

OECD Review of Innovation Policy: Slovenia

Overall assessment and recommendations

Over the past two decades, Slovenia has made very substantial achievements and had notable success in economic and social development, underpinned by a transformation to a market-based economy and economic integration into European markets. This success opened the way for Slovenia's accession to an enlarging European Union, membership in the European Monetary Union, and adherence to the Schengen agreement which greatly facilitates cross-border movement in much of the European continent. In a number of respects Slovenia has been leading among new EU Member States. The country's efforts were once more recognised when in the summer of 2010 Slovenia also became a member of the OECD. While becoming closely integrated into the European and global economy, Slovenia has kept a strong sense of national identity placing high value on its language and culture. Already before 1991, Slovenia had been at the economic forefront within former Yugoslavia. In the two decades that followed, bold decisions, sound economic policy and hard work yielded success and resulted in stability as well as a strong position of this small country of two million inhabitants in Central Europe.

Yet, it has become clear in the recent financial and economic crisis and its aftermath that continued efforts are required to strengthen the international competitiveness of Slovenian firms and to realise high and sustainable economic growth of the economy. It is widely recognised today – and this was highlighted by the OECD Innovation Strategy – that innovation policy can contribute significantly to achieving these goals by harnessing an innovative, knowledge-based economy. In this context, Slovenia has in recent years actively engaged in a process of self-examination, diagnosis and peer review, inviting and supporting various external reviews and assessments which – at least partly – deal with aspects of her innovation policy, seeking to identify and adapt best practice policies, programmes and practices from both its European neighbours and a wider array of global peers.¹

This review is based on the empirically grounded proposition that a country's long-run economic performance depends significantly on the level and quality of its innovation activities, *i.e.* the ability to generate, transfer, and assimilate technological, non-technological, managerial, organisational, and institutional innovations. With full recognition of the current policy initiatives across many EU and non-EU nations directed at what are termed demand-side innovation policies – public measures to increase demand for innovations, to improve conditions for the uptake of innovations or to improve the articulation of demand in order to spur innovations and allow their diffusion² – this review concentrates on supply-side factors. This concentration reflects a considered judgment concerning both sides of the supply-demand interface. First, that the impediments to Slovenia's innovation performance and long-term economic growth exist primarily in structural relationships within and between firms/industries and public sector sources of scientific and technical knowledge. Second, that the growth potential of demand-side innovation policies initiated independently by Slovenia are likely to be

modest, as for all small countries. Third, for specific policies, such as providing technical assistance to small and medium-sized enterprises (SMEs) to accelerate their adoption of new best practice technologies, there is such close equivalence between supply-side and demand-side policies as to make definitional distinctions nugatory.

Achievements and challenges: an increased role for innovation in Slovenia's economic development

Slovenia: a successful transition country...

Slovenia has achieved much over the past two decades. It has managed a successful transition to a market-based economy. This transition differed – in terms both of conditions at the start and the approach taken – from that of other transition economies in central and eastern Europe. All along, Slovenia has remained the most prosperous among this group of economies and leads them in gross domestic product (GDP) per capita.

For more than a decade prior to the recent financial and economic crisis, Slovenia's economic performance was strong. Between 1998 and 2008, GDP per capita grew at an average annual rate of 4.2%, far above the euro area average, and rapidly caught up to OECD and EU GDP per capita averages. In 2007, Slovenia reached 81% of the EU15 average (in current purchasing power parity terms). Gains in labour productivity were the major driver of growth of per capita GDP. The process of catching up was – at least temporarily – interrupted when the Slovenian economy was severely affected by the global financial and economic crisis. GDP contracted by about 8% in 2009, the sharpest decline among present OECD member countries at the time. This led to a partial reversal of previous gains in convergence *vis-à-vis* the EU15. Slovenia is only slowly recovering, and growth projections remain subdued.

The sharp contraction was triggered by a collapse in external demand. However, it was aggravated by structural factors, notably the relatively large share of exports of low value-added goods and services, segments that were hit hard by the crisis. The country's export specialisation increases its exposure to global cyclical downturns and to loss of market shares. Despite Slovenia's dynamic pre-crisis performance, the GDP per capita gap with the advanced OECD economies remains large. It is almost entirely attributable to lagging labour productivity. In 2008, for example, manufacturing productivity was still just around one-third of the euro area average. More cross-border absorption of advanced technological and organisational knowledge can help to close this persistent productivity gap. Fostering the capabilities that facilitate absorption of such knowledge can have high returns.

Looking ahead, the sources of sustained productivity growth can be expected to shift over the longer term. Total factor productivity (TFP), driven by increased domestic innovation, is likely to have to play a relatively more important role as the income gap with the more advanced countries narrows. Beyond the absorption of knowledge generated abroad, this will require raising the levels of "own" innovation activity capacity. As argued in this review, this can be achieved by fostering investment in R&D and innovation while improving the efficiency of the overall innovation system and its constituent parts. Framework conditions – such as well-functioning product and labour markets, low barriers to entrepreneurship, and vigorous competition, including in key services sectors – and increased inward foreign direct investment (FDI) could play an important role. The services sector accounts for an increasingly large share of aggregate

employment, and enhancing its efficiency will be necessary to maintain high productivity growth. This has immediate implications for innovation policy which, as in other countries, is still largely oriented towards manufacturing.

...with a mixed record but high innovation potential

Slovenia's innovation performance is varied. Some innovation input indicators commonly used in international comparisons are broadly on par with or even high relative to Slovenia's GDP per capita. At 1.9% in 2009, Slovenia's R&D intensity (R&D as a percentage of GDP) is higher than that of some OECD countries with similar or even higher levels of GDP per capita (Czech Republic, Greece, Italy, Luxembourg, New Zealand, Norway, Portugal and Spain). No other central or eastern European country's R&D intensity is comparable to Slovenia's. Moreover, its share of business-funded R&D in total R&D expenditure is typical of countries with a more advanced innovation system, and much R&D is performed in the business enterprise sector. Yet, business enterprise expenditure on R&D (BERD) as a percentage of GDP (BERD intensity), while just below the EU average, is far lower than in leading innovators. As in other countries, the bulk of R&D is performed by a small number of firms; in fact, two pharmaceutical firms that produce generic products account for a very large share of Slovenia's BERD.

For innovation outputs, the picture is mixed. Scientific output, measured by the number of scientific articles per million population and international co-authored publications, is high by international standards, although there is some question regarding the connection between these metrics and those related to economic activity. The picture is less positive in other respects. The number of high-technology firms is relatively small and high-technology and service exports are low as a share of total exports. Slovenia lags behind the EU average in patent applications per million population by a large margin, but performs better than almost any other new EU member. The number of triadic patents (per million population) increased between 2001 and 2008 from a low level, in line with increasing R&D inputs.

Overall, in spite of a number of impressive examples and Slovenia's status among (former) transition or new EU member countries, its performance in terms of new firm formation and technology transfer is not very strong. Early entrepreneurial activity cannot be characterised as dynamic, and the same is true of its small and medium-sized enterprises (SMEs) more generally. There are concerns about the economy's capacity to convert research findings into technological innovations. Results from innovation surveys show little change in innovation activity in the manufacturing sector and only a gradual increase in services.

Slovenia's innovation system suffers from certain weaknesses and from some unfavourable legal and financial framework conditions. For example, academic faculty receiving national research funds have little incentive to consider the potential relevance of their work to business sector users, and many SMEs do not actively search for or explore new production processes and business practices. Slow progress in overall innovativeness threatens firms' competitiveness, especially in internationally contested markets. A lack of financial resources is the reason most commonly given by companies for not engaging in innovation activity. Another partial explanation for observed weaknesses in innovation output is the relatively small inflow of FDI, in comparison with Slovenia's deep integration into international goods markets and with the FDI to other

central and eastern European countries. Slovenia’s potential for receiving best-practice technology through inward FDI is not fully realised.

Slovenia seeks to build an effective innovation system and has adopted many best practices from other countries. Recognition of the need to address its shortcomings permeates major new national policy documents, especially the two “Audacious Slovenia” strategy documents for the coming decade: the Research and Innovation Strategy of Slovenia 2011-2020 (RISS) and the National Higher Education Programme 2011-2020 (NHEP). The proposals contained in these plans – e.g. to build on complementary initiatives by universities and public research organisations (PROs) to expand, rationalise and professionalise their technology transfer capabilities, especially in terms of patents, licences, and start-ups – are intended to spur and redirect their activities.

Main strengths and weaknesses of the Slovenian innovation system

Slovenia’s history, geographical location, and cultural and institutional characteristics have to be taken into account in an assessment of the current state of the innovation system and the shaping of the policy responses to new challenges and opportunities. The country – which looks back at a rich and at times dramatic history – emerged as an independent nation at the end of the 20th century. It has managed a successful transition to a market economy and succeeded in developing modern democratic institutions. As a small open economy with a population of about 2 million in the European Union and the European Monetary Union, Slovenia needs to find ways to stay competitive and take advantage of new developments in European and global markets.

The following looks at the Slovenian innovation system in terms of a brief SWOT analysis. Overall, Slovenia has good potential for future development based on its population’s creativity and innovation. Realising this potential by seizing opportunities and responding to emerging threats requires continuous adaptation, however. Like other innovation systems, Slovenia’s is shaped by history and its features reflect the characteristics of the economy and society at large.

Main strengths

The main strengths of the Slovenian innovation system include:

- *Successful socioeconomic development.* Slovenia has successfully managed the transition to a market economy and integration into the international economy.
- *Strong record in economic performance.* Growth was higher than the OECD average in the years preceding the crisis. Slovenia leads new EU members in terms of GDP per capita.
- *Leading innovator among central and eastern European countries,* on a range of innovation-related indicators, including aggregate R&D intensity.
- *Increasing expenditure on R&D,* since the start of the transition. Contrary to most central and eastern European economies, R&D expenditure did not collapse in the early 1990s; it remained stable and even grew during the recent crisis.
- *Strong endowment of scientific and creative talent.* Slovenia is comparatively strong in human resources and well known for their creativity in a broad range of areas.

- *Clusters of excellence in academic and industrial research, e.g. pharmaceuticals.*
- *Substantial increase in the number and quality of scientific publications, which shows that efforts to achieve high academic standards are paying off.*
- *Successful participation in European Framework Programmes.* Slovenian researchers have proven their ability to participate in international research networks.
- *A well-developed set of differentiated institutions engaged in science, technology and innovation.*
- *Strong recognition of the role of innovation in upgrading the economy* as evidenced by the recent adoption of the Research and Innovation Strategy of Slovenia 2011-2020 and the National Higher Education Programme 2011-2020, which also indicate the strong focus on innovation in government, industry and academia.

Main weaknesses

The main weaknesses of the Slovenian innovation system include:

- *A persistent productivity gap vis-à-vis European and OECD averages, despite strong productivity growth prior to the crisis.*
- *Uneven innovation performance, e.g. low patenting, high-technology exports.*
- *Entrenched and – in important respects weak – organisation of universities and PROs, with little propensity to undertake the reforms needed to improve performance.*
- *Universities' and PROs' limited strategic capabilities, with insufficient links between the formulation of government strategy and the ability of the main actors to incorporate it into their organisational strategies.*
- *Widely differing views of stakeholders on scientific excellence, relevance of research, including for technological applications, and research priorities (basic science, industrial technology).*
- *Proliferation of innovation policy instruments with potentially overlapping objectives, e.g. funding programmes to spur co-operation, entrepreneurship and transfer.*
- *Uneven internationalisation.* The Slovenian innovation system is highly internationalised in some respects (e.g. participation in European R&D programmes) but much less so in others (e.g. attraction of foreign researchers and students).

Threats and opportunities

Major opportunities for Slovenia's future development include:

- *Increased contribution of a strong core of academic research to social and economic development, including productivity growth.*
- *Apparently good conditions for boosting innovation and moving up the value chain.*
- *The country's compactness an advantage in terms of focus, speed of implementation, organisational efficiency and ability to adopt niche strategies and adapt quickly in response to emerging market opportunities.*

- *Integration in the European and larger world economy potentially offsetting disadvantages of small size.*
- *Opportunities to develop into an innovation hub and/or node in the (expanding) European Union, in the central European and Balkan regions.*
- *Potential to plug into existing and emerging nodes/hubs of innovation in Europe, America and Asia.*

Major threats for the future development of Slovenia include:

- *Failure to boost productivity, leading to a loss of competitiveness.*
- *Failure to upgrade industry in a rapidly changing global economic environment.*
- *Failure to develop industries that provide solutions/products of higher value added.*
- *Insufficiently integrated platforms to promote technology transfer and links between industry and research and reduced returns on investment in R&D.*
- *Strongly differing perceptions among stakeholders as regards the main problems of the Slovenian innovation system hinder the implementation of needed reforms.*
- *An overly broad range of research areas resulting in lack of depth and competitive edge in the global environment.*

Scope for improving innovation policy

Over the past two decades, Slovenia has done much to adopt and develop a state-of-the-art innovation policy. Yet, as in other countries, there is scope for improvement, and remaining shortcomings need to be addressed in order to increase the contribution of innovation to the country's socioeconomic development. In the past, Slovenia produced several ambitious planning documents relating to science, technology and innovation (STI) (e.g. the National Research and Development Plan 2005-2010) which were not fully implemented. Partly this can be attributed to a lack of long-term policy approaches; rigid and sometimes outdated forms of organisation in public research and higher education may have played a role as well. Moreover the strong interest and commitment of successive Slovenian governments to science and innovation has sometimes led incoming governments to take further initiatives, mainly in a small number of policy areas viewed as particularly important. These include entrepreneurship, consulting services for innovative enterprises and technology transfer. This resulted, on the one hand, in some discontinuities and overlaps, and, on the other, in some "blind spots". The latter are areas in which the pace of reform has been rather slow. University reform is an important example.

Strategic tasks and guiding principles

The overriding tasks of Slovenia's innovation policy are to strengthen innovation as a driver of sustainable growth, to continue the process of convergence with the most advanced EU and OECD economies and to increase the population's living standards. Increased innovation capabilities will help raise the productivity – and thus the competitiveness – of Slovenian manufacturing and services firms. It would also help restructure the Slovenian economy towards more knowledge-based activities and move up the value chain. Specifically, this would involve:

- *Boosting productivity throughout the Slovenian economy* by nurturing and fostering a broad range of innovative activities, through R&D-based innovation but also through innovations in organisation, marketing, business models, etc.
- *Increasing the economic and social benefit of R&D through a reform of the universities and public research organisations.*
- *Streamlining public policy and funding approaches.* This includes increasing the efficiency of innovation policy by streamlining public support for and funding of science, technology and innovation and fostering critical mass.

Hence, Slovenia's innovation policy needs to address challenges related to productivity performance, rationalising public support and funding, reforming universities and PROs and to prioritise and integrate actions that address near-term needs and those that relate to longer-term structural and institutional change.

Boosting productivity through technological and non-technological innovation

A major challenge for Slovenia is to boost productivity throughout the economy. Lagging productivity accounts for most of the gap between Slovenia's GDP per capita and that of the leading European and OECD countries. Successful innovation will be increasingly important in reducing the gap, as innovation is an important source of sustainable growth in productivity, income and increasing social welfare.

The review emphasises the two-pronged challenge that Slovenia confronts in simultaneously addressing the need to raise productivity and competitiveness in the shorter term while initiating and implementing the longer-term structural and institutional changes needed to create a high performing innovation system and a framework facilitating and fostering shifting resources towards the production of knowledge-intensive, higher value added goods and services, that allows for sustained productivity growth, rising income and social wellbeing for the Slovenian population. Hence a forward-looking innovation policy for Slovenia will have to combine:

- *Near-term improvements through innovation based on existing technologies of domestic and foreign origin.* These can give rise to productivity gains. Improved productivity can be achieved by applying existing knowledge to existing practices, moving sequentially from marginally profitable practice to industry average practice to world best practice. Improvements of these types generally require managerial awareness and commitment to improve performance, recruitment, training and retraining of a skilled labour force, and access to trusted sources of technical and managerial knowledge.
- *Long-term improvements in the capability of Slovenia's innovation system to generate and apply new knowledge.* Technological innovation, the generation of new products and processes that flow from the application of new scientific and technological knowledge, is a major source of sustained productivity improvement. Some improvements can also be realised in the short or medium term (e.g. through better co-operation between industry and academia). Other improvements are of a more fundamental character, requiring more profound changes in the way institutions work and interact, and require a long-term perspective.

In view of the need to raise productivity in different sectors and types of firms, a broader concept of innovation may be needed (on this, see OECD, 2010a).³ A strong emphasis on the diffusion of non-technological innovations should complement

Slovenia's effort to build a high-performing science system and improve the research system's links to industry. The reform of universities and PROs is necessary to increase the contribution of innovation to economic performance.

Thorough reform of universities and public research organisations

The evolution of Slovenia's public research sector – universities and PROs – has led to some impressive results in terms of scientific output but also created some obstacles to further improvements in performance and in Slovenia's socioeconomic development (Box 0.1). The challenge is to reform the universities and PROs, the major recipients of national R&D funding, in ways that will overcome these obstacles. The Slovenian authorities clearly understand the need for this reform, as shown by the recently formulated and adopted proposals for restructuring higher education (NPHE) and research and innovation (RISS). These documents are bold and ambitious but call for an additional step: increased institutional autonomy. Such autonomy requires a strong and clear governance model and the Ministry for Higher Education, Science and Technology's (MHEST) active support of the process of change. Universities will require strong leadership and the possibility to build critical mass, with active international recruiting and modern career models. Science funding should support change through appropriate incentives. For PROs, a similar agenda is needed following discussions of the main strategic objectives of each major institute.

Box 0.1. The evolution of the public research sector: achievements and downsides

The performance of the public research sector is encouraging...

The public research sector – which consists of four universities and a larger number of PROs – has been shaped by different factors. By European standards, the Slovenian landscape of higher education institutions (HEIs) and PROs is very young, the oldest being the large University of Ljubljana, founded in 1919. Many institutions were founded in the decades after 1945. This is especially the case for the PROs which – untypically for this world region – were not created under the umbrella of a powerful National Academy of Sciences. Some of the PROs have specific trajectories as distinct, often mono-disciplinary research institutes. The whole “sector” largely appears to be the result of individual political decisions prior to 1991. Given their relatively young age and at times relatively scarce resources, the overall performance of public research – both at PROs and universities – is impressive. Several pockets of international excellence have emerged and continue to grow. Supported by public funding incentives, academic output and scientific impact increased considerably, notably over the last ten years.

...yet hindered by weak organisation and some unduly narrow missions and perceptions

The downside of this development path is that it seems to have contributed to the emergence of a self-referential, enclave-like set of objectives and performance indicators. The overriding goal of academic research is to enhance the international reputation of universities and their faculty with little regard for how, if at all, their research output contributes to other (national) objectives. In particular, the predominant, almost exclusive reliance on bibliometric methods, such as publications and citations, as a measure of academic research performance provides disincentives for university faculty (and also for researchers at PROs) to consider work of relevance to or in collaboration with industry and other non-academic stakeholders in the innovation system. Moreover, the positive achievements in quantitative and qualitative terms typically seem to have developed in small “silos” and to remain encapsulated within individual groups and units. This observation seems trivial at first as scientific excellence is always embedded in individuals and groups. A closer examination suggests however a link between the incentives provided by the research groups' funding programmes on the one hand and the organisational shortcomings at universities and PROs on the other. A high degree of compartmentalisation, internal recruitment practices, over-reliance on bottom-up mechanisms and lack of institutional leadership all seem to be cemented by a funding model that bypasses the organisation's leadership.

Streamlining public policy and funding approaches

Slovenia needs to streamline public support for and funding of private and public research (Box 0.2). The challenge is to rationalise the arrangements and to set strategic and funding priorities. Missing at present is an overall strategic approach that would link instruments to public-sector funding. This would reduce the need for interagency, inter-ministerial co-ordination, and help overcome the small-scale, fragmented, compartmentalised organisation of Slovenia's R&D and innovation programmes referred to in some assessments. An interesting set of initiatives has come with the EU structural funds: competence centres and centres of excellence allow for considerable hardware investments and the build-up of critical mass from existing research strengths. Slovenia should avoid one-off approaches with these instruments and build on them in the years to come.

Box 0.2. Public support for and funding of private and public research

The public support system is characterised by a large variety of actors and programmes...

The strategic governance of science, technology and innovation policy is in the hands of the Ministry of Higher Education, Science and Technology (MHEST) and the Ministry of Economy (ME), complemented by two councils with advisory and planning functions. A complex planning and budgeting structure has considerable influence on this governance structure.

Slovenia provides public support for research and innovation through a diverse set of instruments and agencies. Science funding is in the hands of the Slovenian Research Agency (SRA). It combines a variety of competitive funding schemes typical of a research funding council with a large element of general university fund (GUF) style allocation, carried out in a specific, formally competitive way. These “research group” grants are also an important element of the financing of the country's strong PRO sector. As regards funding for applied research and innovation, the main actors are the Slovenian Technology Agency (TIA), the Agency for Entrepreneurship and Foreign Investments (JAPTI), the Slovene Enterprise Fund (SEF), and increasingly also the Slovene Export Bank (SID). Taken together, these five intermediate actors provide an impressive and occasionally overlapping roster of programmes and support mechanisms for firms and networks. At the level of regional innovation policy there are few policy actors, owing to the centralised structure and the size of the country. The European level plays a very strong role in funding, both through the Framework Programmes for R&D and the structural funds for economic, regional and social development.

...while funding tends to cluster around attractive activities and shows some unintended effects

In the area of technology funding, Slovenia has a multitude of programmes and initiatives to fund co-operative projects and platforms of all kinds, sizes and vintages and to provide consultancy and advisory services to support entrepreneurship, start-ups and early growth. Some problems are reported to have arisen owing to the sheer number of activities and the discontinuities in some forms of support. The number of one-stop shops in the Slovenian innovation system suggests that some streamlining might be beneficial. It would be worthwhile analysing whether agencies and intermediaries tend to flock to the most attractive and visible activities (incubators, etc.). Issues such as fostering firm productivity might deserve more attention. In the area of science funding a strict, formalised selection system and (block grant style) funds for individual research groups has led to quality improvements but seems to reinforce tendencies towards compartmentalisation, continuation of past activities, and a strong, sometimes exclusive focus on scientific research in the public research system.

Some guiding principles

In formulating and implementing policies to carry out the strategic tasks described above, the Slovenian government should apply the following guiding principles:⁴

- *Take a comprehensive approach to fostering innovation throughout the economy.* In view of the need to boost productivity, this should encompass R&D but also non-R&D-based innovation activities, and technological and non-technological innovation. Slovenian innovation policy should avoid an exclusive or too narrow focus on “high technology”. Non-technological or “soft” innovation – notably in the SME sector, which needs to build innovation capabilities but faces certain barriers – offers considerable opportunities for boosting productivity and income growth.
- *Enhance international openness.* International knowledge flows are critical for the development of national innovation systems, especially in a small, open economy, as much of the knowledge needed to sustain innovation-driven growth will have to be absorbed from abroad. Circulation of foreign and national researchers in and out of the country, R&D-related investment by international firms and research performed domestically by organisations of foreign origin are all important in this respect. These channels need to be complemented by access to knowledge through markets for technology, active participation in international innovation networks and research co-operation as well as outward investment in R&D. This requires, in general, the adoption of a genuinely open approach towards internationalisation, including in the academic area.
- *Ensure effective governance.* The government’s commitment should be reflected in adequate budgetary appropriations in support of STI activities and effective governance of STI policy, including the steering and funding of STI policy, and co-ordination across ministries of the wider set of policies affecting innovation performance. The quality of governance in the major pillars of the innovation system, including universities and PROs, is critical. For Slovenia the main tasks ahead are to bring order to the large variety of funding initiatives and to start a full-scale reform of universities and PROs. Good governance also needs appropriate human resources and competences; scarce capacity in Slovenian STI policy making has complicated the task of developing profoundly new approaches, building consensus among stakeholders, and implementing them in the innovation system.
- *Assure quality, relevance and critical mass in public research.* This requires rigorous selection among the research projects and teams applying for support, active involvement of research end users in defining research priorities, and some concentration of resources in selected areas. Competence centres and centres of excellence can play an important role in the longer term. University and PRO reform should provide incentives for strong growth of excellent groups and fields and foster the effective implementation of quality-enhancing measures.
- *Maintain participatory approaches.* Innovation policy should be responsive to the evolving needs of stakeholders in the innovation system. Building a vision that is shared by all major private and public actors is a prerequisite for the successful formulation and implementation of a national STI strategy. This is especially important for innovation systems in which the actors’ interests, incentives or perceptions differ widely. The RISS and NPHE process is an important step in this direction and the issues it raises should be regularly subject to broader stakeholder and public discussion.

- *Emphasise evaluation.* Regular external evaluation – preferably with international participation – of publicly funded support programmes and institutions should become the norm, with practical consequences for further rounds of support. To be useful in decisions that involve the steering of the innovation system, evaluations need to go beyond reporting. More sophisticated, state-of-the-art methodologies and tools are needed for a thorough impact assessment. Evaluation needs to be firmly embedded in the policy cycle so that evaluation results feed back into subsequent policy design. The introduction of performance-based budgeting procedures could bring new momentum to this area.
- *Integrate short- and longer-term measures and persist in the reform effort.* Given the rapidly changing global environment, it seems necessary to act at two levels: taking measures to design, implement and improve shorter-term innovation policies to bolster productivity performance and competitiveness, while moving assertively towards initiating the needed longer-term structural and institutional reforms. These longer-term issues concern changing industrial, university and public research sector organisations to increase returns on investment in research and education by both the private and public sectors through more robust linking of the generation and application of new scientific and technological knowledge. This goes well beyond the “bridging” funding programmes that seem to be well in place. As manifested in the ten-year horizon of the RISS and NPHE strategies, expectations about the time required to realise the desired gains from implementing reforms should be realistic.
- *Build trust.* Building trustful relations across sectors and institutions makes it easier to adapt to changing environments but is a formidable long-term challenge. In Slovenia, existing arrangements seem to be deeply entrenched and strongly defended. Widely differing perspectives, *e.g.* of representatives of the business and academic communities with respect to the need for and desirability of reorienting national support for academic research towards economic or other societal objectives, and a polarised public discourse on these topics can hinder the identification of mutually beneficial, “positive-sum” policy scenarios. Implementing the changes needed to address the above-mentioned challenges requires a combination of cultural, legal, and financial policy and programme innovations, involving adjustments in the relative roles of the constituent sectors of the innovation system, and – most importantly – in their relationships to one another and to society at large. Even under the most favourable conditions it will take time to change perceptions and habits, build trust and learn from success and failure.

This review highlights both the near-term and longer term challenges that Slovenia must confront. Moving up the value chain towards more knowledge-intensive economic activity by fostering business-sector investment in R&D and innovation and improving the allocation and management of public investment in this area will improve Slovenia’s international standing, including *vis-à-vis* larger and technologically more advanced EU members. It will also improve Slovenia’s in many respects already strong position among new EU members and trade partners in the Balkans. Geographic proximity, shared history and economic specialisation create opportunities to develop new markets for Slovenian goods and services, provided that they embody state-of-the-art technical, design and marketing attributes and are produced in an efficient way. Slovenia should also pay due attention to emerging markets in Asia and elsewhere.

Recommendations

In light of these strategic tasks and guiding principles, and taking due account of Slovenia's innovation-related strengths, weaknesses, opportunities and threats, a number of policy recommendations can be made.

Improving framework conditions for innovation

Appropriate framework conditions are an essential aspect of a country's overall innovation performance. Framework conditions that affect innovation include macroeconomic stability, many aspects of the regulatory regime and the tax system, intellectual property rights, competition, and openness to international trade and foreign direct investment. As part of an ongoing effort to pay due attention to their impact on innovation, the government should continuously screen these framework conditions with the following main objectives:

- *Restore and maintain sound macroeconomic conditions*, including the sustainability of public finances, one of the most important prerequisites for dynamic private and public investment in innovation.
- *Foster vigorous competition and adapt regulatory regimes so as to make them conducive to innovation.*
- *Continue efforts to reduce the administrative burden on businesses, including start-ups.*
- *Address aspects of financial system and related regulation that could constrain financing of innovative projects in the business sector.*
- *Identify and address other aspects of framework conditions that reduce the incentives or capabilities of SMEs to enter or step up innovation activities.*
- *Examine and address aspects of the business environment which could hold back foreign direct investment in general, specifically with a view to FDI for R&D and other activities of high innovation content.*

Strengthening the human resource base for science, technology and innovation

Slovenia's education system, notably primary and secondary education, can be considered a solid pillar of the Slovenian innovation system. In the tertiary sector, the diagnosis is somewhat mixed. Tertiary education is beset with various problems including the time students take to complete their studies. The share of tertiary graduates is growing but fails to keep up with the OECD average. The number of science and engineering students and graduates should not lead to complacency in view of demographic trends and changing attitudes. In addition, industrial researchers' qualifications need to be upgraded as the technological sophistication of Slovenian firms increases. Local talent can be nurtured through ambitious skills policies targeting the workforce, including life-long learning. By lifting existing obstacles and distorted incentives, graduation rates could rise and the duration of students' studies could lessen. NPHE as well as RISS foresee a number of reforms that are strongly endorsed by this review. The human resource pool also needs to be strengthened through active internationalisation. Permeability between industry and the public research sector needs to be enhanced. The government should:

- *Take measures to increase the number of researchers and other contributors to innovative activity in industry* in different types of firms and with different levels of formal degrees. This includes the continuation of programmes to fund the transfer of young researchers to firms which generally seems to work well. Further consider providing incentives for personnel to transfer from research organisations to industry and improving support for the hiring of greater numbers of holders of higher academic degrees by industry.
- *Provide for continuous lifelong learning initiatives for the workforce.*
- *Take appropriate measures, including the adaptation of career models in universities and PROs or the introduction of incentives for changing sectors* without losses in remuneration, entitlements or career status. Facilitate more mobility of key personnel between universities, PROs and industry.
- *Maintain Slovenia’s ambitions regarding dual education and the establishment of polytechnics/technical colleges.* Review, in this context, other countries’ experience with establishing universities of applied sciences or polytechnics and the role of local industry in developing specific curricula and assessing future demand for graduates.
- *Reduce explicit and implicit barriers to working in Slovenia for highly qualified people from all over the world.* This is a major task (see also the recommendations regarding internationalisation).

Improving the governance of the innovation system

The governance of the Slovenian innovation system has been shaped by its gradual, step-wise evolution and the adoption of good practices from abroad. Overall, the result can be described as a modern, middle-of-the-road governance structure with performance-based budgeting processes, long-term planning, a science and innovation advisory council with two main ministries in charge, a number of agencies with differing degrees of independence, a funding system with more than 20 individual programmes and a variety of feedback and communication loops.

As in many countries, there is scope for improving the individual elements of the governance system. Performance-based budgeting needs fine tuning and long-term planning should encourage continuity of action. The advisory council needs to improve its record, and the ministries face problems of policy execution owing to understaffing. The “business models” of the main funding agencies and the relations between some agencies and “their” ministries need a close review. Funding programmes have some overlapping portfolios and seem to duplicate efforts of other intermediaries funded by the same agencies. A more mature evaluation culture could contribute to better feedback and communication loops. Improving governance would entail addressing a number of issues.

Overall governance

In general, more needs to be done to achieve arrangements that meet the country’s current and future needs and deliver policy efficiently. Increased efficiency is particularly important in an environment of fiscal consolidation. Moreover, it would enhance the Slovenian population’s acceptance of public expenditure on STI. The government should:

- *Give a clear role to the new high-level advisory council on research and innovation.*
- *Continue making the two main strategy drafts – RISS and NPHE – part of a process of social change, engaging political, academic and business communities as well as the broader public, in view of the strikingly different perceptions in these communities of the properties and needs of the Slovenian innovation system.*
- *Ensure better alignment of SRA's strategy and instruments to change processes in universities and PROs (as stated in the RISS and NPHE documents). The difficult task for SRA will be to contribute to organisational change in universities and PROs without compromising quality.*
- *Streamline the roster and overlapping agendas of agencies engaged in innovation support while ensuring that the tasks ahead will have appropriate organisational capabilities and sufficient numbers of dedicated staff to avoid delays in delivery. This streamlining should encompass operative intermediaries other than funding agencies, notably in the broad area of technology transfer, entrepreneurship and innovation-oriented consulting. Mergers of agencies may be a solution, yet the less visible, but potentially more important, issue of streamlining programmes and reducing overlaps should not be forgotten.*
- *Consider providing MHEST with additional staff in light of the tasks ahead, even at a time of fiscal consolidation.*

Policy mix and specific policy instruments

The Slovenian innovation policy mix show some signs of “overpopulation” and in some cases sends conflicting signals. A number of duplications seem to exist in the support for technology transfer, entrepreneurship, science-industry co-operation and R&D funding. Moreover, some programmes and agencies seem to fund activities both directly and indirectly by subsidising both end users and technology transfer or entrepreneurship intermediary organisations (which provide similar support) at the same time. Further, the science system receives conflicting signals when RISS and NPHE aim at increasing university and PRO autonomy but SRA provides core funding of research groups directly to individual investigators, thus bypassing the organisation. Remedies should not be impossible to find and merger discussions in the area of applied funding agencies are one encouraging sign. To this end, the government should:

- *Consider streamlining the current large array of technology funding programmes. This includes technology transfer, entrepreneurship or co-operation incentives. Fewer larger programmes are generally more effective.*
- *Undertake a critical review of the current principal-agent relations between MHEST, SRA and funding recipients, especially the dominant role of bibliometric indicators for research (group) funding.*
- *Develop and improve demand-side measures, such as innovation-oriented public procurement and integrate them in the Slovenian research and innovation policy portfolio. Not all valid policy goals need to be translated into funding programmes that offer subsidies.*
- *Continue to foster the use of non-grant financial instruments such as equity, mezzanine capital, guarantees or loans. The portfolios of SEF and SID appear as a valuable element of Slovenia's innovation policy.*

Governance of universities and public research organisations

The public research sector – universities and PROs – has not undergone the profound changes that have taken place in other sectors during last two decades. As a consequence, Slovenia enters the increasingly vigorous international competition for talent and scientific and innovation-related results with an outdated (and hence costly) public research organisational model. This review highlights the urgency of comprehensive reform. It is commendable that the two “Audacious Slovenia” strategy documents, RISS and NPHE, foresee the adoption of a number of overdue measures. This review suggests that the reforms should aim at higher international competitiveness, improved leadership, clearer roles and organisational safeguards to complement efforts towards greater autonomy. International competitiveness translates into more attractive positions, international recruitment and the creation of critical mass. Stronger leadership implies empowering rectors, directors, dedicated committees and leaders at all levels with respect to organisational and budgetary matters, while at the same time increasing accountability. Clearer roles and organisational safeguards make autonomy work: MHEST needs a strong and clear governance model and should actively support the process of change. For PROs this means a thorough revision of current approaches to scientific research, user needs and (lack of) critical mass: if a fair process of consultation does not lead to a main strategic objective, other solutions, including potential merger into a university, should be considered. To this end, the government should:

- *Start a full-scale university reform as soon as possible, as well as a reform of PRO governance.* Base this reform process on the NHEP and the RISS as it must include many aspects of the two strategy documents.
- *Make autonomy – firmly tied to accountability and performance – the key precept underlying reforms.* A structured legal and organisational framework needs to be put in place in advance. Build interim evaluation and reporting systems into the transition to autonomy in order to ensure that the reforms produce the intended results. Remain on track while crossing this rocky terrain – a considerable period of time will be needed for all the reforms to take hold.
- *Apply the following additional principles and elements: strong central leadership, international openness, incentives to build on strength and start new fields, incentives for co-operation within and beyond academic spheres, and a modern career track that fosters mobility.*
- *Proceed with the planned restructuring of the financial streams described in the NHEP, taking due account of the complexity of the legal and cultural determinants of the current situation.*
- *Alleviate or remove labour legislation and policies that impede mobility between and among universities, PROs and industry.* This includes remuneration systems that separate compensation for teaching and research.
- *Review social welfare legislation that encourages students to remain students as long as possible, and provide them with incentives to stay on track in their course of studies.*
- *Allow SRA to build on its successful quality-enhancing policy while making it a stronger actor in the forthcoming process of changing the universities.* Incentives provided with project and programme funding need to be aligned with the goals and processes of university reform.

- *Remove barriers and develop an active policy to attract researchers from abroad to universities and PROs.* Whether these are returning expatriates or researchers without a Slovenian background, whether doctoral students or end-of-career professors, all should be welcome in principle.
- *Provide attractive career opportunities for young researchers and researchers from abroad, consider lifting effective restrictions on teaching courses in a foreign language.* In this context examine the experience of countries and regions offering endowed professorship programmes for researchers from abroad.
- *Re-examine and, if required, revisit rationales underlying the options for the individual and collective future of PROs,* notably the proposed functionally differentiated path of scientific institutes and technology institutes.
- *At the same time foster stronger linkages between universities and PROs,* including careers, joint work programmes and investments.

Evaluation

Evaluation allows for better policy formulation and helps to increase accountability. Like many OECD countries, Slovenia should strive for a better, more thorough evaluation culture. The government should:

- *Pay considerably more attention to evaluation,* notably programme and institutional evaluation.
- *Render the evaluation of (larger) programmes, initiatives and organisations mandatory soon* in order to provide feedback and external advice for policy.
- *Draw on international know-how and include evaluators from abroad as this is indispensable for a small country.* To facilitate this, documentation and monitoring of programmes and organisations should be made available in at least one widely accessible international language.

Fostering innovation in the business sector

Before the recent financial and economic crisis, the Slovenian economy recorded steady growth, with many firms specialising as suppliers in international value chains. However, only some Slovenian firms succeeded in becoming truly innovative and raising productivity to the euro zone average. The crisis showed the economy's vulnerability. It became clear that Slovenia needed to raise industrial competitiveness, including by strengthening entrepreneurial and innovative capacities. Considerable energy should go into upgrading firms and sectors with lagging productivity levels through hands-on, pragmatic programmes. At the same time the further development of the best-performing sectors and companies needs to be fostered.

Unleashing innovation in the business sector has a near-term and a long-term component. In the near term improvements can be obtained through innovation based on existing technologies of both domestic and foreign origin. Productivity improvements can be achieved by applying existing knowledge and existing practices, moving sequentially from marginally profitable to industry average practice and to world best practice. Equally, or even more important is the introduction of long-term improvements in the capability of Slovenia's innovation system to generate and apply new knowledge. When choosing both short-term and long-term approaches, international examples of successful smaller countries should be studied and adapted. This includes manufacturing extension

programmes, the broad insertion of quality policies, lifelong learning policies and a stronger focus on non-technological improvements to foster productivity growth.

Further progress can be achieved by continually increasing the sophistication of Slovenian firms, through improved productivity and the identification and nurturing of market niches. Other small countries have successfully employed this approach and achieved high levels of productivity in export-oriented, innovation-based competitiveness. The government should:

- *Maintain efforts to increase the level of R&D and, more broadly, innovation activities in business enterprises.* In addition to improving framework conditions this requires continued public support for enterprises' R&D and innovation to correct market failures that lead to underinvestment in R&D by the private sector. Both young and established firms should be kept in the policy focus, with the portfolio selectively enriched with selected demand-side instruments such as innovation-driven procurement, for example in interesting “green” niches.
- *Pay increased attention to the existing stock of firms, notably SMEs in manufacturing and services, as a way to close Slovenia's productivity gap vis-à-vis the more advanced EU and OECD countries.*
- *Develop specific (low-key) policy measures to foster productivity growth, including through non-technological innovation.* These measures should be designed to yield productivity gains in the short term through continuous introduction and improvement of production technologies, quality improvements, and the related development of skills, including through lifelong learning.
- *Consider measures to strengthen the capacities of intermediary institutions, universities and PROs to design, assemble and deliver productivity-enhancing services and raise awareness.*
- *Encourage the development of social entrepreneurship and social innovation.*

Strengthening the links in the innovation system

Strong links are critical for the performance of innovation systems. The Slovenian government has recognised the need for such links for innovation, notably between industry and universities/PROs. In the last 15 years it has introduced a significant number of policy initiatives to better align innovation actors. It has introduced various schemes for science-industry collaboration, technology transfer and related initiatives regarding entrepreneurship and inter-firm co-operation. Slovenia has also experimented with cluster-oriented policies. Currently, a new layer of programmes is being added. The competence centres and centres of excellence are not only instruments to strengthen links between innovation actors but also an important catalyst for changing the governance of the innovation system.

The government should continue its efforts along these lines while drawing lessons from experience to improve some of the instruments for promoting collaborative innovation. Some effort is required to steer and rationalise this effort. Specifically, the government should:

- *Be attentive to the number of programmes, their evaluation, the decommissioning of less successful initiatives and the critical size of individual interventions.* In addition to avoiding too many small-scale interventions, Slovenia should take care to handle the overall funding portfolio pragmatically.

- *Reduce the number of (semi-)public actors in this field significantly and, at the same time, strengthen actors that are performing well.*
- *Establish better systems for measuring performance of both intermediaries and funding schemes.*
- *Increase the level of co-ordination among various actors and instruments by encouraging greater collaboration and leveraging through formal alliances and networks.*

Fostering critical mass, excellence and relevance in public research

Currently, universities and PROs have an abundance of small groups and cover a multitude of fields. High and growing research productivity, supported by quality-inspired funding instruments, goes hand in hand with the rather mediocre international impact of scientific results. This is an additional argument for a timely reform of the public research sector, including by strengthening these organisations and reviewing incentives provided by organisational set-ups and funding instruments. Competence centres, centres of excellence and development centres – drawing on EU structural funds – are a major step away from small-scale programmes and projects and towards linking infrastructure investment more closely to projects and programmes. The centre programmes can help build critical mass and contribute to both excellence and the industrial/societal relevance of Slovenian research. Slovenia should aim at achieving critical mass in at least some areas. This does not necessarily require top-down priority setting, though a continuation of foresight procedures is recommended.

The government should, apart from all the measures recommended in the sections on public research reform and governance, take the following measures:

- *Use the EU structural funds, notably the competence centres (CC), the centres of excellence (CoE) and the development centres to induce long-term change.* In this area, the pooling of infrastructures, larger investments and critical size are important. Building on current experience, ensure that these centres are also a priority for 2014-2020. The centres of excellence, in particular, should receive considerably more funding in the next period (maybe at the expense of smaller programmes that duplicate national funding) as they can form the core of Slovenia's future research excellence.
- *Learn step by step how to improve prioritisation processes and to shift resources towards selected areas of strength. Areas such as those selected to become CCs and CoE, should contribute to more strategic performance at European and broader international levels.*
- *Avoid over-management and excessive bureaucratisation as the structural funds rules and practices tend to impose a high administrative burden on funding programmes and organisations.*

Maximising the benefits from the internationalisation of R&D and innovation

Integration in international research combined with high absorptive capacity is critical for a small country's success in innovation. Slovenia's level of development, geographical location, European integration and other factors provide a sound basis for internationalisation. Slovenia is an open economy and is integrated in international value chains and trade flows (as evidenced by its high trade-to-GDP ratio). In contrast, (inward

and outward) foreign direct investment has expanded less rapidly than for other central and eastern European countries. This reduces opportunities for learning and ‘for acquiring technological and organisational knowledge and hence limits the potential for R&D spillovers.

Slovenia’s research is, in various respects, well embedded in the international research effort. Its participation in European Framework Programmes, for instance, is strong. Slovenia actively pursues international co-operation in science and technology, but the internationalisation of the Slovenian innovation system is weak in other respects. The number of foreign researchers in universities and PROs is small and the same is true of students from abroad. Therefore, the talent pool is very limited. Slovenia’s lack of attractiveness as an international research location is not necessarily due to its size. In fact there are a number of impediments. These range from the essentially exclusive use of Slovenian as teaching language, to (partly opaque or overly restrictive) selection procedures, unattractive career models and salary regulations, to the question of student fees. The government should:

- *Consider taking a bolder approach to academic openness, beyond linking up domestic academic communities to EU funded projects. In this context opening of academic labour markets and a stronger international profile as an attractive place for higher education are options to consider. A number of countries emerging as players in science, technology and innovation work to rebuild their public research sector by offering the necessary framework conditions and infrastructure and inviting top researchers and students from all over the world.*
- *Encourage business firms, universities and PROs to upgrade their strategic capabilities and become more ambitious in the choice of their participation in international, especially EU programmes. This recommendation is closely related to the success of university and PRO reform. It would imply a shift from small-scale, non-strategic projects towards more complex instruments such as the European Strategy Forum on Research Infrastructures (ESFRI) for infrastructure, joint programming, participation in a second European Institute of Innovation and Technology (EIT) call, the country’s role in the upcoming “Grand Challenges”, etc.*
- *Consider developing an explicit internationalisation strategy for R&D and innovation.*
- *Seize opportunities for science and technology co-operation arising in central Europe and the western Balkans – a region of prospective EU enlargement. In addition, a selective global approach is required to maximise Slovenia’s benefits from the internationalisation of R&D.*
- *Consider “twinning” with other international nodes/hubs of innovation for technology transfer and equity, including venture capital (VC). Consider addressing the shortage of VC and business angels by employing international strategies and tapping capital abroad (including through twin location approaches for start-ups).*
- *Review the overall stance towards internationalisation in view of its potential impact on innovation performance and productivity growth. In this context, review the broader enabling environment for FDI.*

Table 0.1. SWOT (strengths, weaknesses, opportunities, threats) analysis of Slovenia’s innovation system

Strengths	Opportunities
<ul style="list-style-type: none"> • Successful socioeconomic development and good record in economic performance. • Leading new EU member state on many economic and innovation-related indicators. • Strong endowment in scientific talent and culture of research. • Clusters of excellence in academic and industrial research. • Substantial increases in the numbers and quality of scientific publications. • Successful participation in European Framework programmes. • Strong focus on innovation driven by recognised need to upgrade the economy. • Differentiated set of institutions engaged in science, technology and innovation. • Dedication and focus on innovation in government, industry and academic communities. 	<ul style="list-style-type: none"> • In principle good conditions for Slovenia’s economy to boost innovation and move up the value chain. • Integration in the European and larger world economy potentially offsetting disadvantages of small size. • Compact size of country and economy can be an advantage in terms of focus, organisational efficiency and ability to adopt niche strategies and respond quickly to emerging market opportunities. • Increased contribution of strong core of academic research to social and economic development. • Opportunities to develop into an innovation hub and/or node in the (expanding) European Union. • Potential to plug into traditional and emerging nodes/hubs of innovation in Europe, America and Asia.
Weaknesses	Threats
<ul style="list-style-type: none"> • A persistent productivity gap vis-à-vis the European and OECD averages. • Uneven innovation performance in some aspects. • Limited strategic capabilities and weak organisational set-up of universities and PROs. • Incomplete links between strategy formulation and actors’ strategies. • Widely differing views of stakeholders, e.g. scientific excellence versus relevance of research. • Strong perceived differences in priorities for science (basic research) and technology (for industry). • Proliferation of innovation policy instruments with potentially overlapping objectives. • Uneven internationalisation with highly internationalised parts coexisting with largely “closed” ones. 	<ul style="list-style-type: none"> • Failure to boost productivity may lead to loss of competitiveness. • Failure to upgrade the economy in a rapidly changing global economic environment. • Failure to develop industries with higher value added. • Entrenched and – in important respects weak – organisation of universities and PROs with little propensity to undertake the reforms needed to improve performance. • Strongly differing perceptions among stakeholders as regards the main problems of Slovenian innovation system may hinder implementation of needed reforms. • Broad range of research areas may result in lack of depth and competitive edge in the global environment. • Insufficiently integrated platforms to promote technology transfer and linkages between industry and research may reduce returns on investment in R&D.

Notes

1. This review follows several recent internal and external reviews of Slovenia's economic performance and National Innovation System (NIS), e.g. the *OECD Economic Survey: Slovenia 2009* and the *OECD Economic Survey: Slovenia 2011*. An *OECD Territorial Development Review* completed in 2011 was also conducted in parallel with this review. As a Member of the European Union, Slovenia participates in many ways in European programmes, platforms and initiatives in the area of science technology and innovation. The country's innovation policy has recently undergone a "Policy Mix Peer Review" carried out under the auspices of the European Union Scientific and Technical Research Committee (CREST).
2. OECD (2011), *Demand-side Innovation Policies*, OECD Publishing, Paris.
3. As impressive in scope and ambition as are the proposals contained in Slovenia's recently adopted RISS and NPHE documents, this broader vision of innovation, with its attendant requirements for new policies and institutional reforms, has to be further developed.
4. These generic principles will be followed below by concrete recommendations.



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