

Chapter 1.

Overall assessment and recommendations

This chapter presents an overall assessment of Lithuania's innovation system and policy, reflecting the key findings of the review. It identifies strengths and weaknesses and key issues for innovation policy, and develops specific policy recommendations for improving Lithuania's performance in science, technology and innovation.

Achievements and challenges – upgrading the economy and strengthening the role of innovation

After gaining independence in 1990 – together with the two other Baltic states, Estonia and Latvia – Lithuania embarked on two important integration processes: political and economic integration into the European Union (EU), and military integration into the North Atlantic Treaty Organization (NATO). European integration culminated in Lithuania's accession to the European Union in 2004. On 1 January 2015, Lithuania also joined the Economic and Monetary Union (EMU), widely known as the euro area. At present, Lithuania is in the process of accession to the Organisation for Economic Co-operation and Development (OECD), following an official invitation by the OECD Council. Already the process of accession and a fortiori membership to the European Union had a profound impact on Lithuania's economy, and the institutional setup and framework conditions under which it operates. It also triggered profound changes in the Lithuanian innovation system, including in the modes of steering and funding of science, technology and innovation (STI). The process of accession to the OECD offers another important opportunity for Lithuania to strengthen its position in, and integration into, the global economy, and to benefit from OECD experience and peer review processes in various areas, including STI.

While in 1995 Lithuania's gross domestic product (GDP) per capita (USD 8 920) stood at approximately one-third of the OECD average (USD 27 396), it exceeded two-thirds of this benchmark (69%) in 2015 (USD, constant prices and 2010 PPP). Lithuania's macroeconomic performance after independence has been very favourable overall. Lithuania's GDP per capita stands at USD 28 809 (USD, 2015, current prices and purchasing power parity [PPP]), compared to an OECD average of USD 40 144. The country has made much progress in catching up, thereby rapidly narrowing the gap between Lithuania and the advanced countries in the OECD and the EU. While in 1995, Lithuania's GDP per capita stood at one-third of the OECD average, it exceeded two-thirds in 2015. Like other countries, Lithuania was hit hard by the crisis beginning in 2008. Together with the other two Baltic states, Lithuania recorded one of the sharpest contractions of economic output in Europe (close to 15% of GDP in 2009). Thanks to the relatively high degree of flexibility of the economy, underpinned by a generally favourable regulatory framework, the Lithuanian economy rebounded quickly, however.

Still, productivity gaps are large and Lithuania has a long way to go to catch up completely with the OECD average level of per capita income, let alone with the most technologically-advanced OECD countries. The speed of convergence to the OECD average level of income has slowed somewhat in recent years, compared to the pre-crisis years in the 2000s. To close the income and productivity gap with the leading countries in the European Union and the OECD – which is largely accounted for by lagging productivity – Lithuania's innovation capability has to be improved substantially.

Lithuania has a very small domestic market. However, being an open economy well integrated in the European Single Market and the world economy has allowed Lithuania to mitigate disadvantages of small domestic market size. Continued investment in an effective and up-to-date transport and communications infrastructure is essential for reaping the benefits of trade openness by facilitating access to major markets.

Lithuania faces important challenges in the near and longer term: demographic trends are unfavourable and these are exacerbated by a substantial brain drain; the working population is decreasing and there are signs of important skill mismatches; and the

country's innovation performance is low overall, despite important investments made in the context of EU membership and support from EU Structural Funds. To close the income and productivity gap with regard to the leading economies of the European Union and the OECD, Lithuania's innovation capability has to be improved substantially. Raising the current low innovation capabilities of Lithuanian businesses deserves priority attention. In view of Lithuania's unfavourable demographic trends, productivity increases are critical to increasing income per capita – and innovation is the most important sustainable driver of long-term productivity growth. This highlights the importance of a coherent and persistent STI policy in Lithuania.

Main strengths and weaknesses of Lithuania's research and innovation system today

Table 1.1 presents a strengths, weaknesses, opportunities and threats (SWOT) analysis of Lithuania's research and innovation system.

Table 1.1. SWOT analysis of the Lithuanian innovation system

Strengths	Opportunities
<ul style="list-style-type: none"> – Strong macroeconomic performance, leading to convergence – Largely favourable framework conditions for innovation and entrepreneurship – Favourable conditions for the establishment and development of start-ups – High share of tertiary graduates, including in science and technology (S&T) – Increased openness, transparency and stakeholder involvement in STI policy formulation – New research infrastructures – Pockets of research and innovation strength in some areas, e.g. photonics (lasers, photoelectronics, LEDs) and biotechnologies – Improved research system governance – Improved regulatory framework for commercialisation of public research – Growing small and medium-sized enterprise (SME) participation in the European Union's 7th Framework Programme for Research and technological development for 2007-2013 (FP7) and Horizon 2020, and participation in EU networks 	<ul style="list-style-type: none"> – Increase policy attention on research and innovation – Focus on strengthening innovation capabilities in a wider range of firms – Improve horizontal policy coherence and co-ordination (e.g. between the main ministries in charge of STI) – Make business participation a permanent feature of STI policy making – Provide better support for business innovation by upgrading competences of STI public sector policy makers – Reform the research sector (e.g. more competitive funding, international peer review, streamlining) to increase international competitiveness – Improve the contribution of universities/public research organisations to innovation – Pay more attention to societal challenges in STI policy – Make more effective use of research infrastructure – Use research potential created by the "Valley" programmes and open access centres – Enhance integration with international innovation networks – Better use the opportunities of Horizon 2020
Weaknesses	Threats
<ul style="list-style-type: none"> – Specialisation in low/medium technology industries – Very low business activity/investment in R&D and innovation – Low absorptive capabilities of many businesses – Few links between research institutions and businesses – Fragmentation and lack of co-ordination in STI policy making and implementation accompanied by cumbersome legal procedures – Weak evaluation culture and strategic intelligence on innovation policy – Demand-side policies are under-utilised – Too many sub-critical actors in the higher education institutions (HEI) sector striving for the excellence of fundamental research, while paying less attention to applied research – Technology transfer and research commercialisation unconnected to university/PRO culture – Weak international STI linkages 	<ul style="list-style-type: none"> – Unfavourable demographic trends and continued difficulty in attracting and retaining highly-skilled workers in the face of mounting global competition – Decreasing numbers of graduates and PhDs – Stagnation of business investment in R&D and innovation – Decline of EU funding for STI and limited ability of Lithuania to support innovation programmes from the national budget – Failure to adapt STI governance to evolving needs

Key issues and recommendations

Taking account of the SWOT analyses set out in Table 1.1, and the strategic tasks to be addressed by innovation policy, this report has identified a number of key issues and policy recommendations.

Provide favourable framework conditions for innovation

Good framework conditions are essential for innovation. Research shows that framework conditions that affect innovation include: openness to international trade and foreign direct investment (FDI), competitive markets for goods, services and labour; a transparent, fair, non-punitive and predictable system of corporate taxation; a propitious macroeconomic environment; bankruptcy legislation that facilitates resource reallocation while properly protecting creditors; institutions and regulations which impose minimal burdens for doing business; ease of business access to finance; and a system of education and training which efficiently balances skill supply and demand.

Since independence in 1990, and the country's entry into the European Union in 2004, Lithuania has eased product market regulation (PMR) in order to increase competition. By 2013, the PMR index for Lithuania was 1.52, which is in line with the OECD average, and at the same level as Sweden (1.52) and Chile (1.51). Some aspects of the regulatory framework in Lithuania are more market-friendly than in the average OECD country. This includes the degree of state involvement in business operations and the complexity of regulatory procedures. However, as highlighted in the recent OECD Regulatory Policy Review of Lithuania, further assessment is needed to understand to what extent well-designed regulatory policies are implemented in practice.

According to the World Economic Forum's Global Competitiveness Report 2015-16, Lithuania ranks 36 out of 140 countries, just behind Indonesia and ahead of Portugal. Based on the indicators used in that report, Lithuania performs well with respect to the education of its population, its market efficiency and technological readiness. In 2014, for instance, 96% of firms in Lithuania had Internet access, a share comparable to the EU average. However, the same World Economic Forum report suggests that the country lags behind with respect to the efficiency of its institutions, the development of domestic financial markets and labour market efficiency. The inefficiency of government bureaucracy is held to be the most problematic factor for doing business.

Lithuania is now in the top 20 of the World Bank Doing Business ranking. Lithuania has recently implemented important reforms to facilitate the creation of new businesses. For example, according to the World Bank report, between 2005 and 2015 the number of days it takes to register a business has decreased from 26 to 3.5, and the cost to start a business as a share of income per capita has declined by approximately 80%. Lithuania has also simplified bankruptcy procedures over the last ten years, even though insolvency procedures still take more time to be finalised (2.3 years on average) than in the average OECD country (1.8 years). In recent years, Lithuania has considerably strengthened the framework conditions for innovation. However, challenges in some areas remain.

An area where Lithuania needs improvement, as highlighted by the OECD PMR indicators, concerns the restrictions on employing non-EU workers. These restrictions may not only prevent domestic companies from recruiting, they may also discourage the relocation of firms from outside the European Union to Lithuania. At 15%, the statutory rate of corporate income tax is low, and a reduced tax rate of 5% for companies with less than ten employees and EUR 300 000 income per year is also in place.

Another factor affecting competition is the large size of the informal economy. Despite a decrease in recent years, Lithuania’s informal economy is one of the largest in the European Union (by some estimates being in the range of 17% to 26% of GDP). In 2013, respondents to the EBRD-World Bank Business Environment and Enterprise Performance Survey (BEEPS) highlighted the operations of competitors in the informal sector as a barrier to their activities.

Difficulties in access to finance are also an obstacle to entrepreneurship. Lithuania ranks 91 out of 140 countries for ease of access to loans, according to the World Economic Forum Global Competitiveness Report 2015-16. In addition, 16% of firms that participated in the BEEPS survey identified access to finance as an obstacle to their activities, a figure that is higher than in Estonia (5%) and similar to Latvia (15%). It is particularly concerning that firms encountering problems in accessing credit in Lithuania are generally small firms with higher levels of labour productivity. Access to finance can as a consequence be a constraint for the growth of high-potential firms. The relatively recent development of a venture capital sector can partly address these problems: the establishment of the Joint European Resources for Micro and Small Enterprises (JEREMIE) holding fund, a joint effort of the Ministries of Economy and Finance of the Republic of Lithuania and the European Investment Fund (EIF), and the Baltic Innovation Fund (BIF), a joint initiative of EIF and the three Baltic states, are steps in the right direction. A promising recent development is the creation in 2014 of Nextury Ventures, a 100% privately owned venture capital fund. Nevertheless, even in OECD countries where the venture capital sector is most developed, only a tiny minority of all firms receives venture finance. Accordingly, attention must be given to the full range of instruments and policies required to address access to both equity and debt among firms most likely to face access constraints.

Many firms in Lithuania consider infrastructure supply to be below OECD average standards. And limits on the compatibility of the transport, electricity and gas networks with those in the rest of Europe may hinder competition and raise costs for Lithuanian firms. A range of reform initiatives and public investments are under way which will help to mitigate some of these problems.

Recommendations

- Encourage the development of mature system of equity and debt finance to tackle the lack of investment in high-potential growth firms. Explore possibilities to further develop the business angels sector and examine opportunities to enhance the quality of firms’ investment proposals (so-called “investment readiness”), through, for instance, support by mentors and content experts.
- Continue to make bankruptcy procedures more rapid and less costly.
- Continue to improve the regulatory framework, paying particular attention to the efficiency of government institutions.
- Monitor the impact of the current corporate tax regime and ensure it does not create obstacles to the growth of young innovative firms.
- Monitor the effects on Lithuanian firms of the reform initiatives and public investments aimed at addressing infrastructure deficits.

Foster the quality of human resources for innovation

Innovation performance critically depends on highly-skilled human resources. Lithuania shows strengths in this area. For instance, the share of the population aged between 20 and 29 who are enrolled in tertiary education (albeit decreasing) and the share of the working-age population with a tertiary education are well above EU averages. However, there are indications that skill mismatch is high. According to the Research and Higher Education Monitoring and Analysis Centre (MOSTA), in 2013 36% of employed bachelor graduates held positions that did not require a higher-level qualification. MOSTA recently also found that the short-run returns to university education were low compared to other types of education (i.e. vocational and college education). The skill mismatch can be partly explained by the fact that traditional industries dominate Lithuania's business sector, both in terms of value added and export specialisation. These industries are generally characterised by a larger share of jobs without specific skill requirements.

There is scope for improvement of student performance in secondary education. According to the OECD/PISA survey 2012, Lithuanian students score below the OECD average in all three surveyed areas: mathematics (494 for the OECD on average, as compared to 479 for Lithuania), reading (496 across the OECD as compared to 477 for Lithuania), and science (501 across the OECD and 496 in Lithuania). Students in the two other Baltic states performed above Lithuanian students: 491 in mathematics, 489 in reading and 502 in science in Latvia and 521 in mathematics, 516 in reading and 541 in science in Estonia. In mathematics, the performance of Lithuanian students has decreased since the first round of participation in the OECD/PISA survey.

Nearly 35% of Lithuanian firms cite an inadequately educated workforce as a major or severe obstacle to their activities. Other sources suggest that firms consider the availability of skilled graduates and/or workers insufficient. To address some of the skill mismatch in the business sector, the Lithuanian government has reformed the vocational education and training (VET) system. In particular, it established sectoral practical training centres which are open to VET and higher education (HE) students and business sector employees. According to the OECD's Policy Note on Youth in Lithuania, additional measures might include direct subsidies or tax advantages for firms participating in VET activities.

The problem of skill shortage and mismatch is exacerbated by the large outflows and limited inflows of skilled people from and to the country. More than 8% of Lithuania's domestic tertiary-educated population emigrated in the first decade of this century (prior to 2011), a share higher than in comparable eastern European economies. Most immigrants are returning Lithuanian citizens. Attracting highly-skilled non-Lithuanians from abroad – including students and researchers – remains a challenge. The number of foreign students in Lithuania is among the lowest in Europe. The share of non-EU doctoral students is particularly low – at close to 0% – compared with the EU average of 24%.

Lithuania has put in place a number of initiatives and programmes to promote the participation of Lithuanian researchers in international research activities and attract researchers and students from abroad. These initiatives include: grants to conduct visiting periods in research institutions abroad; inviting researchers from abroad to spend time in Lithuania; the development of joint study programmes with foreign institutions; and awards to Lithuanian researchers that perform research activities abroad.

Recommendations

- Strengthen the human resource base for innovation in order to supply businesses with the skills they need to become more innovative. Map the skills needed by Lithuanian companies and encourage dialogue between HEIs and the business sector in the development of tertiary education curricula and programmes.
- Strengthen and extend measures promoting the development of the VET system with a view to meeting business sector needs.
- Address the relatively low performance of students in secondary education relative to their peers in the OECD.
- Foster linkages between Lithuanian researchers and research units abroad (e.g. through sabbaticals, visiting periods abroad [exchanges], or joint research programmes). These measures should target both young researchers and senior research staff.
- Continue addressing the problem of brain drain and lower barriers to attracting and retaining talent from abroad, including non-EU citizens. In the case of attraction of researchers, this can take the form of expanding the offer of post-doctorate studies and facilitating access to visas and work permits for foreign scientists.

Improve public governance of the innovation system: agenda setting, co-ordination and strategic intelligence

Lithuania has clearly made progress in developing its R&D and innovation policy governance, especially during recent years. The requirements of and guidance from the European Commission related to EU Structural Funds has been instrumental in this development, first through the “Lisbon strategy” and subsequently through “smart specialisation”.

The recently launched EU Structural Funds period (2014-20) prominently features “smart specialisation”, and development of Research and Innovation Strategies for Smart Specialisation (RIS3) was a requirement for receiving funding. For the first time, the process for establishing policy priorities was interactive and attempted to engage all key stakeholders, including industry. The process was based on an extensive and systematic analysis of Lithuania’s economic sectors and research competences. This represented an important step towards evidence-based policy making. Stakeholder consultation was made part of the design of new or adapted schemes. The adoption of an evidence-based approach and increased transparency were in line with the requirements of the European Commission, which had to approve RIS3. RIS3 and the more transparent and evidence-based approach are also conducive to a more balanced R&D and innovation policy. For instance, the development of the Smart Specialisation Strategy contributes to achieving a better balance between developing research competencies and addressing industry needs. It also introduced a more application-oriented approach, including in addressing societal challenges. The strategy likewise includes plans to introduce pre-commercial procurement (PCP) as a new demand-side policy measure. Implementation of the strategy is shared between the Ministry of Economy and the Ministry of Education and Science.

Many of the main RIS3 policy objectives and challenges had been identified in, and are part of, the Lithuanian Innovation Development Programme 2014-20. The Innovation Development Programme – a continuation of the Innovation Strategy 2010-20 – aims to mobilise state resources for improving Lithuania’s innovativeness and developing a

competitive economy based on knowledge, technology, qualified human resources and smart specialisation. Implementation of the Innovation Development Programme is shared by nine ministries and six agencies and other public bodies.

Lithuania has engaged many stakeholders in the RIS3 process, co-ordinated by the Ministry of Education and Science and the Ministry of Economy. As occurred with RIS3, the Innovation Development Programme attempted to introduce R&D and innovation into the agenda of other ministries. Indeed, the drafting process involved a host of ministries and agencies, although there was no commensurate involvement of non-governmental organisations (NGOs) and business. Overall however, RIS3, as well as the Innovation Development Programme, can be seen as important milestones in R&D and innovation policy making in Lithuania. However, despite the progress made, the governance system still has a number of weaknesses which need to be addressed.

Strengthen agenda setting and strategic policy coherence

Evidence on Lithuania's strengths and weaknesses was used to develop the research and innovation RIS3. STI policy has been given more focus and the opportunity has been created for more co-ordination between ministries and agencies. RIS3 seems to be accepted widely as one of the main strategic documents for research and innovation. The proof of whether or not RIS3 is supporting a more focused and coherent policy will be its success in changing the wider mix of policies contained in the Operational Programme 2014-20, the measures taken in implementing the Innovation Development Programme, and the Ministry of Science and Education's plans in relation to research and innovation transfer. As many measures are currently still in development, or have just started, it is too early to assess these outcomes.

It will be crucial for Lithuania that the RIS3 serve as a guiding principle for the further implementation of European Structural and Investment Funds (ESIF) programmes during 2014-20. It is also crucial that Lithuania build bridges between R&D and innovation, societal challenges and economic opportunities by better aligning different strategic documents such as the Innovation Development Programme, the National Programme for the Development of Studies, Scientific Research and Experimental (Social and Cultural) Development Programme for 2013-20.

Even though – as mentioned – the RIS3 process was a step in the right direction, policy making and implementation is often hampered by rather cumbersome legal procedures that may be rooted in Lithuania's administrative culture. In addition, strategies in the area of STI policy sometimes set overly optimistic and sometimes unrealistic targets. Evidence of this can be found in several studies and evaluations. The objective to raise gross expenditure for research and development (GERD) intensity (gross expenditure on R&D as a percentage of GDP) to 1.9% by 2020 is an example. As the current level is 1.0%, and little progress has been made over recent years, this objective seems unrealistic. Unrealistic targets undermine the credibility of R&D and innovation policy, and fail to provide guidance and encourage stakeholder commitment. Indeed, instances of weak industry commitment to government-led initiatives can be interpreted as being partly caused by this fact. Achieving this commitment requires credible policies with ambitious but realistic objectives.

Improve horizontal policy co-ordination

A lack of co-ordination was particularly evident in the design and implementation of the Valleys Programme, which was meant to be a programme focused on university-business co-operation and the support of innovative new business development, but became a

programme primarily supporting the public university and research sector. More and better co-ordination, including with business representatives, at the design and early implementation phase might have increased the chance to achieve the original objectives of the programme. A lack of co-ordination has also been evident in the development of science parks, for example via the Inogeb programmes, which contributed to a proliferation of science parks and incubators. The new approach to science and technology parks (STP) policy (as foreseen in the guiding document of the Lithuanian government as of 25 February 2015) might help to improve co-ordination, if the additional STP tasks foreseen are developed within the wider context of changes in the technology transfer tasks of universities and research centres. This new approach should take into account the need for professional capabilities and private sector incentives. Successful science parks across the world have proved that these are necessary for developing business opportunities.

The establishment of the Strategic Council for Research Development and Innovation (SMIT) was a step forward. The council, chaired by the prime minister, consists of representatives of the ministries in charge of STI development, the Research Council of Lithuania (LMT), the Agency for Science, Innovation and Technology (MITA), science and HEIs, business, social and economic partners, and independent experts. The council has been involved in approving RIS3 but does not seem to take an active and strategic role in examining the Lithuanian policy mix or the set of institutions involved in the implementation of STI policy. Strengthening the council's role in these directions could help to sharpen the strategic orientation of Lithuania's innovation policy and improve coherence.

The establishment of MITA in 2010 – by both the Ministry of Economy and the Ministry of Education and Science – is also a promising development as regards horizontal co-ordination. However, the largest support programmes for innovation, financed through ESIF, are not managed by MITA but by the Central Project Management Agency and the Lithuanian Business Support Agency. This limits the reach of MITA in the business sector.

A lack of a systemic STI policy approach together with often cumbersome legal procedures and weak co-ordination between ministries has contributed to a fragmented mix of policies, policy instruments and implementation structures. It is evident from the examples given above – and confirmed by earlier studies and evaluations – that STI policy co-ordination in Lithuania is far from sufficient in any of these dimensions. Ensuring better policy coherence – horizontal, vertical and over time – requires a significant co-ordination effort. Corrective efforts have been made (e.g. in establishing SMIT and MITA) but co-ordination remains weak both at strategic and implementation levels. Learning, for instance, from the RIS3 process and reinforcing the role of SMIT (or a reorganised council), may improve co-ordination at the strategic level. However, further efforts will be needed to enhance co-ordination at operational levels too, notably between agencies and programmes and instruments.

Reducing the fragmentation of institutions and support schemes

The institutions and arrangements currently in place for implementing STI policies are highly fragmented. The large number of agencies responsible for a plethora of schemes makes the R&D and innovation support system complex and difficult to access and use, especially for businesses. One indication of this is the relatively poor uptake of schemes, such as the generous R&D tax incentive. The awareness of various schemes among their key target enterprise groups is low and many choose not to apply to participate because of administrative costs and uncertainty regarding the tax reduction eventually granted. Furthermore, the prevailing administrative practice supports strict implementation with very little flexibility, which is poorly suited for R&D and innovation

activities which are inherently risky. Fragmentation, combined with these weaknesses in policy implementation, is likely to reduce the impact of STI policies.

Fragmentation and the resulting need for co-ordination of policy implementation may be reduced by consolidating institutional structures. The merging of agencies and schemes could be based on functional or target group similarities and complementarities. Consolidating around functional complementarities is more typical in most countries and probably also easier to adopt in Lithuania. Consolidating around target groups is more demanding as it often requires the resulting agencies to manage several different types of schemes. However, merging agencies based on target group similarities leads to more in-depth knowledge of that group, better understanding of impact, and stronger evidence for designing and revising schemes in the future. This approach is also easier to handle for businesses, since they only need to interact with one or a limited number of agencies.

Improving strategic intelligence

There is a need to foster the emergence of a stronger culture of evidence-based STI policy making. Ministries would benefit significantly from building their in-house competences related to strategic intelligence. Use of independent external expertise is a viable and often necessary option, but its value is likely to remain limited without sufficient in-house competences. A step-change in this regard would be the systematic monitoring and analysis of support to business R&D innovation across different agencies and support schemes which currently seem to be unavailable.

The evidence-base developed in the context of the RIS3 process, together with other strategy processes, studies and evaluations, provide a solid base for further developing STI-related strategic intelligence in Lithuania. The role of MOSTA in gathering evidence for the use of decision makers has been important in this regard, and MOSTA has been able to strengthen its own capabilities. Strategic intelligence with regard to business innovation activities appears underdeveloped. Developing the required integrated business intelligence within the Ministry of Economy might be considered, as this ministry co-ordinates the many agencies collecting relevant information. Nevertheless, this still poses the question of how to link together strategic intelligence across the whole research and innovation system.

Recommendations

- Consider launching a systematic review of all STI-related programmes, possibly under the aegis of a reinforced strategic council. This would help to find an appropriate balance, for instance between public funding for fundamental research, applied research and business innovation, or the balance between supporting high-tech companies and innovation followers.
- In future strategy and policy design, draw on the experience of the RIS3 process and other research and innovation-related strategies, and aim at adopting an open, transparent, participative and evidence-based approach. Make specific efforts to enhance regular stakeholder participation, notably of industry.
- Launch an institutional reform of STI policy implementation by improving co-ordination, and consolidate agencies and support programmes where overlaps exist. Establish an appropriate approach (functional, target group-specific, or other) for programmes and adopt a more industry and society need-based approach within the consolidated implementation structure and in the design of consolidated schemes.

- Consider establishing a common information platform for following up users (applicants and beneficiaries) and monitoring R&D and innovation support across agencies and schemes. This would provide critical information for policy design and evaluation and facilitate the integration of all relevant monitoring data into one database and thereby follow beneficiaries and their results in a more comprehensive way, which would provide a solid basis for impact analysis. In parallel, the development of a virtual one-stop-shop (single entry point) for potential beneficiaries would ease access to an otherwise complex support system.
- Explore the strengths and weaknesses of different options for strengthening the development and use of high-quality strategic intelligence on the science, research and innovation system.
- Follow principles of good practice in policy evaluation. Among other things, this entails making explicit a commitment to policy evaluation at the highest level, mandating evaluations when public funding is provided, insisting on developing data and evaluation strategies as a pre-requisite for the start of programmes, using a mix of evaluation methods (according to the nature of the policy or programme concerned, including evaluation by external and international experts), and committing to public diffusion of evaluation findings of publicly-funded programmes.

Better balance the policy mix, fostering innovation in the wider business sector

Lithuania's R&D and innovation policy mix of the last decade has featured a relatively large number of policy measures encompassing education, research and innovation, the environment, labour and infrastructure. R&D and innovation have been further supported by efforts to establish favourable and stable conditions for R&D and innovation activities, with a special emphasis on access to equity finance.

Within the policy mix, there has been a strong emphasis on research and science-driven innovation. Most funding schemes supporting business R&D and innovation were in some way linked to research and research infrastructures (for example InoKlaster LT+, innovation vouchers, and national high-technology and biotechnology programmes).

It is therefore not surprising that business R&D and innovation support measures have focused on two main target groups: companies already active in R&D and innovation, and potential high-growth start-ups. Enterprises already engaged in R&D are likely beneficiaries of both the schemes aimed at business R&D activities and infrastructure (Intelektas LT and LT+) and the R&D tax incentive. They may also be the indirect beneficiaries of the research infrastructures, although this depends strongly on the match between industry needs and the underlying interests for developing specific research infrastructures. Start-ups and innovative companies are also the main beneficiaries of equity funds set up with the EIF (JEREMIE and the BIF).

There are only a limited number of smaller-scale measures for companies outside the two target groups mentioned. These include support for technical feasibility studies and innovation support services (InoCekiai, Inogeb LT, Asistentas). Support for incremental innovation, firm training (for the adoption of new technologies and innovation) as well as non-technological forms of innovation (i.e. development or improvement of new business models and organisational and managerial practices) are also currently absent in the business innovation policy mix.

While there has also been some effort to develop relevant infrastructures and related services to support research and innovation activities among a wider range of enterprises

(Inogeb LT-2), they have been technology-push oriented. Even the measures that could be targeted at raising companies' R&D and innovation capacities (through employment of R&D personnel) focuses on knowledge-intensive SMEs, not potential new R&D and innovation performers. The rationale focuses on enhancing researcher employment, rather than increasing the number of companies able to become R&D and innovation performers.

As already mentioned, business R&D and innovation started to receive more attention towards the end of the last EU Structural Funds period (2007-13), especially during preparation of the new period (2014-20). The main challenge is the relatively small number of companies in Lithuania engaged in R&D and innovation (Box 1.1). The policy mix should reflect the fact that raising awareness of the importance of R&D and innovation, facilitating competence building and the absorptive capacities of companies, and other measures aimed at increasing the number of companies capable and willing to engage in R&D and innovation, are vital for Lithuania's competitiveness.

The R&D and innovation policy mix has some visible gaps. Efforts to develop demand-side measures for supporting innovation have only been initiated recently. Policies show very little recognition of the importance of organisational or service-sector innovation. The current policy framework lacks support mechanisms for basic forms of innovation and technology diffusion in SMEs, in spite of the documented difficulties of this group of firms in engaging in innovation activities and innovation performance, as opposed to large firms and European peers. In addition, apart from export and FDI promotion and the EUREKA programme, international collaboration is seldom featured or recognised in business-oriented R&D and innovation support schemes.

Much effort has been put to developing infrastructures supporting business R&D and innovation (Valleys, open access centres, technology centres, science parks, etc.). However, the group of targeted businesses remains small compared to the investment in these infrastructures. There is an urgent need to assist a much larger range of companies to become involved in innovation and R&D in order to make good use of the support infrastructure and justify its further development in the longer term. This will entail improving the participation of SMEs in policy programmes through, for instance, support for project preparation (e.g. assisting SMEs in the drafting of applications for individual and collaborative projects with research institutions) and enhancing policy awareness (e.g. campaigns and involving SME chambers in the promotion of policy instruments). Improving the policy mix to expand the range of support to other forms of innovation activity such as organisational innovation and to other sectors (services) are also relevant lines of action. The extent to which the apparent mismatch might be closed through shifts in policy, including policy towards financing, must be further examined.

There are some signs, however, that in the new EU Structural Funds period the match between the business R&D and innovation landscape and policy is improving. Schemes such as innovation vouchers, and co-financing support for protecting intellectual property, international certifications, and various other "soft" measures providing innovation and business support services (e.g. technology auditing, marketing and design services, technical assistance to address specific problems including quality issues, production process and automation, information systems and environmental compliance), are likely to reach potential R&D and innovation performers. Cluster initiatives can also be effective in this respect, if they are industry-driven and carefully designed.

Box 1.1. Innovation-related features of Lithuania's business sector

Lithuania's manufacturing sector mostly consists of low- and medium-low-technology industries. The share of these industries in manufacturing output exceeds 80%. Lithuanian manufacturers have predominantly specialised in the production of raw material-intensive goods (e.g. food, fertilisers, and refined petroleum products) and labour-intensive goods (e.g. textiles, clothing, wood products, and furniture). Medium-high and high-technology industries are growing (5% to 7% annually according to Eurostat), but their contribution to the economy is still low by international standards (high-tech exports account for only 5.8% of total exports).

The share of R&D personnel is below the EU average, but increased over the last decade (from 6.6‰ to 8.6‰ of total employment). The increase is primarily due to an increase in researchers of approximately 30%. The number of business R&D personnel has recorded a similar trend.

The share of innovative companies in the total business population is one-third (compared to one-half among European innovation leaders). Only 20% of SMEs are innovative, while countries classifiable as European innovation leaders record more than twice that share. Average innovation expenditure per company is low at EUR 86 000 (1.4% of turnover), especially compared to innovation leaders (where the equivalent figure is EUR 1 million, or more than 3% of turnover).

Innovation in Lithuanian business enterprises is largely non-R&D-driven. Innovative activities are mostly of an incremental character and focus on productivity increases, often related to process innovations and market innovations. Acquisition of equipment and software account for 70% of total innovation expenditure, while among European innovation leaders the share is 5-15%. The structure of innovation expenditure indicates that the majority of innovative companies are catching up by transferring technology, mostly from abroad. To some extent this may also be related to the strong emphasis on R&D infrastructures, tangible investments and access to finance in R&D and innovation policy during the 2007-13 period.

Only 15.7% of Lithuanian SMEs innovate in-house. Accordingly, patenting activities are limited. The number of patent co-operation treaty (PCT) patent applications is 0.9 per billion GDP, which is less than 25% of the EU average (3.9) and about 10% of the figure seen in European innovation leaders (10). Co-operation on business R&D and innovation is rare. Only 8.8% of innovative SMEs collaborate in their innovation activities. In addition to limited business R&D and collaboration, and a low number of enterprises engaged in R&D-driven innovation, science-based entrepreneurship and patenting activities remain low. Given that public sector R&D accounts for the major part of GERD, the knowledge transfer gap is a particularly serious concern. While several policy measures are in place to address the gap, impact is limited and focuses on start-ups and a small number of R&D-intensive companies.

According to the Innovation Union Scoreboard, Lithuania's overall innovation output is moderate compared to other EU28 countries, well below the EU average, and far behind European innovation leaders. Furthermore, there are no signs of a catch-up process.

It is commendable that Lithuania has introduced a voucher scheme. Such schemes can be useful in targeting the immediate needs of businesses in the area of innovation and R&D. They can help raise awareness among enterprises of services offered and lead to extended collaboration, once sufficient trust has been built. Vouchers can be designed to cover services offered by public research organisations, universities and private providers. This requires that the operating agency set the necessary code of conduct and rules for the voucher scheme and organise a certification of service providers, for example through a public tender process. This allows agencies to focus on operating schemes rather than growing the public sector by hiring experts providing services to companies. This approach

is worth considering in areas where sufficient supply of private services exists. Voucher schemes also have their limitations and pitfalls (such as becoming driven by the interests of the service provider rather than industry, especially if the provision is subsidised to 100%).

With respect to industry-oriented cluster and networking programmes, companies can launch collaborations related to their immediate business concerns, such as export promotion and short-term priority necessities such as training and firm upgrading. As they build trust and identify shared challenges, the collaboration might start to be extended to innovation and R&D, or other areas of strategic interest. As companies learn and gain in experience, their capabilities and willingness to collaborate with public research institutes is also likely to increase. Lithuania's R&D and innovation policy has to be better aligned to industry needs. The relatively low number of businesses currently able to engage in R&D and innovation indicates that public support measures should be better targeted. After the significant investments of recent years in building and modernising research infrastructures, support should now go more towards companies that may benefit from them. Support should consist of a mix of soft and hard measures, facilitating awareness, identification of innovation-related business opportunities, competence development, R&D and innovation activities, and commercialisation, exporting and growth.

With respect to innovation-oriented procurement, it is essential that competition in the tender process be preserved. The threat to competition in innovation-oriented procurement comes from the greater interaction and information exchange that can occur between the procurer and suppliers, relative to purely arms-length procurement. General government procurement can also be made more innovation friendly with little additional risk simply by specifying the goods and services to be procured in terms of their functionalities – what they will do when used – rather than in terms of pre-determined technical characteristics. Specific skills and capacities also need to be developed to implement innovation-oriented procurement successfully. And since procurement of innovation represents a significant change in public sector culture, it may be advisable to pilot the respective schemes before launching them in full scale.

Recommendations

- Improve policy outreach by focusing on increasing the share of R&D and innovation performers in the business sector. This will entail the following actions:
 - Provide assistance to firms (SMEs and young firms) in the preparation of proposals, especially for first-time applicants.
 - Introduce or strengthen competence-building schemes targeted to companies not yet engaged in R&D and innovation. These may include support for the insertion of skilled staff in business firms, use of external innovation support services, training and other competence-building activities.
 - Facilitate SMEs' connectivity with the innovation system, especially in the acquisition of human resources, e.g. facilitating links with the education and research system, and supporting hiring of new qualified personnel (e.g. engineers and technical personnel).
- Strengthen awareness-raising measures to reach a wider range of companies. These may include awareness of international market trends, new emerging technologies, changing industry structures and business models. Work with SMEs chambers and industry groups to promote and diffuse new policy instruments. Put

more emphasis on industry-needs-driven, low-barrier schemes to attract more companies to launch innovation activities that go beyond R&D (non-technological innovation and commercialisation). These could also include schemes encouraging companies to engage in organisational and service-sector innovation. Study the feasibility of integrating service and organisational innovation into existing support for business enterprises.

- Continue developing demand-side policy measures. The most promising might be public procurement of innovation. This mechanism, however, requires careful design and implementation, and it is therefore recommendable to conceive first a pilot programme before launching it in full scale. Develop a long-term strategy for the support of collaborative networking arrangements among firms. Support only those that have real industry involvement/commitment and a joint agenda for collaborative research, innovation and/or education and where the private sector shows readiness to invest time and resources in collaborative activities.
- If Lithuanian policy makers seek to expand cluster-related activities or support, the following generic observations should provide a degree of orientation:
 - Consider that clusters should be business driven and are a tool for co-ordination, not an end in itself. Their success depends on industry leadership and effective co-operation to address bottlenecks hindering competitiveness.
 - A policy on clusters should encourage dialogue and co-operation between firms and the public sector (particularly at local and regional levels of government). This dialogue could identify and lead to the development of inter-firm networks, an improved quality of government action (e.g. in co-locating complementary public investments, such as research facilities).
 - Government should work with existing and emerging clusters rather than trying to create entirely new clusters.
 - Policy makers should also assess the wider determinants of cluster success, which may in fact be the best targets of policy. Such determinants include transport, land-use planning, housing, the quality of public amenities and labour market policies.

Enhance the performance of the higher education (HE) sector

The research and HE sector has been reformed over recent years. Research funding now consists of institutional funding and a number of sources of competitive funding. The mostly international peer review for research units, using a wider set of performance criteria than merely publications, has been an important step towards aligning the Lithuanian research sector more closely with the international research community.

Relative to its population size, Lithuania has a large number of HEIs. In total Lithuania boasts 22 universities (of which 14 are state-owned and eight private) and 24 colleges (of which 13 are state-owned and 11 private). Since 2000, the HE sector has twice undergone significant reforms, starting with the reforms in 2000 introducing the European model binary education system (introducing bachelor's and master's degrees). A second reform was launched in 2009 modernising the HEI sector, introducing more competitive funding and enhancing the autonomy of universities.

The research institute sector has seen a significant restructuring as well. Today, Lithuania's research institute landscape comprises 13 state institutes. Before 2010 there were many more, which were recently merged or amalgamated with universities. Funding of the research institutes consists of basic financing for long-term R&D and the arts as well as competitive funding. Some of the research institutes have high international standing and take part in Horizon 2020 projects.

The scientific achievements of the Lithuanian universities and research institutes in terms of performance measures such as international co-publications, publications in peer-reviewed journals and citations are relatively poor compared to other EU countries. A recent international research assessment of Lithuanian research groups showed that some are strong national players with international recognition. But there were no strong international players among Lithuanian research actors. In most science domains the research groups were average national players. The research assessment found that many groups were strong national players with international potential in terms of societal and economic impact as well as in terms of infrastructure. This means that the large investments in research infrastructure in the previous EU Structural Funds cycle have provided the research sector with a good infrastructural basis. However, this has still to be translated into internationally attractive research. Across all scientific domains research management was considered weak.

The research assessment identified future potential in research groups across agricultural sciences, biological sciences, biomedicine, physical sciences, some pockets of the humanities and technological sciences. The assessment found that the large number of research institutions results in small research units which do not co-operate and which duplicate research themes. The research assessment exercise also found that the Research Council of Lithuania (LMT) should more systematically use independent international peer review in assessing research grants.

It is commendable that the second reform and modernisation has been put in place after the adoption of the new Law on Higher Education and Research (2009). Nevertheless, the objectives of advancing modernisation and achieving better performing HEI institutions seem to be hampered by the highly fragmented structure of the HEI and research institute sectors. The sub-critical size of many research units impedes the setting of strategic research priorities at the institutional level.

Additional changes are needed in the structure, incentives and culture of the public research sector in order to achieve a paradigm shift. Universities report directly to parliament rather than to the government. This makes structural change in the HE system more difficult to achieve and steer. Moreover, with decreasing student numbers, and institutional funding dependent on the number of students, there is a risk that competing universities will focus on the popularity of the degree courses rather than the provision of high-quality education and research matching the needs of the business sector.

Lithuania invested a considerable amount of funding in research and innovation in the previous EU Structural Funds period (2007-13). Much of this funding was allocated to the Valley initiative. While the objectives of the Valley can be applauded, the approach did lead to a new set of mechanisms and networks that were set up specifically to manage the Valleys across existing universities and research institutes. This added to the fragmentation and complexity of the overall system. The Valley initiative has made a positive contribution to upgrading the infrastructure of the universities and research institutes involved, but it has not changed the structural issue of a lack of co-operation between the publicly-funded research sector and the business sector.

The collaboration between public research and the business sector is still weak, some positive exceptions notwithstanding. A number of initiatives have been taken to improve collaboration. Much of the attention has been given to building technology transfer facilities and improving awareness and knowledge of intellectual property rights (IPR). These activities should be conducted as part of the university's or research institute's objective to engage with business and society in Lithuania. If the main goal is to acquire more funding for the universities or research institutes, the stakeholders should realise that very few HEIs across the world succeed in earning money from their technology transfer activities. It is contract research rather than technology transfer that has the potential to generate a significant additional income stream. A key mechanism used in Lithuania to improve the commercialisation of research is the establishment of science parks and local technology centres. These are available across the country. Lithuania has nine STPs. These seem to compete, on the one hand, for companies to locate their business at the park and, on the other hand, to compete for public support for technology transfer, IPR, start-up coaching and related activities. Some of these parks have a clear (technological) focus while others have a more generic profile. The Ministry of Economy is part owner of some of these parks, which potentially gives some parks a preferential position compared to parks with different ownership. There are indications that Lithuania has too many parks in relation to the potential number of residents. Of course, some regional technology parks might fulfil local functions that differ from those located in the more urbanised areas with key universities. The guidance document on STP as of February 2015 defines the specific roles and objectives of these parks and hence the role of government support in regard to these objectives. The (relatively few) international examples of very successful science parks show that professional and business-oriented functions need to be developed to conduct high-quality technology transfer services and that strong institutional support is needed at the highest level in the universities that host these parks. This needs a concerted policy approach from education, science and innovation policy.

Recommendations

- Consider consolidating the HE institutional landscape, including through possible mergers, so that advantages of scale and scope can be achieved. Currently, there are (too) many universities of sub-critical size, which prevents them from becoming visible and strong actors in international research and innovation networks. The current situation also stands in the way of building advanced research management capacity in the institutions, which is a requirement for the structural shift towards a modernised HEI landscape intended by the Law of Higher Education and Research.
- More generally, foster the research management capabilities of research institutions and of research units to prepare them for international co-operation (e.g. participation in Horizon 2020) and collaboration with the business sector.
- Provide incentives for HEIs to collaborate more closely in both education and research.
- Turn the international research assessment of Lithuanian research units into a systematic, built-in feature of the research system and apply a broad set of performance indicators which span research excellence as well as relevance and impact, including the contribution towards industry-academia partnerships and collaborations.

- Provide stronger incentives for research organisations to develop more systematic and professional technology transfer structures and activities. Require universities and other research organisations to develop technology transfer strategies and action plans with sufficiently ambitious objectives and indicators focusing on relevance and impact. Allocate part of basic funding, or part of funding from selected schemes (including infrastructure funding), based on the quality of technology transfer strategies and action plans, and later based on achieved results.
- Define the objectives, and ascertain the feasibility and long-term viability, of the portfolio of STP more clearly, in the context of the more professional and business-oriented services that universities need to develop and in line with the thematic specialisation defined in the RIS3.
- Steer the Valleys and open access centres towards better meeting industrial needs.

Supporting international knowledge linkages

While the internationalisation of Lithuania's STI activities has made progress in recent years, it still remains weak in a number of respects. For example, Lithuania produced 304 international scientific co-publications per million population in 2012, compared to a European average of 343. Lithuania's main scientific partners are large European countries such as Germany, France and the United Kingdom, or geographically close Nordic countries such as Sweden, Finland or Denmark. Cross-border co-operative patenting activity of Lithuanian companies is very low.

As expected, participation in European programmes represents much of the international activity of Lithuanian research actors. Most Lithuanian research and HEIs participate in European programmes. According to the final monitoring report for the European Union's Seventh Framework Programme for Research and Technological Development (FP7), the success rate of Lithuanian applicants (20%) was similar to the European average (20.5%). It is encouraging that participation in European programmes is increasing: the number of applications from Lithuanian companies was higher for FP7 than for Framework Programme 6 (FP6) and the success rate of SMEs also increased (18.9% for FP6 against 21.8% for FP7). As a result, the share of funding allocated to Lithuanian SMEs increased from 11.7% in FP6 to 29.7% in FP7.

International knowledge linkages are particularly important for small countries. In order to promote the international engagement of STI actors, the Lithuanian government has put in place initiatives to support scientific exchanges with foreign researchers and PhD students. In addition, HEIs have developed action plans to promote internationalisation, which include participation in international networks (such as the European University Association) and the development of joint study programmes with institutions abroad, as well as mobility programmes.

The internationalisation of the Lithuanian research and innovation system is enhanced by the implementation of the Programme for Brain Regain and Attraction which aims both at encouraging the re-immigration of Lithuanian researchers and attracting researchers from abroad. In addition there is government support for Lithuanian organisations to be represented in European Technology Platforms. These representatives are mostly from the country's technical universities.

There is still much scope and a great need for improvement to strengthen the international linkages of the science and innovation system. Reforming the HE sector is certainly an important element in a long-term strategy. Without a high-quality domestic

research base, support for internationalisation will have little effect. Measures were available in the previous Operational Programme that feature internationalisation. It is important that the measures be evaluated carefully to assess which (combination) of them has worked well, which measures did not have an impact and what gaps might still need to be addressed. Internationalisation should become a key strategic driver for the management of universities and research centres. This implies that measures should not only focus on individual researchers: they should also focus on embedding internationalisation in the research management of institutions.

International reviews of Lithuania's research actors have shown that there are pockets of potential international strength in some domains and institutes. RIS3 could help identify the domains in which international alliances are most likely. The lack of internal co-operation measures on the side of the business sector merits particular attention.

Recommendations

- Further promote participation in European and other international STI programmes by allocating more resources, targeting both public sector research institutions and firms.
- Consider developing an overarching national internationalisation strategy involving all relevant ministries and stakeholders to promote alignment of the internationalisation strategies of individual STI actors.
- Support opportunities and introduce incentives for international collaboration and engagement in selected R&D and innovation support schemes, in particular aimed at R&D and innovation performers in the business sector.
- Continue the support measures for internationalisation of the public research system. Draw lessons from the previous EU Structural Funds programming period from evaluations of past internationalisation support measures. Based on these lessons, decide what type of measures should be continued, which measures did not have an impact and what gaps still need to be addressed.
- Support institutional capacity building at universities and research centres to enhance internationalisation as a core element of institutions' strategies. RIS3 can help decide which domains offer the best opportunities for linkages with international R&D and business communities.



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