business sector - while the academic sector is well-organized and generally good at expressing its policy positions, the business sector is more scattered with diverse interests and much less involvement in policy making.

Thus, the asymmetry challenge necessitates also governance reforms as key areas of response to it. One of the ways the government is attempting to deal with the governance side of the challenge is to support creation of R&D officer positions in line ministries. Furthermore, in 2016 first plans have emerged to join some of the agencies dealing with EU structural funds. There is also a proposal to merge Enterprise Estonia and the Estonian Research Council in order to promote cooperation in the public sector

[15] Äripäev, September 1, 2016: http://www.aripaev.ee/uudised/2016/09/01/ravimihiiu-miljonisust-eestisse-bravo-pharma-vahiuuringute-tehnoloogia-arenduskeskus

when implementing RD&I policies and enforce joint decision making in funding the RD&I policy. Whether this will be carried out remains to be seen.

5.2 Challenge 2: Promote private investment in R&I by addressing the low pace of technological upgrading in industry

Description

Private investment in R&D has been decreasing in the last couple of years and after the oil shale sector related boom in 2011-12 it has returned to the pre-boom level (see section 4.2). In 2016 Estonia received a CSR to "promote private investment in research, development and innovation".

While manufacturing is Estonia's leading economic activity in terms of value added, employment and exports, the country still lags behind European average productivity. CIS surveys show that low technology and less research intensive innovations dominate in the Estonian manufacturing sector (Kaarna et al 2015). Besides, the low tech sectors (e.g. wood and food) provide higher value added than high tech sectors (Ruttas-Küttim and Stamenov 2016). As already pointed out, most manufacturing companies engage in contract manufacturing for European and global value chains. Overall, process innovations dominate over science driven technology upgrading (Kaarna et al 2015). Preliminary results from CIS 2014 show that key obstacles for non-innovators are their low demand for innovations and lack of good ideas (Statistics Estonia, 2016).

Estonian manufacturing companies are not very strong in design and development capacities, both in terms of in-house capabilities[16] and networks they belong to or are able to leverage for their own business and production processes. This makes most manufacturers relatively weak at interpreting new or emerging market trends and signals, thus these companies have strong obstacles in climbing the value ladder towards activities with higher value added and profit margins.

Policy response

The Enterprise Development Programme is the main programme (€73m) that aims to support well-thought-out company development, improved action planning, innovation implementation and product development. In the course of the development programme, each participating enterprise is supposed to launch new products and services that are more profitable than their predecessors. It targets industrial enterprises and companies active in smart specialisation fields, operating for at least 3 years, with minimum 8 employees and already having some experience in exporting or having increased their sales each year by 10% on average. The programme does not only provide funding, it also aims to give to its "clients" business development guidance.

The Start-up grant (total budget €8.1m) also aims to support the creation of enterprises that have a lot of development potential, and thereby expand regional entrepreneurship and number of exporters. Companies that receive the grant have the obligation to meet certain goals, such as creating new jobs and increasing sales revenue.

For the current period of structural funding (2014-2020), Estonia has started to shift somewhat the way industry support works - away from direct grant support and towards investment instruments (loans, equity funding). Among the new financial instruments are the EstFund fund-of-funds and the COSME counter-guarantees. EstFund is a €60m risk capital fund-of-funds, complementary to the Baltic Innovation Fund (BIF), oriented at early-stage investment in business ideas and supported by Structural funds and the European Fund for Strategic Investments (EFSI). An agreement for the establishment of

[16] According to CIS2012, 20% of Estonian enterprises are engaged continuously in in-house R&D activities compared to 41% in Finland and 29% in Sweden.

the fund was reached between KredEx, MEAC and the European Investment Fund (EIF) in March 2016. The COSME counter-guarantee agreement between KredEx and the EIF (also benefiting from EFSI support) will allow KredEx to support €200m of loans and leases. Approximately 1,000 SMEs are estimated to receive financing for their business ideas.

Last but not least, an Industrial Policy Green Book was developed by MEAC in 2015-2016. This process took place in parallel to smart specialization discovery processes, and while the Green Book development was personally led by the then Minister for Entrepreneurship, Urve Palo, it was based on extensive input from diverse industry associations. The process is yet to be finalized and there is a new minister in charge. The importance of this document is that the government is for the first time trying to engage in some sort of industrial policy by bringing together the relevant stakeholders. The Green Book proposes a wide array of activities to increase competitiveness of Estonian industry - from preferential tax treatment for energy intensive industries to labour market coordination mechanisms and a new industry placement system.

Policy Assessment

Estonia has started to shift the way industry support works towards increased use of financial instruments. It is therefore a key challenge for this period to change organizational culture in the main funding agencies towards a new way of policy thinking and implementation (more bank-like and less bureaucratic) and to change the mindset on the level of both policy makers and final beneficiaries (the target group). In any case, it might be highly useful to experiment with such new ways of implementing industry support as there are persistent doubts whether grant support measures deployed in the 2000s have had any meaningful impact on industrial upgrading (National Audit Office 2014)[17]. Indeed, given the fact that Estonian banking sector is overwhelmingly in the hands of foreign owners, it might be worth considering transforming innovation and economic policy agencies (such as KredEx, Enterprise Estonia) into a development bank-like institution that takes positions in companies it supports either via loans or equity. Furthermore, as large parts of the RD&I budget are based on structural funds that will likely diminish after 2020, such investment vehicles would provide a sensible exit strategy from reliance on EU funding. Also, such investment vehicles could provide options for Estonian pension funds to diversify their local portfolios by participating in the capitalization of such a "bank" structure. There are encouraging signs that this is already happening with BIF and EstFund.

5.3 Challenge 3: Improve the unbalanced public sector innovation effort

Description

Public sector innovation efforts since early 2000s have been firmly focused on the development of e-government infrastructure (x-road architecture, e-ID card) and less on service development and public procurement for innovative solutions. There are notable exceptions in e-services developments, such as e-voting, e-taxes (around 95% of taxes are declared online in Estonia), e-contracts and some social services as well. Innovation efforts in these areas, particularly in service development, have become a key focus in the post-2008 crisis environment. For instance, the e-residency programme for non-residents who want to make use of Estonia’s e-government infrastructure to run their

[17] The National Audit office has found that the economic impact of the €166 million of support paid out from 2007-2013 to further companies' innovativeness and capacity for growth has been limited and random. Only half of the six main measures aimed at supporting innovation helped the supported companies to achieve better results in terms of increasing exports or added value than companies that received no support.

businesses in or through Estonia is one such ambitious initiative that was launched recently. In essence, the idea is to offer government-as-a-service globally and amounts to "exporting" public services globally.

However, other aspects of public sector innovations have been almost neglected during the 2000s and 2010s. Particularly important are two weakly developed areas: co-production and cross-border policy and service development. In terms of co-creation of public services together with civil society Estonia generally has had very few experiences and the underlying reason is the weak engagement of civil society actors in public policy and public service design in general (Tõnurist, Kattel, Lember 2015). Estonia has also had few experiences with public procurement for innovative solutions.

Policy response

Estonia has recognized this issue and in 2016 the Government Office has set up two tasks forces: one on zero bureaucracy, the other on public sector innovation and social entrepreneurship. These are temporary tasks forces that will finish their work and come up with specific recommendations by 2017. In addition, the Government Office is responsible, through its Top Civil Service Competence Centre, for top level civil servants training programmes. In 2015 and 2016 these programmes are concentrated on public sector innovation and creativity.

Moreover, the "Development of national procurement policy" measures (total budget €40m) aims to increase the role of the public sector as the leader of innovation in enterprises under the fields of growth of smart specialisation, i.e. in commissioning and initiating R&D and innovation. The innovations include innovative procurements, development activities of enterprises under the leadership of the public sector, design of public services, public and private sector partnership, demonstration projects, as well as the infrastructure and information technology solutions required. In this framework a new measure “State as a smart customer” was launched in 2016 to improve demand-side innovation policies (total budget €20m, co-financed by EU structural funds). The measure will be executed by Enterprise Estonia and will support Estonian public procurers to undertake innovation procurements.

Policy Assessment

The public sector has been, on the one hand, highly innovative - the success of e-government solutions is widely recognized and has brought international attention to Estonia. On the other hand, other public sector innovation aspects – supporting technological upgrading through regulatory and procurement activities, co-creation of services together with civil society – have been rather poor. Given the unbalanced nature of public sector innovation efforts in Estonia, it might be a good idea to set up a permanent office for public sector innovation in the Government Office. Such an office would have - similarly to MindLab in Denmark - a role of a facilitator and entail specific skills (e.g. on design and innovation processes within the public sector). Furthermore, positive examples by the Ministry of Economic Affairs and Communications, and of the Ministry of Social Affairs in creating chief innovation/information officer positions could be emulated by other ministries, large state owned companies and larger public agencies as well.

As one of the smallest economies in the EU, cross-border policy cooperation is one of the ways for Estonia to specialize, also in R&D, and deepen efficiency in the public sector. As all three Baltic economies are in a similar level of development, closer cooperation in policy planning (e.g. investments into R&D infrastructure) and coordination of policy design and implementation (e.g. joint research calls) would offer new opportunities both for companies and universities. Similarly, given the close economic integration of Estonian manufacturing industry with Nordic economies, an Estonia-Nordic cooperation would yield positive results and economies of scale in using public funds to spur R&D and innovation efforts (Tõnurist, Piret, Kattel 2016). There are very few such efforts despite ample political rhetoric and declarations that support such cross-border efforts. One

positive example is the Baltic Innovation Fund, set up in 2012 by three Baltic countries as a fund-of-funds investment vehicle.

In sum, in order to realize its role as a leading innovator, the government could intensify its demand side innovation promotion efforts and make its e-infrastructure as accessible and user friendly to the business sector as possible in order for the private sector to take advantage of it and to seek economies of scale, at least in the Baltic region. In that respect, the recently launched e-residency programme is the step in the right direction.

6. Creating and stimulating markets

This section aims at describing and assessing national level efforts to introduce demand-side innovation policies to stimulate the uptake of innovation or act on their diffusion, including public procurement and regulations supporting innovation. It also analyses policy measures aimed at internationalisation of companies with the aim of increasing the innovativeness of the economy.

Estonian RD&I policy has been relatively strongly supply driven since its inception in late 1990s. In addition, general economic policy environment is also strongly leaning towards supporting markets rather than creating them. In the RD&I policy arena these policy attitudes are most clearly expressed by supporting both basic and applied research, collaboration between universities and companies, exports, and so on. Only with the current 2014-2020 EU structural funding programming period new policy ideas (for the Estonian context) around procuring innovative solutions have emerged. Market creating policies generally presuppose high level of analytical skills within public organizations, industry associations and other stakeholders but in the Estonian case these skills need to be improved.

Public procurement has already been successfully applied in the ICT domain in Estonia and has achieved moderate success in defence. In order to support modernisation of the private sector, a more generic policy targeting innovation in public procurements has recently gained interest in the country and it has moved away from a "no policy" policy (Lember and Kalvet 2014). In 2016, Estonia launched its first demand driven innovation initiative, "State as a smart customer" (see policy response to challenge 3). There are, however, no general national targets on public procurement of innovative goods and services.

The Rules for Good Legislative Practice and Legislative Drafting (passed by the Government in 2011) stipulate that when any legislative intent, concept and draft act is prepared, an impact assessment is carried out, a report on the impact assessment is prepared and an ex-post impact assessment is carried out in compliance with the Methodology of impact assessment (approved by the Government in 2012). The same principles and methodology also applies to strategies and other policy measures of all fields, including innovation policies. There is no special government department responsible for overseeing the impacts of regulation on innovation.

Internationalisation of companies is supported under the following measures during the 2014-2020 period:

- Promoting exports.[18] Enterprise Estonia has been allocated €19.5m for various export promotion activities ranging from supporting participation in international markets to consulting services and training courses.
- Supporting foreign investments in Estonia.[19] Enterprise Estonia has been allocated €2m to target and approach specifically large international companies

[18] Details are available here: https://www.mkm.ee/en/objectives-activities/economic-development/entrepreneurship-and-innovation#export13

(with turnover exceeding €100 million), R&D units of major international companies, data centres and international venture capital funds.

[19] Details are available here: https://www.mkm.ee/en/objectives-activities/economic-development/entrepreneurship-and-innovation#foreign-investments-into-estonia14.

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List of abbreviations and definitions

BERD	Business Enterprise Research and Development Expenditure
BIF	Baltic Innovation Fund
COSME	EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises
CSR	Country Specific Recommendation
DESI	Digital Economy and Society Index
EIF	European Investment Fund
EIPTTC	Estonian Intellectual Property and Technology Transfer Centre
EFSF	European Financial Stability Facility
EU	European Union
FDI	Foreign Direct Investment
FP	Framework Programme
GBAORD	Government Budget Appropriations or Outlays on Research and Development
GDP	Gross Domestic Product
GERD	Gross domestic expenditure on Research and Development
ICT	Information and Communications Technology
MEAC	Ministry of Economic Affairs and Communications
MER	Ministry of Education and Research
PRO	Public Research Organisation
RD&I	Research, Development and Innovation
SBA	Small Business Act

Factsheet

	2009	2010	2011	2012	2013	2014	2015	2016
GDP per capita (euro per capita)	10600	11000	12500	13600	14400	15200	15600	
Value added of services as share of the total value added (% of total)	70.62	68.84	66.93	67.6	67.71	67.79	69.17	
Value added of manufacturing as share of the total value added (%)	14.13	15.69	16.57	15.91	15.54	16.15	15.84	
Employment in manufacturing as share of total employment (%)	19.16	19.03	20.1	18.97	18.97	18.4	18.93	
Employment in services as share of total employment (%)	61.15	62.2	60.53	61.47	61.89	62.73	61.76	
Share of Foreign controlled enterprises in the total nb of enterprises (%)	1.58	1.4	1.33	1.27	1.22			
Labour productivity (Index, 2010=100)	95.1	100	98.7	103	104.3	106.8	105.8	
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	0.56	0.57	0.82	0.66	0.8	0.7		
Summary Innovation Index (rank)	19	18	19	16	16	18	19	
Innovative enterprises as a share of total number of enterprises (CIS data) (%)				47.6		26.5		
Innovation output indicator (Rank, Intra-EU Comparison)			20	19	20	21		
Turnover from innovation as % of total turnover (Eurostat)		12.3		7.8				
Country position in Doing Business (Ease of doing business index WB)(1=most business-friendly regulations)						16	16	12
Ease of getting credit (WB GII) (Rank)						22	27	
EC Digital Economy & Society Index (DESI) (Rank)						12	8	7
E-Government Development Index Rank		20				15		13
Online availability of public services – Percentage of individuals having interactions with public authorities via Internet (last 12 months)	46	50	53	54	48	51	81	77
GERD (as % of GDP)	1.4	1.58	2.31	2.12	1.73	1.45	1.5	
GBAORD (as % of GDP)	0.68	0.7	0.76	0.81	0.82	0.72	0.7	
R&D funded by GOV (% of GDP)	0.68	0.7	0.76	0.81	0.82	0.72	0.69	
BERD (% of GDP)	0.62	0.79	1.46	1.22	0.82	0.63	0.69	
Research excellence composite indicator (Rank)				14				
Percentage of scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country		8.23	7.47	8.06	7.21			
Public-private co-publications per million population	23.96	24.75	19.55	12.83	12.12	6.84		
World Share of PCT applications	0.03	0.03	0.03	0.02	0.01	0.02		

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