



OECD Reviews of Innovation Policy

SLOVENIA



OECD Reviews of Innovation Policy: Slovenia

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Foreword

The OECD review of Slovenia's innovation policy is part of a series of OECD country reviews.* It was requested by the Slovenian authorities, represented by the Ministry of Higher Education, Science and Technology (MHEST) and was carried out by the OECD Directorate for Science, Technology and Industry (DSTI) under the auspices of the Committee for Scientific and Technological Policy (CSTP). The review draws on the results of a series of interviews with major stakeholders of Slovenia's innovation system and on a background report commissioned by the Slovenian authorities. This background report (Bucar *et al.*, 2010) was prepared by a team of Slovenian experts: Maja Bucar (main author) together with Andreja Jaklic and Bostjan Udovic. It contains a broad range of valuable information that is widely drawn upon in this report.

The purpose of this review is to obtain a comprehensive understanding of the key elements, relationships and dynamics which drive the Slovenian innovation system and the opportunities to enhance it through government policy. More specifically, the review will:

- Provide an independent and comparative assessment of the overall performance of Slovenia's national innovation system (NIS).
- Recommend where improvements can be made within the system.
- Formulate recommendations on how government policies could contribute to such improvements, drawing on the present experience of other OECD countries as well as on the envisaged global development of R&D and innovation capabilities and trends.

The review is intended to be relevant to a wide range of stakeholders in Slovenia, including government officials, entrepreneurs and researchers as well as the general public, and to provide an accessible and comprehensive presentation of Slovenian innovation to a global audience using OECD communication channels. A draft "overall assessment and recommendations" (OAR) containing numerous observations and recommendations was delivered at the end of December 2010. This final report draws on and elaborates the OAR and has benefitted from comments provided by the Slovenian authorities (MHEST).

This report was drafted by Michael Stampfer (consultant to the OECD; Managing Director, Vienna Science and Technology Fund – WWTF, Austria), Irwin Feller (consultant to the OECD; Professor Emeritus, Pennsylvania State University and Senior Visiting Scientist, American Association for the Advancement of Science, United States) and Walter Lee (consultant to the OECD; at the time Head, Technology Transfer Network – TTN, A*STAR, Singapore), under the supervision of and with contributions from Gernot Hutschenreiter (Country Studies and Outlook Division, DSTI, OECD). Michael Hofer (WWTF, Austria) contributed to the finalisation of the report by providing statistical support and web-based research.

The review owes much to Slovenian government officials, in particular Jana Kolar (Director General, Directorate for Science and Technology, MHEST) and Ales Mihelic (Head, Sector Technology, MHEST). Andrej Cvelbar (Sector Technology, MHEST) helped in providing background information, arranging the interviews in Slovenia, in supporting the OECD team throughout the process and in commenting on the drafts of this report, which was completed in the autumn of 2011 and reflects the situation at that time.

*www.oecd.org/sti/innovation/reviews

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Abbreviations and acronyms

AAGR	Average Annual Growth Rate
ACS	Automobile Cluster Slovenia
A*STAR	Agency for Science, Technology and Research
BERD	Business Expenditures for Research and Development
CC	Competence Centre
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CEITEC	Central European Institute of Technology
CNRS	<i>Centre National de la Recherche Scientifique</i>
CoE	Centre of Excellence
COMET	Competence Centres for Excellent Technologies
COST	European Cooperation in Science and Technology
EIS	European Innovation Scoreboard
EIB	European Investment Bank
EIT	European Institute of Technology
ELI	Extreme Light Infrastructure
EMUNI	Euro Mediterranean University
EPO	European Patent Office
ERA	European Research Area
ERC	European Research Council
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EUA	European University Association
EUREKA	Raising the Competitiveness of European Business through Technology
FDI	Foreign Direct Investment
FP	Framework Programme
FTE	Full Time Equivalent
GeoZS	Geological Survey of Slovenia
GERD	Gross Expenditures for Research and Development
GODEA	Government Office for Development and European Affairs

GOVERD	Governmental Intramural Expenditures for Research and Development
GUF	General University Funds
HC	Headcount
HE	Higher Education
HEI	Higher Education Institution(s)
HERD	Higher Education Expenditures for Research and Development
HR	Human Resources
HRST	Human Resources in Science and Technology
IB	Biological Institute
IC	Chemical Institute
ICRC FNUSA	International Clinical Research Centre at the St. Anne's Hospital
IER	Institute of Economic Research,
IJS	Institute Jozef Stefan
IMF	International Monetary Fund
IMT	Institute of Metals and Technology
INCO	Specific RTD Programme in the field of co-operation with third countries and technological co-operation with the countries of central and eastern Europe
INV	Institute for Ethnic Studies
INZ	Institute for Contemporary History
IUS	Innovation Union Scoreboard
JAPTI	Public Agency for Entrepreneurship and Foreign Investments
JPI	Joint Programming Initiative
KIC	Knowledge and Innovation Community (EIT)
LERU	League of European Research Universities
ME	Ministry of Economy
MF	Ministry of Finance
MHEST	Ministry of Higher Education, Science and Technology
NIS	National System of Innovation
NPHE	National Plan for Higher Education 2011-2020
NRDP	National Research and Development Plan
NSRF	National Strategic Reference Framework
OAR	Overall Assessment and Recommendations
OECD	Organisation for Economic Co-operation and Development
OP	Operational Programme
PHARE	Poland and Hungary: Aid for Restructuring of the Economies
PRO	Public Research Organisation

R&D	Research and Development
RFC	Research Funding Council
RISS	Research and Innovation Strategy of Slovenia 2011-2020
SASA	Slovenian Academy of Sciences
SEA	Social Enterprise Association
SEF	Slovene Enterprise Fund
SFB	<i>Spezialforschungsbereiche</i> (Special Research Programmes) in Austria
SID (Bank)	Slovene Export Corporation (Bank)
SME	Small and Medium Enterprises
SORS	Statistical Office of the Republic of Slovenia
STREP	Specific Targeted Research Projects
SSF	Slovenian Science Foundation
SRA	Slovenian Research Agency
S&T	Science and Technology
TEMPUS	Programme for HE modernisation in CEEC and other regions
TFP	Total Factor Productivity
TIA	Slovenian Technology Agency
TTN	Technology Transfer Network
TTO	Technology Transfer Office
UG, UOG	<i>Universitäts(-organisations)gesetz</i> , Austrian University legislation
UI	Urban Planning Institute
UL	University of Ljubljana
UM	University of Maribor
VEM	“One-stop shop” business point; VEM also means “I know” in Slovenian
WEF	World Economic Forum
ZAG	National Building and Civil Engineering Institute
ZRC SAZU	Scientific Research Centre of the Slovenian Academy of Sciences (SASA)

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
• 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.	• 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
• 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.	• 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.

Examen de l'OCDE de la politique d'innovation de la Slovénie : Évaluation globale et recommandations

Au cours des deux dernières décennies, la Slovénie a accompli d'énormes progrès et a affiché une réussite remarquable en matière de développement économique et social, sous-tendue par un passage à l'économie de marché et par une intégration économique sur les marchés européens. Ce succès a ouvert la voie à l'adhésion du pays à l'Union européenne alors en plein élargissement, à sa qualité de membre de l'Union monétaire européenne, et à son adhésion aux accords de Schengen, ce qui a grandement facilité les mouvements transfrontières sur une bonne part du continent européen. À certains égards, la Slovénie est en tête des nouveaux États membres de l'UE. Les efforts déployés par le pays ont encore une fois été reconnus lorsqu'à l'été 2010, la Slovénie est également devenue membre de l'Organisation de coopération et de développement économiques (OCDE). Tout en s'intégrant étroitement à l'économie européenne et mondiale, la Slovénie a conservé un fort sens de l'identité nationale, en privilégiant sa langue et sa culture. Déjà avant 1991, le pays se trouvait aux avant-postes sur le plan de l'économie au sein de l'ex-Yougoslavie. Dans les deux décennies qui ont suivi, des décisions ambitieuses, une politique économique saine et un travail acharné lui ont valu le succès et se sont traduits par une position solide de ce petit pays d'Europe centrale comptant deux millions d'habitants.

Pourtant, il est devenu évident, lors de la récente crise financière et économique et au lendemain de cette crise, qu'il fallait poursuivre les efforts pour renforcer la compétitivité internationale des entreprises slovènes et pour obtenir une croissance économique forte et durable. Aujourd'hui, tout le monde s'accorde à reconnaître (et cela a été mis en évidence par la Stratégie de l'OCDE pour l'innovation) que la politique d'innovation peut contribuer de façon significative à ces objectifs en mobilisant une économie innovante, fondée sur le savoir. Dans ce contexte, la Slovénie s'est, ces dernières années, engagée activement dans un processus d'auto-examen, de diagnostic et d'examen par les pairs, en invitant et en favorisant plusieurs examens et évaluations externes qui ont trait, du moins partiellement, aux aspects de sa politique d'innovation, et en cherchant à recenser et à adapter les politiques, les programmes et les pratiques exemplaires de ses voisins européens et d'un large éventail de pairs à l'échelle mondiale¹.

Le présent examen s'appuie sur l'hypothèse empirique que la performance économique à long terme d'un pays dépend de manière significative du niveau et de la qualité de ses activités d'innovation, à savoir son aptitude à produire, transférer et assimiler des innovations technologiques, non technologiques, managériales, organisationnelles et institutionnelles. Reconnaissant pleinement que les initiatives actuelles en matière de politique de nombreux États membres et non membres de l'UE concernent ce qu'il est convenu d'appeler les « politiques d'innovation côté demande » (mesures publiques visant à augmenter la demande d'innovation, à améliorer les conditions d'adoption des innovations ou à améliorer la formulation de la demande pour stimuler l'innovation et permettre sa diffusion²), le présent examen se concentre sur les facteurs côté offre. Cette

concentration traduit un jugement éclairé concernant les deux côtés de l'interface offre et demande, à savoir que premièrement, les entraves aux performances d'innovation de la Slovénie et à sa croissance économique à long terme existent principalement dans les relations structurelles à l'intérieur et entre les entreprises/industries et les sources publiques de savoir scientifique et technologique. Deuxièmement, le potentiel de croissance des politiques d'innovation côté demande menées par la Slovénie est vraisemblablement modeste, comme c'est le cas pour tous les petits pays. Troisièmement, pour les mesures spécifiques comme la mise à disposition des PME d'une aide technique pour accélérer leur adoption des nouvelles technologies issues de pratiques exemplaires, il existe une telle équivalence entre les politiques côté offre et côté demande que le fait d'établir des distinctions sur le plan des définitions est inefficace.

Réalisations et enjeux : un rôle accru de l'innovation dans le développement économique de la Slovénie

Slovénie : un pays en transition qui réussit ...

La Slovénie a réalisé beaucoup de choses au cours des deux dernières décennies. Elle a géré avec succès son passage à l'économie de marché. Ce passage diffère, tant dans les conditions de départ que dans l'approche adoptée, de celle des autres économies en transition d'Europe centrale et orientale. Tout au long de ces années, la Slovénie est restée la plus prospère de ce groupe d'économies, et se classe en tête en termes de produit intérieur brut (PIB) par habitant.

Pendant plus d'une décennie précédant la récente crise financière et économique, la Slovénie a affiché de fortes performances économiques. Entre 1998 et 2008, le PIB par habitant a augmenté au rythme annuel de 4.2 %, ce qui est beaucoup plus que la moyenne enregistrée dans la zone euro, et a rapidement rattrapé les PIB moyens par habitant de l'OCDE et de l'UE. En 2007, la Slovénie a atteint 81 % de la moyenne de l'UE15 (en PPA). Les gains de productivité du travail ont été le principal moteur de la croissance de son PIB par habitant. Le processus de rattrapage a été, du moins temporairement, interrompu par le fait que l'économie slovène a été durement touchée par la crise économique et financière mondiale. Son PIB s'est contracté d'environ 8 % en 2009, soit le recul le plus marqué parmi les pays membres de l'OCDE à l'époque. Cela a conduit à une inversion partielle des gains précédents en matière de convergence par rapport aux pays de l'UE15. La Slovénie ne se reprend que lentement et les projections de croissance restent mitigées.

La forte contraction a été déclenchée par un effondrement de la demande extérieure. Mais elle a été aggravée par des facteurs structurels, notamment la part relativement importante des exportations de biens et de services à faible valeur ajoutée, segments ayant été durement touchés par la crise. La spécialisation du pays dans l'exportation accroît son exposition aux ralentissements conjoncturels mondiaux et à la perte de parts de marché. En dépit des performances dynamiques d'avant la crise, l'écart de PIB par habitant par rapport aux économies avancées de l'OCDE demeure important. Il est presque entièrement imputable au retard dans la productivité du travail. En 2008, par exemple, la productivité manufacturière atteignait tout juste environ un tiers de la moyenne de la zone euro. Une plus grande assimilation transfrontière du savoir technologique et organisationnel avancé peut aider à combler cet écart de productivité persistant. Développer les capacités facilitant l'assimilation de ce savoir peut avoir des retombées considérables.

Dans une optique plus lointaine, on peut s'attendre à ce que les sources de croissance durable de la productivité se modifient à plus long terme. La productivité totale des facteurs (PTF), tirée par une augmentation de l'innovation intérieure, devrait avoir un rôle relativement plus important à jouer à mesure que l'écart de revenu avec les pays plus avancés se resserre. Outre l'assimilation du savoir produit à l'étranger, cela exigera un relèvement des niveaux de capacité « propre » en matière d'innovation. Comme indiqué dans le présent examen, cela peut être obtenu en encourageant l'investissement dans la R-D et l'innovation tout en améliorant l'efficacité du système d'innovation dans son ensemble et dans ses parties constitutives. Des conditions cadres telles que des marchés des produits et du travail qui fonctionnent bien, de faibles obstacles à l'entrepreneuriat et une concurrence vigoureuse (y compris dans les secteurs des services clés) ainsi qu'une augmentation de l'IDE entrant pourraient jouer un rôle important. Le secteur des services représente une part de plus en plus grande de l'emploi global, et l'accroissement de son efficacité sera nécessaire pour maintenir une croissance de la productivité élevée. Cela a des implications immédiates pour la politique de l'innovation qui, comme dans d'autres pays, demeure largement orientée vers l'activité manufacturière.

... avec des antécédents mitigés mais un fort potentiel d'innovation.

Les performances de la Slovaquie en matière d'innovation sont variées. Certains indicateurs des intrants de l'innovation couramment utilisés dans les comparaisons internationales se situent à un niveau approprié, voire élevé, par rapport au PIB national par habitant. À 1.9 % en 2009, l'intensité de la R-D (soit la R-D en tant que pourcentage du PIB) de la Slovaquie était supérieure à celle de certains pays de l'OCDE qui affichent des niveaux comparables, ou plus élevés, de PIB par habitant (Espagne, Grèce, Italie, Luxembourg, Norvège, Nouvelle-Zélande, Portugal et République tchèque). Aucun autre pays d'Europe centrale ou orientale n'enregistre d'intensité de la R-D comparable à celle de la Slovaquie. Par ailleurs, sa proportion de R-D financée par les entreprises dans les dépenses totales de R-D est typique de celle des pays dotés d'un système de l'innovation plus élaboré, et une grande partie des activités de R-D sont menées dans le secteur des entreprises. Toutefois, si les dépenses de R-D des entreprises (BERD) en tant que pourcentage du PIB (intensité de la BERD) atteignent presque la moyenne de l'UE, elles sont beaucoup plus basses que dans les principaux pays innovants. Comme dans d'autres pays, la plus grosse partie des activités de R-D sont menées par un petit nombre d'entreprises ; dans les faits, la BERD de la Slovaquie est due en très grande partie à deux entreprises pharmaceutiques qui produisent des médicaments génériques.

Pour ce qui est des extrants de l'innovation, le tableau est contrasté. La production scientifique, mesurée par le nombre d'articles scientifiques par million d'habitants et de publications écrites en coopération avec des auteurs étrangers, est élevée par rapport au niveau international, même s'il convient de préciser qu'il existe des doutes quant au lien entre cette mesure et l'activité économique. D'autres pans du secteur de l'innovation sont moins performants. Le nombre des entreprises de haute technologie est relativement faible et les exportations de haute technologie et de services ne représentent qu'une part minime des exportations totales. La Slovaquie affiche des résultats largement inférieurs à la moyenne de l'UE pour ce qui est des demandes de brevets par million d'habitants, mais se place devant la quasi-totalité des autres nouveaux membres de l'UE dans ce domaine. Le nombre des brevets triadiques (par million d'habitants) a augmenté entre 2001, où son niveau était relativement faible, et 2008, parallèlement à la hausse des intrants de la R-D.

Globalement, en dépit de quelques exemples édifiants et du statut dont elle jouit au sein des (anciens) pays en transition ou des nouveaux pays membres de l'UE, la Slovénie affiche des performances médiocres en termes de création d'entreprise et de transfert de technologie. Les activités des entreprises en début de croissance ne peuvent être qualifiées de dynamiques, une remarque qui s'applique également de manière plus générale aux petites et moyennes entreprises (PME). La capacité de l'économie de traduire les découvertes scientifiques en innovations technologiques suscite des doutes. Les résultats d'enquêtes sur l'innovation montrent que les activités d'innovation menées par le secteur manufacturier n'ont que peu évolué, et que le changement n'est que progressif dans le secteur des services.

Le système d'innovation de la Slovénie accuse des lacunes et est pénalisé par un certain nombre de conditions cadres juridiques et financières défavorables. Ainsi, les enseignants universitaires dont les recherches sont financées par des fonds publics ne sont que peu incités à prendre en considération l'intérêt que peuvent présenter leurs travaux pour les utilisateurs du secteur privé, et de nombreuses PME ne cherchent pas réellement à expérimenter ou à mettre en œuvre de nouveaux processus de production ou des pratiques innovantes. La lenteur du rythme auquel progresse la capacité globale d'innovation menace la compétitivité des entreprises, en particulier sur les marchés internationaux où règne la concurrence. Le manque de ressources financières est la raison la plus souvent invoquée par les entreprises pour expliquer leur frilosité en matière d'innovation. Les faiblesses observées au niveau des extrants de l'innovation s'expliquent également par l'apport relativement faible d'IDE, comparé à l'intégration profonde de la Slovénie dans les marchés internationaux de biens, et à l'IDE dont bénéficient d'autres pays d'Europe centrale et orientale. La Slovénie n'exploite pas pleinement sa capacité d'absorber les meilleures pratiques étrangères liées à la technologie fournies par le biais des apports d'IDE.

La Slovénie s'emploie à mettre en place un système d'innovation efficace et a adopté de nombreuses pratiques optimales parmi celles en vigueur dans les autres pays. Des documents majeurs définissant les orientations nationales publiés récemment reconnaissent la nécessité de remédier aux lacunes du système. Il s'agit en particulier des deux documents intitulés « Audacieuse Slovénie » qui énoncent les orientations pour la décennie à venir : la Stratégie de recherche et d'innovation de la Slovénie 2011-2020 (RISS) et le Programme national de l'enseignement supérieur 2011-2020 (NHEP). Les propositions contenues dans ces programmes – comme mettre à profit la complémentarité des initiatives menées par les universités et les organismes de recherche publics (ORP) pour élargir, rationaliser et professionnaliser les capacités de transfert de technologie de ces deux catégories d'institution, en particulier dans les domaines des brevets, des licences, et de la création d'entreprises innovantes – ont pour objectif de stimuler et de réorienter les activités d'innovation.

Les principales forces et faiblesses du système d'innovation de la Slovénie

L'histoire de la Slovénie, sa situation géographique et ses caractéristiques culturelles et institutionnelles doivent être prises en compte lorsque l'on évalue le contexte dans lequel s'inscrit actuellement le système national d'innovation et la nature des mesures prises par les autorités face aux nouveaux enjeux et aux perspectives émergentes. Le pays – qui s'appuie sur un riche passé émaillé d'épisodes parfois tragiques – a acquis son indépendance à la fin du XX^e siècle. Il a su gérer habilement sa transition vers une économie de marché et est parvenu à instaurer des institutions démocratiques modernes.

En tant qu'économie ouverte mais de petite taille, d'une population d'environ 2 millions d'habitants et membre de l'Union européenne et de l'Union monétaire européenne, la Slovénie doit trouver les moyens de préserver sa compétitivité et de tirer parti de l'évolution récente du marché européen et des marchés mondiaux.

Les paragraphes suivants contiennent une brève analyse des points forts et des faiblesses du système d'innovation de la Slovénie, ainsi que des opportunités qui se présentent à lui et des menaces auxquelles il fait face. Si l'on se base sur la créativité et l'innovation de sa population, les perspectives de développement de la Slovénie sont globalement favorables. Le pays devra toutefois s'adapter en permanence afin de concrétiser son potentiel, de saisir les opportunités qui se présentent et de faire face aux nouvelles menaces. À l'instar d'autres systèmes d'innovation, celui de la Slovénie est façonné par l'histoire du pays, et ses caractéristiques reflètent celles de l'économie et de la société dans son ensemble.

Principaux points forts

Les principaux points forts du système d'innovation de la Slovénie sont notamment :

- *Un développement socioéconomique réussi.* La Slovénie a négocié efficacement sa transition vers une économie de marché et son intégration dans l'économie internationale.
- *Un bilan solide en termes de performances économiques.* La croissance de la Slovénie était supérieure à la moyenne de l'OCDE au cours des années précédant la crise. Le pays est également en tête des nouveaux membres de l'UE pour ce qui est du PIB par habitant.
- *Une place de leader de l'innovation parmi les pays d'Europe centrale et orientale,* dans divers indicateurs liés à l'innovation, notamment l'intensité globale de R-D.
- *Des dépenses de R-D en hausse* depuis le début de la transition. À l'inverse de celles de la plupart des économies d'Europe centrale et orientale, les dépenses de R-D de la Slovénie ne se sont pas effondrées au début des années 90. Elles sont restées stables et ont même augmenté lors de la crise récente.
- *Un vivier de scientifiques et de compétences en matière d'innovation.* La Slovénie est comparativement bien dotée en ressources humaines, et ces dernières sont réputées pour leur créativité dans une vaste palette de domaines.
- *Des pôles d'excellence dans la recherche universitaire et industrielle,* dans l'industrie pharmaceutique, par exemple.
- *Une augmentation considérable du nombre et de la qualité des publications scientifiques,* qui témoigne de la réussite des mesures visant à rehausser les normes académiques.
- *Une participation fructueuse aux Programmes cadres européens.* Les chercheurs slovènes ont apporté la preuve de leur capacité de s'intégrer aux réseaux de chercheurs internationaux.
- *Une panoplie bien rodée d'institutions différenciées* intervenant dans les domaines de la science, de la technologie et de l'innovation.
- *Une prise de conscience appuyée du rôle de l'innovation dans la modernisation de l'économie,* ainsi qu'en atteste l'adoption récente de la Stratégie de recherche et

d'innovation de la Slovénie 2011-2020 et du Programme national de l'enseignement supérieur 2011-2020, qui témoigne également de l'importance prioritaire attachée par les autorités, l'industrie et la sphère universitaire à l'innovation.

Principales faiblesses

Les principales faiblesses du système d'innovation de la Slovénie sont notamment :

- *Un écart de productivité persistant* par rapport aux moyennes européenne et des pays de l'OCDE, et ce, en dépit d'une forte croissance de la productivité au cours de la période précédant la crise.
- *Des performances inégales en matière d'innovation*, comme le faible niveau des demandes de brevets et des exportations de haute technologie.
- *Une organisation rigide – et dans des domaines importants, relâchée – des universités et des ORP, qui n'est que peu propice au lancement des réformes nécessaires pour améliorer les performances.*
- *Les capacités stratégiques limitées des universités et des ORP*, et des liens insuffisants entre la formulation de l'orientation gouvernementale et la capacité des principaux acteurs d'intégrer cette orientation à leurs propres stratégies.
- *De grandes divergences d'opinion entre les différents acteurs* en matière d'excellence scientifique, de pertinence de la recherche, notamment à des fins d'applications scientifiques, et de priorités de la recherche (science fondamentale, technologie industrielle).
- *La multiplication des instruments de la politique de l'innovation, lesquels risquant de poursuivre les mêmes objectifs*, comme notamment les programmes de financement destinés à stimuler la coopération, l'entrepreneuriat et le transfert de technologie.
- *Une internationalisation inégale.* Le système d'innovation de la Slovénie est à certains égards hautement internationalisé (pour ce qui est notamment de la participation du pays aux programmes européens de R-D) mais l'est bien moins dans d'autres domaines (lorsqu'il s'agit par exemple d'attirer les chercheurs et les étudiants étrangers).

Les menaces et les opportunités

Les principales opportunités pour le développement futur de la Slovénie incluent notamment :

- *Une contribution croissante d'un pan de la recherche universitaire au développement social et économique, notamment à la croissance de la productivité.*
- *Des conditions qui semblent favorables pour stimuler l'innovation et remonter dans la chaîne de valeur.*
- *La petite taille du pays en fait un atout en termes de concentration, de rapidité d'exécution, d'efficacité organisationnelle et d'aptitude à adopter des stratégies de niche et à saisir avec réactivité les opportunités qui se présentent sur les marchés.*

- *L'intégration du pays à l'économie européenne et mondiale, qui peut lui permettre de compenser les inconvénients liés à sa petite taille.*
- *La possibilité de devenir un pôle et/ou un nœud d'innovation au sein des régions de l'Union européenne (en expansion), d'Europe centrale et des Balkans.*
- *La possibilité de se raccorder aux pôles/nœuds d'innovation existants et émergents en Europe, en Amérique et en Asie.*

Les principales menaces au développement futur de la Slovénie incluent notamment :

- *L'incapacité de stimuler la productivité, qui entraînerait une perte de compétitivité.*
- *L'incapacité de moderniser l'industrie, dans un environnement économique mondialisé en évolution rapide.*
- *L'incapacité de développer des secteurs d'activité qui fournissent des solutions/produits à plus forte valeur ajoutée.*
- *Le manque d'intégration des plateformes destinées à promouvoir le transfert de technologie et les liens entre l'industrie et la recherche, et la baisse des retours sur investissement dans la R-D.*
- *De fortes divergences d'opinions entre les différents acteurs concernant les principales difficultés auxquelles se heurte le système d'innovation national, qui font obstacle à la mise en œuvre des réformes nécessaires.*
- *Une recherche qui se « disperse » et qui manque ainsi de profondeur et d'atouts face à la concurrence internationale.*

La marge d'amélioration de la politique de l'innovation

Ces vingt dernières années, la Slovénie a déployé des efforts considérables pour adopter et élaborer une politique de l'innovation moderne. Toutefois, comme dans d'autres pays, cette politique peut encore être améliorée et les lacunes qu'elle continue d'afficher doivent être palliées afin de renforcer la contribution de l'innovation au développement socioéconomique du pays. Dans le passé, la Slovénie a publié plusieurs documents de planification ambitieux relatifs à la science, la technologie et l'innovation (STI) (comme le Plan national de recherche et développement 2005-2010) qui n'ont pas été entièrement mis en œuvre. Ces échecs peuvent être attribués en partie à l'absence d'orientations stratégiques sur le long terme. L'organisation rigide et parfois obsolète de la recherche publique et de l'enseignement supérieur peut également avoir une part de responsabilité. Par ailleurs, l'intérêt prononcé et l'engagement démontrés par les gouvernements nationaux successifs en faveur de la science et de l'innovation ont parfois conduit chaque nouveau gouvernement à prendre des mesures de manière « isolée », essentiellement dans un nombre limité de domaines d'action considérés comme étant particulièrement importants, et notamment l'entrepreneuriat, les services de conseil aux entreprises innovantes et le transfert de technologie. Cette stratégie s'est traduite d'une part par un manque de continuité dans l'action et des chevauchements, et d'autre part par des « zones fantômes », des domaines négligés dans lesquels le rythme des réformes était relativement lent. La réforme universitaire en est un exemple de choix.

Missions stratégiques et principes directeurs

Les objectifs principaux de la politique d'innovation de la Slovénie sont de renforcer le rôle de l'innovation en tant que moteur d'une croissance durable, de poursuivre le processus de convergence avec les économies les plus avancées de l'UE et de l'OCDE, et d'améliorer le niveau de vie de la population. Un accroissement des capacités d'innovation contribuera à augmenter la productivité – et par là, la compétitivité – des entreprises manufacturières et des sociétés de services slovènes. Il faciliterait également la restructuration de l'économie nationale en direction d'activités reposant davantage sur la connaissance, et sa remontée sur la chaîne de valeur. Plus précisément, cette politique nécessiterait :

- *D'imprimer un élan à la productivité dans l'ensemble de l'économie slovène en favorisant et en promouvant une vaste palette d'activités d'innovation, en misant à la fois sur l'innovation reposant sur la R-D, mais également sur l'innovation organisationnelle et commerciale, et sur l'innovation en termes de modèle d'entreprise, notamment.*
- *D'accroître les retombées positives de la R-D sur l'économie et la société en réformant les universités et les organismes de recherche publics.*
- *De rationaliser la politique et les stratégies publiques de financement.* Il s'agirait notamment d'accroître l'efficacité de la politique d'innovation en simplifiant les dispositifs publics de soutien et de financement de la science, de la technologie et de l'innovation, et de viser à atteindre une masse critique.

La politique d'innovation de la Slovénie doit ainsi relever des défis liés aux performances de la productivité, à la simplification du soutien et du financement publics, à la réforme des universités et des ORP, et à la hiérarchisation et à l'intégration des mesures destinées à répondre aux besoins à court terme et de celles qui ont trait à un changement structurel et institutionnel de plus longue haleine.

Stimuler la productivité par l'innovation technologique et non technologique

Un enjeu de première importance pour la Slovénie consiste à stimuler la productivité dans l'ensemble de son économie. La faiblesse de la productivité est en effet en grande partie responsable de l'écart entre le PIB par habitant de la Slovénie et celui des premiers pays d'Europe et de l'OCDE. L'innovation, en ce qu'elle est une source fondamentale de croissance durable de la productivité, des revenus et du bien-être social, jouera un rôle de plus en plus important dans la réduction de cet écart.

L'examen met en évidence le double défi que doit relever la Slovénie, à savoir augmenter sa productivité et sa compétitivité à court terme, tout en lançant et en mettant en œuvre les changements structurels et institutionnels nécessaires pour permettre l'instauration d'un système d'innovation performant et d'un cadre apte à faciliter et à promouvoir la réorientation des ressources vers la production de biens et de services à forte intensité de savoir et à plus forte valeur ajoutée, elle-même nécessaire pour ouvrir la voie à une croissance durable de la productivité, des revenus et du bien-être social pour la population slovène. Compte tenu de ce qui précède, la politique d'innovation de la Slovénie devra être forcément tournée vers l'avenir et associer :

- *Des améliorations à court terme par le biais d'une innovation reposant sur les technologies en vigueur d'origine nationale et étrangère.* Ces améliorations peuvent entraîner des gains de productivité. Il conviendra d'appliquer les

connaissances actuelles aux pratiques en vigueur, et d'abandonner progressivement les pratiques relativement peu rentables au profit des pratiques moyennes en vigueur dans le secteur, puis des meilleures pratiques internationales. Les améliorations de ce type nécessitent généralement une sensibilisation et un engagement au plus haut niveau en faveur de l'augmentation des performances, du recrutement, de la formation et de la reconversion d'une main-d'œuvre qualifiée, ainsi que l'accès à des sources fiables de savoir technique et managérial.

- *Des améliorations à long terme de la capacité du système d'innovation de la Slovaquie de produire et d'appliquer de nouveaux savoirs.* L'innovation technologique, la création de nouveaux produits et processus qui découlent de l'application d'un savoir scientifique et technologique nouveau est une source essentielle d'amélioration durable de la productivité. Il est également possible de parvenir à des améliorations à court ou moyen terme (notamment en renforçant la coopération entre l'industrie et la sphère universitaire). D'autres améliorations, d'une nature plus fondamentale, requièrent pour leur part des changements plus profonds au niveau du fonctionnement des institutions et de leurs interactions, et doivent être envisagées dans une optique à plus long terme.

Compte tenu de la nécessité d'augmenter la productivité dans différents secteurs et types d'entreprises, il pourrait être nécessaire d'élargir le concept de l'innovation (à ce sujet, voir OCDE, 2010a)³. Les efforts déployés par la Slovaquie pour mettre en place un système scientifique performant et améliorer les liens entre ce système et l'industrie doivent être accompagnés par la volonté de placer au premier plan la diffusion des innovations non technologiques. La réforme des universités et des ORP est nécessaire pour accroître la contribution de l'innovation aux performances économiques.

Une réforme approfondie des universités et des organismes publics de recherche

Tout au long de son évolution, le secteur de la recherche publique en Slovaquie – à savoir les universités et les ORP – a produit quelques résultats impressionnants en termes de production scientifique, mais n'a par ailleurs pas pu empêcher la formation d'obstacles à toute nouvelle amélioration des performances et du développement socioéconomique du pays (encadré 0.1). L'enjeu consiste aujourd'hui à réformer les universités et les ORP, qui sont les principaux bénéficiaires du financement public de la R-D, de manière à ce qu'ils puissent surmonter ces obstacles. Les autorités slovaques sont pleinement conscientes de la nécessité d'entreprendre de telles réformes, ainsi que l'ont prouvé récemment l'élaboration et l'adoption de propositions visant à restructurer l'enseignement supérieur (NPHE) et la recherche et l'innovation (RISS). Ces documents, qui laissent transparaître une certaine dose d'audace et de témérité de la part des autorités, exigent une mesure supplémentaire : le renforcement de l'autonomie des institutions. Une telle autonomie ne pourra être atteinte sans un modèle de gouvernance clair et solide, et l'apport, par le ministère de l'Enseignement supérieur, de la Science et de la Technologie (MHEST), d'un soutien actif au processus de changement. Les autorités devront donner aux universités les moyens d'agir en toute autonomie et la possibilité d'atteindre une masse critique, en recrutant à l'international et en proposant des évolutions de carrière adaptées au monde actuel. Le financement de la science doit appuyer ce changement en fournissant les incitations appropriées. Le même plan d'action doit s'appliquer aux ORP, à l'issue de négociations destinées à définir les principaux objectifs de chaque grand institut.

Encadré 0.1. L'évolution du secteur de la recherche publique : réalisations et aspects négatifs

Bien qu'affichant des performances encourageantes ...

Le secteur de la recherche publique – qui est composé de quatre universités et d'un nombre plus important d'ORP – a subi l'influence de différents facteurs. En comparaison avec ceux des autres pays d'Europe, le système slovène des établissements d'enseignement supérieur et des ORP est extrêmement récent, l'établissement le plus ancien étant l'Université de Ljubljana, dont la création remonte à 1919. De nombreuses institutions ont été fondées au cours des décennies qui ont suivi la fin de la Seconde Guerre mondiale, et en particulier les ORP qui, contrairement à ce qui est généralement le cas dans cette région du monde, n'ont pas été regroupés sous l'égide d'une Académie nationale des sciences. Certains ORP se distinguent par un passé d'institut de recherche bien souvent consacré à une discipline unique. Globalement, l'ensemble du « secteur » semble être le fruit de décisions politiques prises isolément avant 1991. Compte tenu de son ancienneté relativement faible et des ressources modestes dont elle a disposé à certaines époques, la recherche publique – qu'il s'agisse des ORP ou des universités – affiche des performances impressionnantes. Elle a donné naissance à plusieurs poches d'excellence internationale qui continuent de se développer aujourd'hui. Soutenues par les incitations du financement public, la production universitaire et les retombées de la science ont fortement augmenté, en particulier au cours de la dernière décennie.

... le secteur public de la recherche souffre de la faiblesse de son organisation et de l'étroitesse inadaptée de certaines missions et perceptions

Cette trajectoire de développement a un revers, en ce qu'elle semble avoir favorisé l'émergence d'une série d'objectifs et d'indicateurs de performances autocentrés et excluant tout paramètre extérieur. L'objectif primordial de la recherche universitaire est d'améliorer la réputation des universités et du corps enseignant sur la scène internationale, sans chercher, ou à peine, à savoir si sa production contribue à d'autres objectifs (nationaux). En particulier, le fait que les performances de la recherche universitaire soient évaluées majoritairement, voire exclusivement, au moyen de méthodes bibliométriques, telles que le nombre des publications et des citations, n'incite pas les professeurs (et les chercheurs des ORP) à prendre en considération l'utilité que présentent leurs travaux pour l'industrie et les autres acteurs non universitaires du système d'innovation, ou à envisager de collaborer avec ces derniers. Par ailleurs, les réalisations positives en termes qualitatifs et quantitatifs semblent avoir vu le jour au sein de petits îlots enclavés et être restées confinées à l'intérieur de groupes et d'unités individuels. Cette remarque peut sembler peu pertinente au premier abord, car l'excellence scientifique prend toujours naissance dans des individus ou au sein de groupes. Toutefois, un examen plus approfondi permet de mettre en évidence un lien entre les incitations fournies par les programmes de financement des groupes de recherche et les lacunes de l'organisation des universités et des ORP. Une compartimentalisation élevée, des pratiques de recrutement en interne, une trop forte dépendance à l'égard de dispositifs ascendants et le manque d'autonomie des institutions semblent tous cimentés par un modèle de financement qui contourne la direction des institutions.

Simplifier la politique et les stratégies publiques de financement

La Slovénie doit simplifier le soutien et le financement publics apportés à la recherche publique et privée (encadré 0.2). L'enjeu consiste à simplifier les dispositifs en vigueur et à définir les priorités en matière de financement et de stratégie. Il manque à l'heure actuelle une stratégie globale qui établirait un lien entre les instruments et le financement du secteur public. Cette stratégie rendrait moins nécessaire la coordination entre les organismes et les ministères et contribuerait à surmonter les obstacles que constituent la petite taille, la fragmentation et la compartimentalisation de l'organisation des programmes de R-D et d'innovation de la Slovénie, souvent mentionnées dans certaines évaluations. Les fonds structurels européens ont donné naissance à une série d'initiatives intéressantes : les centres de compétences et les centres d'excellence ont libéré des investissements considérables en matériel et ont permis la constitution d'une masse critique à partir des points forts que présente actuellement la recherche. La Slovénie doit éviter les stratégies « au coup par coup » et bâtir son approche globale à partir de ces instruments au cours des années à venir.

Encadré 0.2. Soutien et financement publics de la recherche publique et privée

Le système public de financement se caractérise par une grande diversité d'intervenants et de programmes ...

L'orientation stratégique de la politique de la science, de la technologie et de l'innovation relève du ministère de l'Enseignement supérieur, de la Science et de la Technologie (MHEST) et du ministère de l'Économie (ME), épaulés par deux conseils dotés de fonctions consultatives et de planification. Ce mode de gouvernance est fortement influencé par une structure complexe en matière de planification et d'établissement du budget.

La Slovénie apporte un financement public à la recherche et à l'innovation par le biais de divers instruments et organismes. Le financement de la science est du ressort de l'Agence slovène de la recherche (ARRS). Il s'articule autour de divers dispositifs de financement concurrentiel comme on en trouve dans les conseils de financement de la recherche, avec des dotations importantes sur le modèle des fonds généraux des universités, qui ont un fonctionnement spécifique et concurrentiel. Ces financements des « groupes de recherche » constituent également un élément important du financement du puissant secteur national des ORP. S'agissant du financement de la recherche appliquée et de l'innovation, les principaux acteurs sont l'Agence slovène de la technologie (TIA), l'Agence pour l'entrepreneuriat et les investissements étrangers (JAPTI), le Fonds slovène pour les entreprises (SEF), et, de plus en plus, la Banque slovène pour les exportations (SID). Ces cinq acteurs proposent une palette impressionnante et parfois redondante de programmes et de dispositifs de financement aux entreprises et aux réseaux de recherche. À l'échelon régional, la politique de l'innovation ne compte qu'un petit nombre d'acteurs, compte tenu de la structure centralisée et de la taille du pays. Les institutions européennes jouent un rôle majeur dans le financement, à fois par le biais des Programmes cadres pour la R-D et des fonds structurels pour le développement économique, régional et social.

... alors que les financements ont tendance à se concentrer sur les activités les plus intéressantes et ont des effets secondaires inopinés

Dans le domaine du financement de la technologie, la Slovénie est dotée d'une multitude de programmes et de projets destinés à financer les projets et les plateformes coopératifs de toute nature, toute taille et toute origine, et à fournir des services de conseil et d'orientation en faveur de l'entrepreneuriat, des jeunes entreprises et de la croissance de ces dernières. Le nombre pléthorique de ces activités et la discontinuité dans certaines formes de soutien donneraient lieu à quelques difficultés. Le nombre de guichets uniques que compte le système slovène d'innovation donne à penser qu'une simplification de ce système aurait des avantages. Il serait utile de tenter de savoir si les organismes et les intermédiaires ont tendance à privilégier les activités les plus intéressantes et les plus visibles (incubateurs, etc.). Des questions telles que la productivité des entreprises mériteraient peut-être davantage d'attention. Dans le domaine du financement de la science, un système de sélection strict et très formalisé, ainsi que des fonds (de type dotation forfaitaire) alloués à chaque groupe de recherche ont entraîné des améliorations de la qualité mais semblent renforcer les tendances en direction de la compartimentalisation, de la poursuite d'activités anciennes et d'une concentration prononcée, parfois exclusive, sur la recherche scientifique dans le système public de recherche.

Certains principes directeurs

Lors de l'élaboration et de l'application des politiques visant à mettre en œuvre les objectifs stratégiques décrits plus haut, les autorités slovènes devront respecter les principes directeurs suivants⁴:

- *Adopter une approche globale de la promotion de l'innovation à l'échelle de l'ensemble de l'économie.* Compte tenu de la nécessité de stimuler la productivité, cette approche doit englober les activités d'innovation reposant sur la R-D et les autres, ainsi que l'innovation technologique et non technologique. La politique slovène de l'innovation doit éviter de se concentrer de manière trop exclusive ou trop étroite sur la « haute technologie ». L'innovation non technologique ou innovation douce – en particulier dans le secteur des PME qui a besoin de constituer des capacités d'innovation mais fait face à certains obstacles – présente

des perspectives non négligeables pour stimuler la productivité et la croissance des revenus.

- *Renforcer l'ouverture internationale.* Les flux internationaux de connaissances sont essentiels au développement des systèmes nationaux d'innovation, en particulier dans une petite économie ouverte, car la majorité du savoir nécessaire pour entretenir une croissance tirée par l'innovation devra être absorbée à partir de l'étranger. La circulation des chercheurs étrangers et nationaux à l'intérieur et à l'extérieur du pays, les investissements de R-D consentis par les entreprises internationales et les activités de recherche menées sur le territoire national par des organisations d'origine étrangère sont tous importants à cet égard. Ces canaux doivent être complétés par un accès à la connaissance via les marchés des technologies, une participation active aux réseaux internationaux d'innovation et une coopération dans la recherche, ainsi que par l'investissement extérieur dans la R-D. À cette fin, une stratégie ouverte doit être adoptée en direction de l'internationalisation, notamment dans la sphère universitaire.
- *Assurer une gouvernance efficace.* L'engagement des autorités doit se traduire par des dotations budgétaires appropriées concernant le soutien apporté aux activités de la STI, par une gouvernance efficace de la politique de la STI, notamment de son pilotage et de son financement, et par la coordination entre les différents ministères de la vaste panoplie de mesures ayant une influence sur les performances de l'innovation. La qualité de la gouvernance dans les principaux pans du système d'innovation, notamment dans le secteur des ORP et des universités, est essentielle. Pour la Slovaquie, il s'agira à l'avenir de mettre de l'ordre dans la multitude des initiatives de financement, et de lancer des réformes de grande envergure des universités et des ORP. Une saine gouvernance passe également par une offre appropriée de ressources humaines et de compétences ; le manque de capacités nationales d'élaboration des politiques de la STI rend difficiles le développement de stratégies radicalement innovantes, la mise en place d'un consensus entre les différents acteurs, et l'application des stratégies dans le système d'innovation.
- *Veiller à la qualité, à la pertinence et à la présence d'une masse critique dans la recherche publique.* Il convient pour cela de sélectionner de manière très rigoureuse les projets et les équipes de recherche demandant un financement, de faire participer activement les chercheurs à la définition des priorités de la recherche et de concentrer les ressources sur des domaines sélectionnés. Les centres de compétences et d'excellence peuvent jouer un rôle important à plus long terme. La réforme des universités et des ORP doit susciter une forte croissance des groupes et des domaines d'excellence et favoriser une mise en place efficace de mesures de renforcement de la qualité.
- *Poursuivre des stratégies participatives.* La politique de l'innovation doit être réactive face à l'évolution des besoins des acteurs du système d'innovation. La réussite de l'élaboration et de la mise en œuvre de toute stratégie nationale dans le domaine de la STI passe inmanquablement par la mise en place d'une stratégie partagée par l'ensemble des principaux acteurs privés et publics. Cette condition préalable est particulièrement importante pour les systèmes d'innovation dans lesquels les intérêts, les incitations ou les perceptions des intervenants diffèrent fortement. Les processus exposés dans la RISS et dans le NPHE constituent une

étape importante dans cette direction et les questions qu'ils soulèvent doivent faire régulièrement l'objet d'un débat plus vaste rassemblant les acteurs et le public.

- *Mettre l'accent sur l'évaluation.* Une évaluation externe régulière – de préférence avec une participation internationale – des programmes et des institutions financés par des fonds publics doit devenir la norme, dont il conviendra de tirer des conséquences concrètes pour l'octroi de financements à l'avenir. Afin d'étayer utilement les décisions relatives au pilotage du système d'innovation, les évaluations ne doivent pas reposer uniquement sur des notifications. Des méthodologies plus élaborées et modernes sont nécessaires pour mener à bien une évaluation d'impact rigoureuse. L'évaluation doit être solidement ancrée dans le cycle d'élaboration des politiques de manière à ce que ses résultats soient intégrés à la conception des politiques ultérieures. La mise en place de procédures d'établissement budgétaire reposant sur les performances pourrait imprimer un nouvel élan à cet égard.
- *Associer des mesures à court terme et des initiatives à plus long terme et veiller à achever les réformes.* Compte tenu de la rapidité d'évolution du contexte mondial, il semble nécessaire d'agir à deux niveaux : prendre des mesures pour concevoir, mettre en œuvre et améliorer les politiques d'innovation à plus court terme de façon à stimuler les performances de la productivité et de la compétitivité, tout en agissant de manière résolue en direction du lancement des réformes structurelles et institutionnelles nécessaires à plus long terme. Les enjeux qui se présentent à plus long terme ont trait à la nécessité de modifier l'organisation de la recherche dans les sphères industrielle, universitaire et publique, de manière à accroître les retours sur investissements dans la recherche et l'éducation, aussi bien dans le secteur privé que dans le secteur public, en consolidant les liens entre la production et l'application des nouvelles connaissances scientifiques et technologiques. Il sera pour cela nécessaire d'aller bien au-delà des programmes de financement « de transition » qui semblent bien installés. Comme en témoigne l'horizon fixé à dix ans dans les stratégies exposées dans la RISS et le NPHE, les attentes relatives au délai nécessaire pour permettre aux réformes de porter leurs fruits doivent être réalistes.
- *Instaurer la confiance.* Si l'instauration de relations de confiance entre les secteurs et les institutions permet de s'adapter plus facilement aux mutations de l'environnement, elle n'en demeure pas moins un défi considérable sur le long terme. En Slovaquie, les dispositifs en vigueur semblent solidement enracinés et farouchement défendus. Les fortes divergences d'opinions, notamment entre les représentants des entreprises et de la sphère universitaire pour ce qui est de la nécessité de réorienter le soutien public en faveur de la recherche universitaire vers des objectifs économiques ou d'autres objectifs de la société, et un débat public très polarisé sur ces questions peuvent faire obstacle à la recherche de plans d'action « à somme positive » présentant des avantages pour l'ensemble des parties prenantes. Mettre en œuvre les changements nécessaires pour relever les défis cités plus haut nécessite des innovations au niveau des programmes et des politiques d'ordres culturel, légal et financier, et notamment des adaptations des rôles respectifs des secteurs qui constituent le système d'innovation, et – le plus important – de leurs relations entre eux et avec la société dans son ensemble. Les perceptions et les habitudes ne changeront pas en une nuit, et ce, même en présence des conditions les plus favorables. Instaurer la confiance et dégager les enseignements de ses réussites et de ses échecs prend du temps.

Le présent examen met en lumière les défis auxquels la Slovénie fait face à court et à plus long terme. Si le pays parvient à remonter le long de la chaîne de valeur en direction d'activités économiques à plus forte intensité de savoir en stimulant l'investissement privé dans la R-D et l'innovation, et en améliorant la ventilation et la gestion de l'investissement public dans ce domaine, elle consolidera sa position sur la scène internationale, notamment vis-à-vis de membres de l'UE plus grands et plus avancés sur le plan technologique. Cette évolution lui permettra en outre d'améliorer sa position, déjà solide à de nombreux égards, parmi les nouveaux membres de l'UE et les partenaires commerciaux dans les Balkans. La proximité géographique, une histoire commune et une spécialisation économique créent des opportunités en matière de développement de nouveaux marchés pour les biens et services slovènes, à condition qu'ils représentent ce qu'il y a de mieux en matière de technique, de conception et de commercialisation, et qu'ils soient produits de manière efficiente. La Slovénie doit également considérer avec l'intérêt qui s'impose les marchés émergents en Asie et dans les autres régions du monde.

Recommandations

À la lumière de ces objectifs stratégiques et de ces principes directeurs, et compte tenu des points forts, des faiblesses, des opportunités et des menaces liés à l'innovation, la Slovénie peut trouver utiles les recommandations suivantes :

Améliorer les conditions cadres de l'innovation

Des conditions cadres appropriées sont un aspect essentiel des performances globales de l'innovation d'un pays. Au nombre des conditions cadres qui influent sur l'innovation figurent la stabilité macroéconomique, de nombreux aspects du régime réglementaire et du système fiscal, les droits de propriété intellectuelle, la concurrence et l'ouverture au commerce international et à l'investissement direct étranger. Dans le cadre de l'attention constante qu'elles portent à l'impact de ces facteurs sur l'innovation, les autorités doivent suivre en permanence l'évolution de ces conditions et poursuivre les objectifs suivants :

- *Instaurer et entretenir des conditions macroéconomiques saines*, et notamment veiller à la pérennité des finances publiques, l'une des conditions préalables les plus importantes pour le dynamisme de l'investissement privé et public dans l'innovation.
- *Préserver la vigueur de la concurrence et adapter les régimes réglementaires afin qu'ils soient propices à l'innovation.*
- *Poursuivre les efforts destinés à alléger la charge administrative sur les entreprises, et notamment sur les jeunes entreprises.*
- *Remédier aux caractéristiques du système financier et de la réglementation le concernant susceptibles d'entraver le financement de projets innovants dans le secteur privé.*
- *Mettre au jour les autres aspects des conditions cadres qui sapent les incitations ou les capacités des PME de lancer ou de développer leurs activités d'innovation, et y remédier.*
- *Passer en revue et modifier les aspects de l'environnement dans lequel évoluent les entreprises susceptibles de brider l'investissement direct étranger en général, et*

en particulier pour ce qui est de l'IDE affecté à la RD et à d'autres activités à fort contenu d'innovation.

Renforcer les ressources humaines de la science, de la technologie et de l'innovation

Le système pédagogique de la Slovaquie, et en particulier l'enseignement primaire et secondaire, peut être considéré comme un pilier solide du système national d'innovation. Le bilan est plus mitigé pour ce qui est de l'enseignement supérieur, qui souffre de divers dysfonctionnements, notamment au niveau du temps nécessaire aux élèves pour arriver au terme de leurs études. La proportion des diplômés de l'enseignement supérieur ne cesse de croître mais à un rythme inférieur à celui de la moyenne de l'OCDE. Compte tenu de l'évolution démographique et du changement des mentalités, le nombre des élèves et des diplômés en sciences et technique ne doit pas être une source de satisfaction. Par ailleurs, dans l'industrie, les compétences des chercheurs doivent être modernisées en raison de la sophistication technologique croissante des entreprises slovaques. Il est possible de favoriser l'émergence de compétences locales par des politiques ambitieuses ciblées sur la main-d'œuvre, portant notamment sur l'apprentissage tout au long de la vie. La suppression des obstacles en vigueur et des incitations mal conçues pourrait se traduire par une augmentation du pourcentage de diplômés et une diminution de la durée des études. Le NPHE et la RISS prévoient tous deux certaines réformes auxquelles le présent examen se rallie entièrement. L'offre des ressources humaines doit également être renforcée par une internationalisation active. Les liens entre l'industrie et le secteur public de la recherche doivent être consolidés. Les autorités doivent :

- *Prendre des mesures destinées à accroître le nombre des chercheurs et des autres acteurs qui contribuent à l'innovation dans l'industrie* dans différents types d'entreprise et avec des niveaux divers de qualifications officielles. À cette fin, il conviendra notamment de poursuivre les programmes globalement satisfaisants visant à financer le transfert de jeunes chercheurs dans les entreprises. Il faudrait en outre envisager d'inciter le personnel des organismes de recherche à rejoindre le secteur industriel, et améliorer le soutien à l'embauche, par l'industrie, d'un nombre plus élevé de titulaires de diplômes universitaires d'un plus haut niveau.
- *Permettre à la population active de continuer à se former tout au long de la vie.*
- *Prendre les mesures appropriées, notamment adapter les évolutions de carrière dans les universités et les ORP, ou mettre en place des incitations au changement de secteur sans baisse de rémunération, perte des acquis ou déclassement.* Faciliter une plus grande mobilité du personnel clé entre les universités, les ORP et l'industrie.
- *Préserver les ambitions nationales en matière de formation en alternance et de création d'instituts technologiques/de collèges techniques.* Examiner, dans ce contexte, le bilan tiré par les autres pays en matière de création d'universités de sciences appliquées ou de technologies, ainsi que le rôle de l'industrie locale dans l'élaboration de programmes particuliers et l'évaluation de la demande future en diplômés.
- *Atténuer les facteurs explicites et implicites qui empêchent les individus hautement qualifiés du monde entier de travailler en Slovaquie.* Il s'agit là d'une entreprise majeure (voir également les recommandations relatives à l'internationalisation).

Améliorer la gouvernance du système d'innovation

La gouvernance du système slovène d'innovation doit beaucoup à son évolution progressive et pas à pas, et à son adoption de bonnes pratiques de l'étranger. Le résultat global peut être qualifié de structure de gouvernance moderne et modérée, dotée de processus de budgétisation reposant sur les performances, d'une planification à long terme, d'un conseil consultatif sur la science et l'innovation relevant de deux ministères, de plusieurs organismes jouissant de degrés divers d'autonomie, d'un système de financement composé de plus de 20 programmes et de divers circuits de retour d'information et de communication.

À l'instar du système de gouvernance de nombreux pays, celui de la Slovénie peut être amélioré si l'on agit sur chacun de ses constituants. La budgétisation reposant sur les performances doit être affinée et la pérennité des actions doit être encouragée par une planification à long terme. Le conseil consultatif doit améliorer son bilan et les ministères ont des difficultés à faire appliquer leurs politiques en raison d'un problème de sous-effectif. Les « modèles économiques » selon lesquels fonctionnent les principaux organismes de financement et les relations entre certains de ces organismes et leur ministère de tutelle doivent être examinés de près. Les activités des programmes de financement se recoupent quelque peu et semblent reproduire les efforts d'autres intermédiaires financés par les mêmes organismes. Une culture de l'évaluation plus sophistiquée pourrait contribuer à améliorer les circuits de l'information et de la communication. L'amélioration de la gouvernance nécessiterait de se pencher sur un certain nombre de questions.

La gouvernance globale

De manière générale, il convient d'accentuer les efforts visant à mettre en place des dispositifs qui répondront aux besoins actuels et futurs du pays et permettront d'appliquer efficacement les politiques. L'amélioration de l'efficacité est particulièrement importante dans un contexte de consolidation budgétaire. Elle permettrait en outre de rallier plus facilement l'adhésion du public en faveur des dépenses publiques engagées pour la STI. Les autorités doivent :

- *Définir clairement le rôle du nouveau conseil consultatif à haut niveau sur la recherche et l'innovation.*
- *Continuer de concevoir les deux principaux documents stratégiques – la RISS et le NPHE – comme faisant partie intégrante d'un processus de changement de la société auquel participent les sphères politique, universitaire et privée, ainsi que le grand public, compte tenu des opinions antagonistes qu'ont ces différentes communautés des caractéristiques et des besoins du système slovène d'innovation.*
- *Veiller à un meilleur alignement de la stratégie et des instruments de la SRA de manière à modifier les processus en vigueur dans les universités et les ORP (ainsi qu'indiqué dans la RISS et le NPHE). La difficulté pour la SRA consistera à contribuer au changement de l'organisation dans les universités et les ORP sans nuire à la qualité.*
- *Rationaliser la liste et les programmes faisant doublon des organismes participant au soutien de l'innovation, tout en veillant à ce que les missions à accomplir à l'avenir puissent s'appuyer sur les capacités organisationnelles appropriées et un effectif dédié en nombre suffisant, afin d'éviter les retards. Cette rationalisation*

doit englober les intermédiaires fonctionnels autres que les organismes de financement, notamment dans le vaste domaine du transfert de technologie, de l'entrepreneuriat et du conseil en matière d'innovation. La fusion de différents organismes pourrait être une solution, même s'il convient de ne pas négliger la question moins visible, mais peut-être plus importante, de la rationalisation des programmes et de la diminution des chevauchements.

- *Envisager de doter le MHEST d'agents supplémentaires* compte tenu de l'ampleur de la tâche à accomplir, et ce, en dépit du contexte de consolidation budgétaire.

La panoplie des mesures et les instruments d'action spécifiques

La panoplie de mesures déployée par les autorités slovènes en matière d'innovation montre des signes de « surpopulation » et transmet parfois des messages contradictoires. Les domaines du transfert de technologie, de l'entrepreneuriat, de la coopération entre la science et l'industrie et du financement de la R-D semblent souffrir d'un certain nombre de chevauchements d'activités. Par ailleurs, certains programmes et organismes semblent financer des activités à la fois directement et indirectement, en subventionnant aussi bien les utilisateurs finals que les organismes intermédiaires œuvrant pour le transfert de technologie ou l'entrepreneuriat (qui apportent une aide similaire). Le système scientifique reçoit en outre des messages contradictoires lorsque la RISS et le NPHE poursuivent l'objectif d'accroître l'autonomie des universités et des ORP, alors que la SRA apporte un financement de base direct à des groupes de recherche, agissant ainsi en marge de l'organisation officielle. Il devrait être possible de remédier à cette situation et les négociations sur la possibilité de fusions en cours dans les organismes de financement appliqué sont un signe encourageant. À cet égard, les autorités doivent :

- *Envisager de simplifier l'offre actuellement très vaste de programmes de financement de la technologie.* Au nombre de ces programmes figurent les incitations en faveur du transfert de technologie, de l'entrepreneuriat et de la coopération. Il est généralement plus efficace de fonctionner avec un nombre plus restreint de programmes de plus grande ampleur.
- *Se livrer à un examen critique du rapport de mandant à mandataire qui lie actuellement le MHEST, la SRA et les bénéficiaires des financements,* et en particulier du rôle prépondérant des indicateurs bibliométriques dans le financement de la recherche et des groupes de recherche.
- *Élaborer des mesures agissant sur la demande, ou améliorer les mesures de ce type en vigueur,* comme des achats publics axés sur l'innovation, et les intégrer dans la stratégie nationale en matière de recherche et d'innovation. Les objectifs stratégiques ne nécessitent pas tous d'être traduits en programmes de financement.
- *Continuer à promouvoir le recours à des instruments de financement autres que les subventions, à savoir les capitaux propres, le financement mezzanine, les garanties ou les prêts. Les programmes du SEF et de la SID sont une composante utile de la politique nationale d'innovation.*

La gouvernance des universités et des organismes de recherche publics

Le secteur de la recherche publique – universités et ORP – n'a pas subi les changements profonds par lesquels sont passés les autres secteurs au cours des vingt dernières années. Par conséquent, la Slovénie ne peut s'appuyer que sur un modèle obsolète (et de

fait, coûteux) d'organisation de la recherche publique alors qu'elle doit lutter contre la concurrence internationale de plus en plus féroce en matière de personnel hautement qualifié et de résultats de la science et de l'innovation. Le présent examen souligne la nécessité impérieuse d'entreprendre une réforme globale. On peut se réjouir que les deux documents stratégiques « Audacieuse Slovaquie » prévoient l'adoption d'un certain nombre de mesures qui n'a que trop tardé. Le présent examen permet de penser que les réformes doivent avoir pour objectif le renforcement de la compétitivité internationale, l'amélioration de la direction, la définition de rôles plus clairs, et la mise en place de garanties organisationnelles destinées à appuyer les efforts visant à atteindre une plus grande autonomie. La compétitivité internationale permet aux pays de mieux se placer sur la scène mondiale, de recruter à l'international et de constituer une masse critique. Afin de renforcer l'autonomie des institutions, il conviendra de donner aux recteurs et aux directeurs des universités, aux comités et aux responsables de tous les échelons des pouvoirs sur les questions d'organisation et de budget, tout en renforçant leur obligation de rendre des comptes. Une définition claire des rôles et la présence de garanties organisationnelles sont garantes d'une autonomie réussie : le MHEST doit pouvoir s'appuyer sur un modèle de gouvernance solide et clair, et doit activement œuvrer en faveur du processus de changement. Pour les ORP, cela signifie que les stratégies en vigueur relatives à la recherche scientifique, aux besoins des utilisateurs et au manque de masse critique doivent être revues en profondeur : si un processus de consultation équitable ne permet pas de dégager un objectif stratégique unique, d'autres solutions, et notamment la possibilité de fusionner en une université, devront être envisagées. À cette fin, les autorités doivent :

- *Entamer une réforme globale des universités, et ce, le plus rapidement possible, ainsi qu'une réforme de la gouvernance des ORP.* Le processus de réforme devra s'inspirer du NHEP et de la RISS car il devra prendre en compte de nombreux aspects de ces deux documents stratégiques.
- *Faire de l'autonomie – qui doit être étroitement liée à la responsabilité et aux performances – le principe majeur qui sous-tend les réformes.* Un cadre juridique et organisationnel structuré doit être mis en place au préalable. Des systèmes d'évaluation et de notification intermédiaires devront accompagner la transition vers l'autonomie, de manière à garantir que les réformes aient les résultats escomptés. Ne pas dévier de la trajectoire fixée, et ce, en dépit des nombreux obstacles – une période relativement longue sera nécessaire pour permettre à l'ensemble des réformes de produire leurs effets.
- *Mettre en application les principes et éléments supplémentaires suivants : direction centralisée puissante, ouverture internationale, incitations à mettre à profit les atouts et à se lancer dans de nouveaux domaines, incitations à la coopération au sein et au-delà de la sphère universitaire, et conception de trajectoires de carrière modernes favorisant la mobilité.*
- *Mettre en place la restructuration des canaux de financement prévue dans le NHEP, en tenant compte comme il se doit de la complexité des caractéristiques juridiques et culturelles du contexte en vigueur.*
- *Alléger ou supprimer la législation et les politiques du travail qui entravent la mobilité interne et externe du personnel des universités, des ORP et de l'industrie.* Il s'agit notamment des systèmes de rémunération qui établissent une distinction entre les activités d'enseignement et de recherche.

- *Revoir la législation en matière de protection sociale qui favorise l’allongement de la durée des études, et inciter les étudiants à ne pas repousser indéfiniment leur entrée sur le marché du travail.*
- *Permettre à la SRA de mettre à profit sa stratégie efficace d’amélioration de la qualité en lui donnant un rôle plus important dans le processus à venir de réforme des universités. Les incitations fournies parallèlement au financement des projets et des programmes doivent être alignées sur les objectifs et les processus de la réforme des universités.*
- *Supprimer les obstacles et élaborer une politique active destinée à attirer les chercheurs étrangers dans les universités et les ORP nationaux. Qu’il s’agisse d’expatriés souhaitant regagner la Slovénie ou de chercheurs n’y ayant jamais vécu, d’étudiants en doctorat ou de professeurs en fin de carrière, tous devraient être bienvenus.*
- *Offrir aux jeunes chercheurs et aux chercheurs étrangers des perspectives de carrière intéressantes, envisager de supprimer les limitations en vigueur relatives aux cours dispensés dans une langue étrangère. Dans ce contexte, s’intéresser à l’expérience des pays et des régions qui proposent aux chercheurs étrangers d’occuper un poste de professeur sur leur territoire.*
- *Réexaminer et, si nécessaire, revoir les arguments à partir desquels ont été élaborées les différentes options relatives à l’avenir individuel et collectif des ORP, et notamment la proposition visant à différencier les fonctions des instituts scientifiques et des instituts technologiques.*
- *Parallèlement, promouvoir le renforcement des liens entre les universités et les ORP, par le biais de l’harmonisation des carrières, de l’élaboration de programmes de travail conjoints et de l’investissement.*

Évaluation

L’évaluation est positive pour l’élaboration des politiques et le renforcement de la transparence. À l’instar de nombreux pays de l’OCDE, la Slovénie doit s’efforcer de promouvoir une culture de l’évaluation plus approfondie. Les autorités doivent :

- *Attacher une importance beaucoup plus grande à l’évaluation, et en particulier à celle des programmes et des institutions.*
- *Rendre rapidement obligatoire l’évaluation des programmes, des initiatives et des organismes (les plus importants) afin de faire bénéficier l’élaboration des politiques des informations obtenues dans le cadre de ces évaluations.*
- *Faire appel au savoir-faire international et associer des spécialistes étrangers à la conduite des évaluations ; il s’agit là d’une nécessité vitale pour un petit pays. Afin de faciliter la réalisation de cette exigence, la documentation et le suivi des programmes et des organismes doivent être disponibles dans au moins une langue internationale courante largement pratiquée.*

Promouvoir l'innovation dans le secteur privé

Avant la récente crise économique et financière, l'économie slovène enregistrait une croissance régulière ; de nombreuses entreprises nationales s'étaient spécialisées en tant que fournisseurs dans les chaînes de valeur internationales. Malgré tout, seul un petit nombre d'entre elles avait atteint un niveau d'innovation satisfaisant et était parvenu à hisser leur productivité au niveau moyen de la zone euro. La crise a démontré la vulnérabilité de l'économie nationale. Il est devenu évident que la Slovénie devait impérativement améliorer la compétitivité de son industrie, notamment en renforçant ses capacités d'innovation et celles de ses entreprises. Des efforts massifs doivent être déployés pour moderniser les entreprises et les secteurs à la traîne pour ce qui est de la productivité, en mettant en œuvre des programmes concrets et pragmatiques. Parallèlement, il convient de continuer à encourager l'essor des secteurs et des entreprises les plus performants.

Les mesures visant à libérer l'innovation dans le secteur privé doivent adopter une double perspective, à court et à long terme. À court terme, l'innovation reposant sur les technologies en vigueur d'origine nationale et étrangère peut apporter des améliorations. La mise en application du savoir existant et des pratiques en vigueur, et l'abandon progressif de pratiques peu rentables au profit des pratiques les plus courantes dans chaque secteur, puis des meilleures pratiques internationales, peuvent entraîner une amélioration de la productivité. La mise en place d'améliorations à long terme de la capacité du système national d'innovation de générer et d'appliquer un nouveau savoir est aussi, si ce n'est plus, important. Lors de la sélection des stratégies à court comme à long terme, il convient d'étudier et d'adapter les exemples de pays de taille plus réduite qui ont obtenu de bons résultats. Les stratégies choisies peuvent inclure des programmes de diffusion des technologies dans le secteur manufacturier, l'instauration globale de politiques de qualité, des mesures en faveur de l'apprentissage tout au long de la vie, et la réorientation sur les améliorations non technologiques de manière à favoriser la croissance de la productivité.

Des efforts visant à rehausser de façon ininterrompue le niveau de sophistication des entreprises slovènes en améliorant leur productivité et en identifiant des niches de marché peuvent permettre de réaliser des progrès supplémentaires. D'autres petits pays ont appliqué, avec succès, cette stratégie, qui leur a permis d'atteindre des niveaux élevés de productivité dans la compétitivité axée sur les exportations et reposant sur l'innovation. Les autorités doivent :

- *Poursuivre leurs efforts visant à accroître le niveau de la R-D et, de manière plus générale, des activités d'innovation menées par les entreprises.* En plus d'une amélioration des conditions cadres, ces efforts réclament un soutien public permanent de la R-D et de l'innovation des entreprises, destiné à pallier les défaillances du marché qui entraînent un sous-investissement dans la R-D dans le secteur privé. Les autorités doivent cibler leurs mesures aussi bien sur les jeunes entreprises que sur celles d'entre elles qui sont déjà bien établies. Ces mesures doivent s'appuyer sur une sélection d'instruments agissant sur la demande, tels que ceux visant à orienter les achats publics sur l'innovation, notamment dans des niches « vertes ».

- *Accorder une attention croissante aux entreprises en activité, notamment aux PME du secteur manufacturier et des services, dans le but de réduire l'écart de productivité entre les entreprises slovènes et celles de pays plus avancés de l'UE et de l'OCDE.*
- *Élaborer des mesures spécifiques (simples) en faveur de la croissance de la productivité, notamment par le biais de l'innovation non technologique.* Ces mesures doivent être conçues pour générer des gains de productivité à court terme via l'introduction et l'amélioration continue des technologies de production, l'amélioration de la qualité et le développement des compétences nécessaires, notamment au moyen de l'apprentissage tout au long de la vie.
- *Envisager de concevoir des mesures destinées à renforcer les capacités des institutions intermédiaires, des universités et des ORP de concevoir, de mettre en place et de fournir des services permettant d'améliorer la productivité, et mener des activités de sensibilisation.*
- *Promouvoir le développement de l'entrepreneuriat social et de l'innovation sociale.*

Renforcer les liens au sein du système d'innovation

Les performances des systèmes d'innovation dépendent fortement de la solidité des liens qui les tissent. Les autorités slovènes reconnaissent l'importance de ces liens, notamment entre l'industrie et les universités/ORP, pour l'innovation. Au cours des 15 dernières années, elles ont pris de nombreuses mesures destinées à améliorer l'alignement des acteurs de l'innovation. Elles ont lancé divers dispositifs de collaboration entre la science et l'industrie et de transfert de technologie, et pris des mesures en faveur de l'entrepreneuriat et de la coopération entre les entreprises. Elles ont également entrepris d'axer leurs politiques sur la formation de pôles. Elles sont aujourd'hui sur le point de mettre en place une strate supplémentaire de programmes. Les centres de compétences et les centres d'excellence ne sont pas que des instruments visant à renforcer les liens entre les différents acteurs de l'innovation, ils apparaissent également comme d'importants catalyseurs du changement de la gouvernance du système d'innovation.

Les autorités doivent continuer dans cette voie tout en dégageant les enseignements de leur expérience afin d'améliorer certains des instruments destinés à promouvoir l'innovation collaborative. Leurs initiatives doivent cependant être guidées et rationalisées. En particulier, les autorités doivent :

- *Suivre et surveiller l'évolution du nombre de leurs programmes, de leur évaluation, de l'abandon des moins efficaces d'entre eux et de la taille critique de chacune de leurs interventions.* En plus d'éviter la multiplication des programmes de faible envergure, les autorités doivent veiller à gérer de manière pragmatique leur portefeuille de financement.
- *Réduire sensiblement le nombre des acteurs (semi-) publics intervenant dans ce domaine,* tout en apportant une aide aux plus performants d'entre eux.
- *Instaurer des systèmes plus efficaces de mesure des performances des intermédiaires et des dispositifs de financement.*

- *Accroître le niveau de coordination entre les divers acteurs et instruments en favorisant la collaboration et les effets multiplicateurs via des regroupements et des réseaux formels.*

Promouvoir la masse critique, l'excellence et la pertinence dans la recherche publique

Les universités et les ORP sont actuellement rassemblés en une multitude de petits groupes et interviennent dans des domaines très variés. La productivité élevée, et croissante, de la recherche nationale, soutenue par des dispositifs de financement axés sur la qualité, va de pair avec une médiocrité relative des retombées des résultats de la science sur la scène internationale. Ce constat vient renforcer les arguments en faveur d'une réforme immédiate du secteur de la recherche publique, qui consisterait notamment à renforcer les ORP et à revoir les incitations offertes par les cadres organisationnels et les instruments de financement. Les centres de compétences, les centres d'excellence et les centres de développement – créés avec les Fonds structurels de l'UE – constituent une étape majeure en vue de se démarquer des programmes et des projets de petite envergure, et de relier plus étroitement les investissements dans l'infrastructure aux projets et aux programmes. Les programmes des centres peuvent faciliter l'obtention d'une masse critique et contribuer à la fois à l'excellence de la recherche slovène et à sa pertinence pour l'industrie et la société. Les autorités doivent avoir pour objectif d'atteindre une masse critique dans un certain nombre de domaines. Si elles ne se trouvent pas forcément dans l'obligation de définir elles-mêmes les domaines prioritaires, elles seraient bien avisées de mettre en place une veille prospective ininterrompue.

En plus de l'ensemble des mesures recommandées dans les sections consacrées à la réforme et à la gouvernance de la recherche publique, les autorités doivent entreprendre les actions suivantes :

- *Mettre à profit les fonds structurels de l'UE, en particulier ceux affectés aux centres de compétences, aux centres d'excellence et aux centres de développement, pour initier un changement à long terme.* Dans ce domaine, la mise en commun des infrastructures, l'augmentation des investissements, et la taille critique sont tous des facteurs importants. Les autorités doivent veiller, sur la base du bilan actuel, à ce que ces centres continuent d'être une priorité pour 2014-2020. Les montants alloués aux centres d'excellence, en particulier, doivent être revus sensiblement à la hausse au cours de cette période (et ce, éventuellement aux dépens de programmes plus limités qui font double emploi avec les financements nationaux) car ce sont ces centres qui forment la future élite de la recherche slovène.
- *Apprendre petit à petit à améliorer les processus d'établissement des priorités, et à réorienter les ressources sur un petit nombre d'atouts. Les domaines tels que ceux sélectionnés pour devenir des centres de compétences et des centres d'excellence doivent aider la Slovénie à améliorer ses performances stratégiques à l'échelon européen et sur la scène internationale.*
- *Éviter de surcharger les structures de direction et se garder d'une bureaucratisation excessive, d'autant plus que les règles et les pratiques à suivre dans le cadre des fonds structurels représentent généralement un lourd fardeau administratif pour les programmes et les organismes de financement.*

Optimiser les retombées positives de l'internationalisation de la R-D et de l'innovation

L'intégration dans la recherche internationale, alliée à de fortes capacités d'absorption, sont des facteurs essentiels pour permettre à un petit pays de réussir dans l'innovation. Le niveau de développement, la situation géographique et l'intégration européenne de la Slovénie, parmi d'autres facteurs, lui constituent une assise solide pour son internationalisation. La Slovénie est une économie ouverte et bien intégrée dans les chaînes de valeur et les échanges internationaux (ainsi qu'en témoigne le niveau élevé de son ratio échanges-PIB). À l'opposé, l'investissement direct (entrant et sortant) a augmenté moins rapidement que dans d'autres pays d'Europe centrale et orientale. Cette lenteur sape les perspectives d'apprentissage et d'acquisition de connaissances technologiques et organisationnelles, et limite par conséquent les retombées potentielles des activités de R-D.

À divers égards, les activités de recherche de la Slovénie sont bien intégrées dans l'effort de recherche international. La participation du pays aux Programmes cadres européens, par exemple, est dynamique. La Slovénie prend part à la coopération internationale dans les domaines de la science et de la technologie, mais l'internalisation de son système d'innovation reste faible dans les autres domaines. Le nombre des chercheurs étrangers dans les universités et les ORP est faible, à l'image de celui des étudiants étrangers. Le vivier de talents dont dispose le pays est par conséquent très limité. Le faible intérêt que présente la Slovénie en tant que site de recherche international n'est pas forcément dû à la taille du pays, mais plutôt à plusieurs facteurs décourageants qui le caractérisent. Ceux-ci vont de l'utilisation quasi-exclusive du slovène comme langue d'enseignement à des procédures de sélection partiellement opaques ou exagérément restrictives, ou à des trajectoires de carrière et des réglementations en matière de rémunération peu attirantes, sans parler de la question des frais de scolarités. Les autorités doivent :

- *Réfléchir à la possibilité d'adopter une stratégie plus audacieuse en matière d'ouverture de la sphère universitaire*, et ne pas se limiter à mettre en rapport les milieux universitaires nationaux et les projets financés par l'UE. Dans ce contexte, l'ouverture des marchés du travail universitaires et le renforcement de l'attractivité internationale du pays en matière d'enseignement supérieur sont des solutions à envisager. Plusieurs nouveaux acteurs de la science, de la technologie et de l'innovation s'emploient actuellement à réformer leur secteur de la recherche publique en instaurant les conditions cadres et les infrastructures nécessaires, et en attirant les meilleurs chercheurs et étudiants du monde entier.
- *Encourager les entreprises, les universités et les ORP à moderniser leurs capacités stratégiques et à faire preuve de davantage d'ambition dans le choix de leur participation aux programmes internationaux, et en particulier à ceux de l'UE*. Cette recommandation dépend étroitement de la réussite des réformes des universités et des ORP. Elle nécessiterait d'abandonner les projets non stratégiques de petite envergure au profit d'instruments plus complexes comme le Forum européen sur les infrastructures de recherche (ESFRI), l'établissement de programmes conjoints, la participation au deuxième appel de l'Institut européen d'innovation et de technologie (EIT) et au futur programme « Grand challenges », etc.
- *Réfléchir à l'élaboration d'une stratégie explicite d'internationalisation de la R-D et de l'innovation*.

- *Saisir les opportunités qui se présentent dans les domaines de la coopération dans la science et la technologie en Europe centrale et dans les Balkans de l'ouest – une région potentiellement concernée par l'élargissement de l'UE. Par ailleurs, une stratégie globale sélective doit être mise en place pour optimiser les retombées positives, pour la Slovénie, de l'internationalisation de sa R-D.*
- *Envisager un « jumelage » avec d'autres pôles/nœuds d'innovation internationaux en vue d'un transfert de technologie et dans le but de résoudre la question du capital propre, notamment du capital-risque. Remédier à la pénurie de capital-risque et d'investisseurs providentiels en ayant recours à des stratégies internationales et en allant chercher les capitaux à l'étranger (notamment par le biais d'un réseau de jumelage pour les start-up).*
- *Revoir l'orientation globale en direction de l'internationalisation à la lumière des retombées qu'elle peut avoir sur les performances de l'innovation et la croissance de la productivité. Dans ce cadre, revoir l'environnement global de l'IDE.*

Notes

1. Cet examen fait suite à plusieurs examens internes et externes récents des performances économiques de la Slovénie et du système national d'innovation (SNI), comme, par exemple, *l'Étude économique de l'OCDE : Slovénie 2009*, et *l'Étude économique de l'OCDE : Slovénie 2011*. Un *Examen du développement territorial par l'OCDE* achevé en 2011 a également été mené en parallèle à la présente étude. En tant que membre de l'Union européenne, la Slovénie participe à bien des égards à des programmes, plates-formes et initiatives communautaires dans le domaine de la science, de la technologie et de l'innovation. La politique d'innovation du pays a récemment été soumise à un Examen par les pairs des panoplies de mesures (*Policy Mix Peer Review*) effectué sous l'égide du Comité de la recherche scientifique et technique de l'Union européenne (CREST).
2. OCDE (2011), *Demand-side Innovation Policies*, Editions de l'OCDE, Paris
3. Cette conception plus vaste de l'innovation, qui réclame la mise en place de politiques nouvelles et de réformes institutionnelles, est aussi impressionnante pour ce qui est de son ampleur et de son ambition que les propositions énoncées dans les deux documents récemment adoptés par la Slovénie, à savoir, la RISS et le NPHE. Son élaboration doit se poursuivre.
4. Ces principes génériques seront suivis plus bas par des recommandations concrètes.

Tableau 0.1. Analyse AFOM (atouts-faiblesses-opportunités-menaces) du système d'innovation de la Slovénie

Atouts	Opportunités
• Un développement socioéconomique réussi et un bilan satisfaisant en termes de performances économiques. • Une position de leader parmi les nouveaux États membres de l'UE, au regard de nombreux indicateurs de l'économie et de l'innovation. • Une offre abondante de main-d'œuvre scientifique et une culture de la recherche. • Des pôles d'excellence dans la recherche universitaire et industrielle. • Une augmentation considérable du nombre et de la qualité des publications scientifiques. • Une participation fructueuse aux Programmes cadres européens. • Une large place accordée à l'innovation et la reconnaissance de la nécessité de moderniser l'économie. • Des institutions distinctes qui se consacrent à la science, à la technologie et à l'innovation. • Un engagement et une mobilisation en faveur de l'innovation au sein des administrations, de l'industrie et de la sphère universitaire.	• Des conditions théoriquement propices à la prise, par les autorités, de mesures visant à stimuler l'innovation et à remonter la chaîne de valeur. • Une intégration à l'économie européenne et mondiale susceptible de compenser les inconvénients liés à la petite taille du pays. • Un pays et une économie compacts, ce qui peut être un avantage en termes de concentration, d'efficacité organisationnelle et de capacité d'adopter des stratégies de niche et de réagir prestement face aux nouvelles opportunités que présentent les marchés. • Une contribution croissante d'un pan de la recherche universitaire au développement économique et social. • La possibilité de devenir un pôle et/ou un nœud d'innovation au sein de l'Union européenne (en élargissement). • La possibilité de se raccorder aux pôles/nœuds d'innovation existants et émergents en Europe, en Amérique et en Asie.
Faiblesses	Menaces
• Un écart de productivité persistant par rapport aux moyennes des pays européens et de l'OCDE. • Une innovation aux performances parfois inégales. • Des capacités stratégiques limitées et un cadre organisationnel faible pour les universités et les ORP. • Des liens insuffisants entre l'élaboration des stratégies et les acteurs de ces dernières. • Une forte divergence d'opinions entre les différentes parties prenantes, et notamment un antagonisme entre l'excellence scientifique et la pertinence de la recherche. • Des différences prononcées entre les priorités de la science (recherche fondamentale) et celles de la technologie (industrie). • La multiplication des instruments de la politique de l'innovation, avec le risque de recoupement des objectifs. • Une internationalisation inégale des différents pans du système national d'innovation.	• L'incapacité de stimuler la productivité risque d'entraîner une perte de compétitivité. • L'incapacité de moderniser l'économie dans un environnement économique mondial en évolution rapide. • L'incapacité de développer des secteurs d'activité à plus forte valeur ajoutée. • Une organisation enclavée – et à de nombreux égards, relâchée – des universités et des ORP, peu propice au lancement des réformes nécessaires pour améliorer les performances. • Une forte divergence d'opinions entre les différentes parties prenantes concernant les principaux problèmes auxquels se heurte le système d'innovation national, qui risque d'entraver la mise en œuvre des réformes nécessaires. • Une recherche qui se « disperse » et qui manque ainsi de profondeur et d'atouts face à la concurrence internationale. • Le manque d'intégration des plateformes destinées à promouvoir le transfert de technologie et les liens entre l'industrie et la recherche, qui pourrait diminuer les retombées des investissements dans la R-D.

Chapter 1

Economic performance and framework conditions for innovation

This chapter gives a short overview of Slovenia's macroeconomic performance and highlights features of its economic development, including its increasing integration in European and global markets – with increasing openness to international trade and foreign direct investment – and sketches some salient features and patterns of structural change in production and trade. It also addresses the current state of important framework conditions for innovation. It concludes with a discussion of the potential role of innovation in Slovenia's economic development in the longer term.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Slovenia's integration and accession to the European Union have deeply influenced the country's economic development, with a profound and lasting impact on its institutional framework and on policy making, not least in the area of science, technology and innovation. Overall, Slovenia has performed well – especially until the onset of the recent financial and economic crisis in 2008 – and has been able to maintain its leading position among former transition and new EU member countries. However, recent developments – especially a sharp downturn in the recent crisis – shed some doubt on the sustainability of its position. The crisis hit Slovenia particularly hard and exposed the vulnerability of parts of its economy. Moreover, for various reasons Slovenia has found it harder than other countries to embark on a dynamic path of recovery and has suffered some loss of competitiveness.

1.1. Macroeconomic performance and productivity growth

Slovenia has very successfully managed its transition to a modern, market-based economy. This process differed – both in the conditions at the start of the process and the approach taken for structuring and implementing the process – from that adopted in other transition economies in central and eastern Europe. All along, Slovenia has remained the most prosperous of these economies and has led this group in terms of gross domestic product (GDP) per capita.¹

For more than a decade preceding the financial and economic crisis that started in 2008, Slovenia recorded strong economic performance. Between 1998 and 2008, GDP per capita grew at an average annual rate of 4.2%, far above the euro area average. Among European OECD members Slovenia was outperformed by only two other transition economies, Poland and the Slovak Republic. Strong growth resulted in rapid catch-up in GDP per capita relative to OECD and EU averages. In 2007, Slovenia reached 81% of the EU15 average, up from 67% in 1997 (in current purchasing power parity terms).

Gains in labour productivity – 4.0% a year – were the major driver of per capita GDP growth during 1997-2007. The rise in labour productivity was attributable to efficiency gains, *i.e.* to growth of total factor productivity (TFP) by an annual 2.2%, and to a somewhat lesser extent to capital deepening (1.9%). Innovation, through the absorption of advanced technologies, production methods and managerial practices from more advanced countries, has contributed to TFP growth, helped by deepening integration into the global economy (OECD, 2009a).

The process of catch-up was at least temporarily interrupted by the global financial crisis. GDP contracted by about 8% in 2009, the sharpest decline among OECD member countries. Only Estonia, which joined the Organisation later, was hit harder. Other small open economies such as Finland and Ireland were also strongly affected. Slovenia's industrial employment, which had recorded impressive gains between 2005 and 2008 following the transition period, reached a peak of 816 000, fell to 793 000 in 2008 and to 772 000 in 2009.

After six consecutive quarters of decline, Slovenia's GDP started growing modestly in the second quarter of 2010 owing to increasing foreign demand and restocking. In contrast, domestic demand – both consumption and in particular investment – continued to decline. After a spectacular fall in 2009, industrial production gained momentum in

2010. Output growth was most pronounced in export-oriented manufacturing industries such as electrical equipment and cars and the trade deficit lessened (Vidovic, 2011).

Like other national and international research institutions, the Vienna Institute for International Economic Studies highlighted the importance of developments in the European Union for sustained improvement in Slovenia's economy. High unit labour costs may reduce Slovenia's export competitiveness (Vidovic, 2011).

The recovery – which had been mainly sustained by the external sector – almost came to a halt in the third quarter of 2011 (OECD, 2011b). Unemployment has risen to close to 8.5% while inflation remains low. Real GDP growth is estimated to have reached 1.0% in 2011 and is projected to remain very weak in 2012 (0.3%), with sluggish domestic demand and a lack of support from exports. The deleveraging of the corporate sector and a weak external environment is likely to weaken growth throughout the first half of 2012, with both consumption and investment being flat. Employment is projected to fall until the fourth quarter of 2012, when the unemployment rate is expected to peak. Activity is projected to pick up again in late 2012, and GDP growth is projected to reach 1.8% in 2013. Risks to the projections are predominantly on the downside.

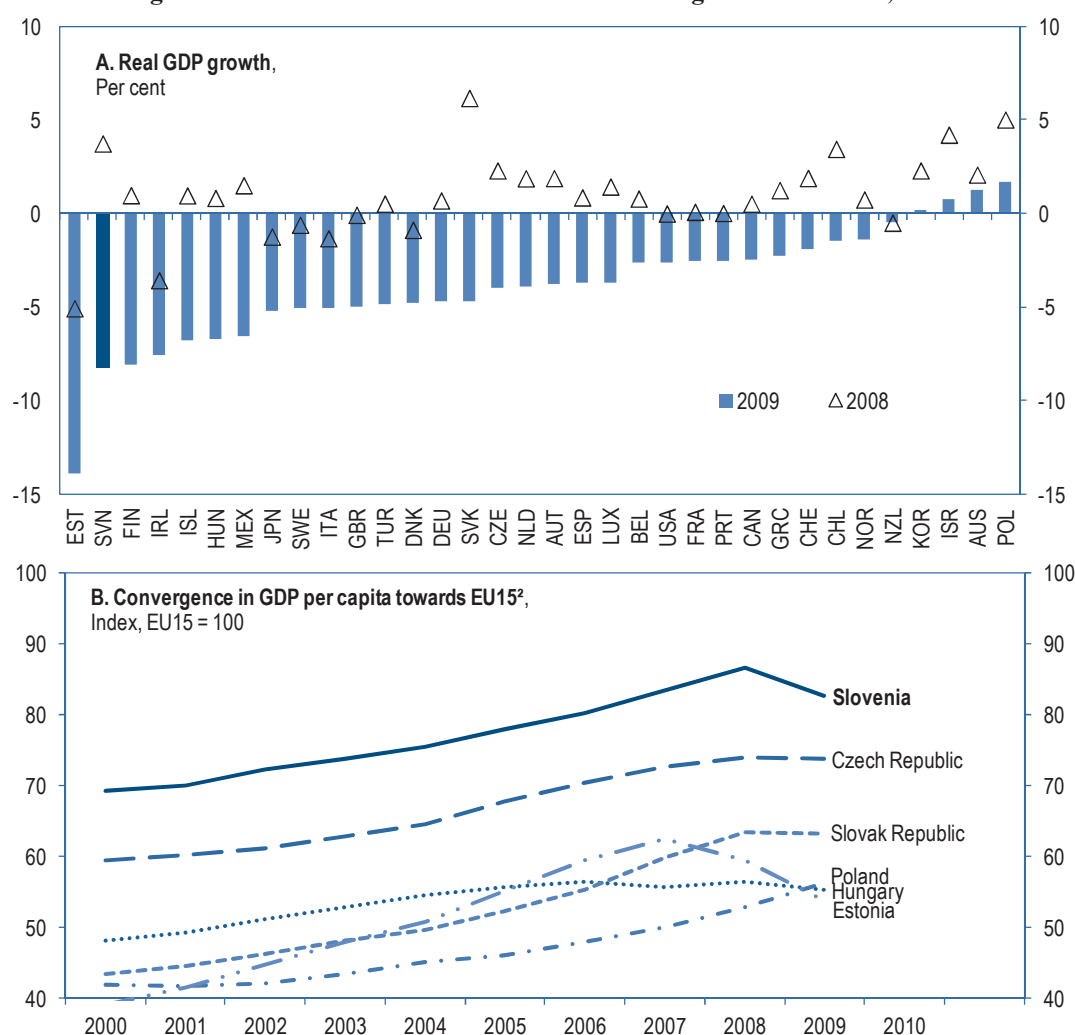
Some recent developments have shed doubt on the viability of further structural reforms that are needed to revive growth and boost innovation. For example, the “Mini Jobs Act” – which aimed to regulate student work and increase the flexibility of temporary labour contracts (for more detail, see OECD, 2011a) – was voted down in a referendum in 2011.

Whatever the short-term prospects, the recession led to a partial reversal of recent gains in convergence (see Figure 1.1 on next page) *vis-à-vis* the EU15. Medium-term projections by national and international institutions predict a slowdown of potential growth for the next five years as compared to the pre-crisis period (IMAD, 2010; IMF, 2011).

As indicated above, the sharp contraction of economic activity was largely due to a decline in Slovenia's manufacturing sector, triggered by a collapse in external demand. This is unsurprising for a small open economy deeply integrated in international markets, and Slovenia is one of the European economies with the highest trade (exports plus imports) to GDP ratios. However, the downturn was aggravated by structural factors, notably an unfavourable composition of exports, which shows a relatively large share of low value-added goods and services, the segments that were hardest hit by the crisis.

Performance in the wake of the crisis differed markedly across sectors. Automotive components were severely affected but some high-technology manufacturing goods, such as medical equipment and pharmaceuticals, continued to grow. It has been noted that during the period of strong economic growth, the Slovenian economy did not sufficiently restructure towards activities with high value added per employee. As the crisis “has the biggest impact on lower-tech and labour-intensive industries, Slovenia is now faced with intensive restructuring of the economy. However, this involves mostly the loss of labour-intensive jobs and is not matched by the creation of new jobs” (IMAD, 2010, p. 20). Its specialisation in the export of low-valued added goods and services is likely to have increased Slovenia's exposure to global cyclical downturns – and perhaps limited productivity gains in the traded goods sector.

Figure 1.1. Effect of the crisis on GDP and convergence in Slovenia, 2009



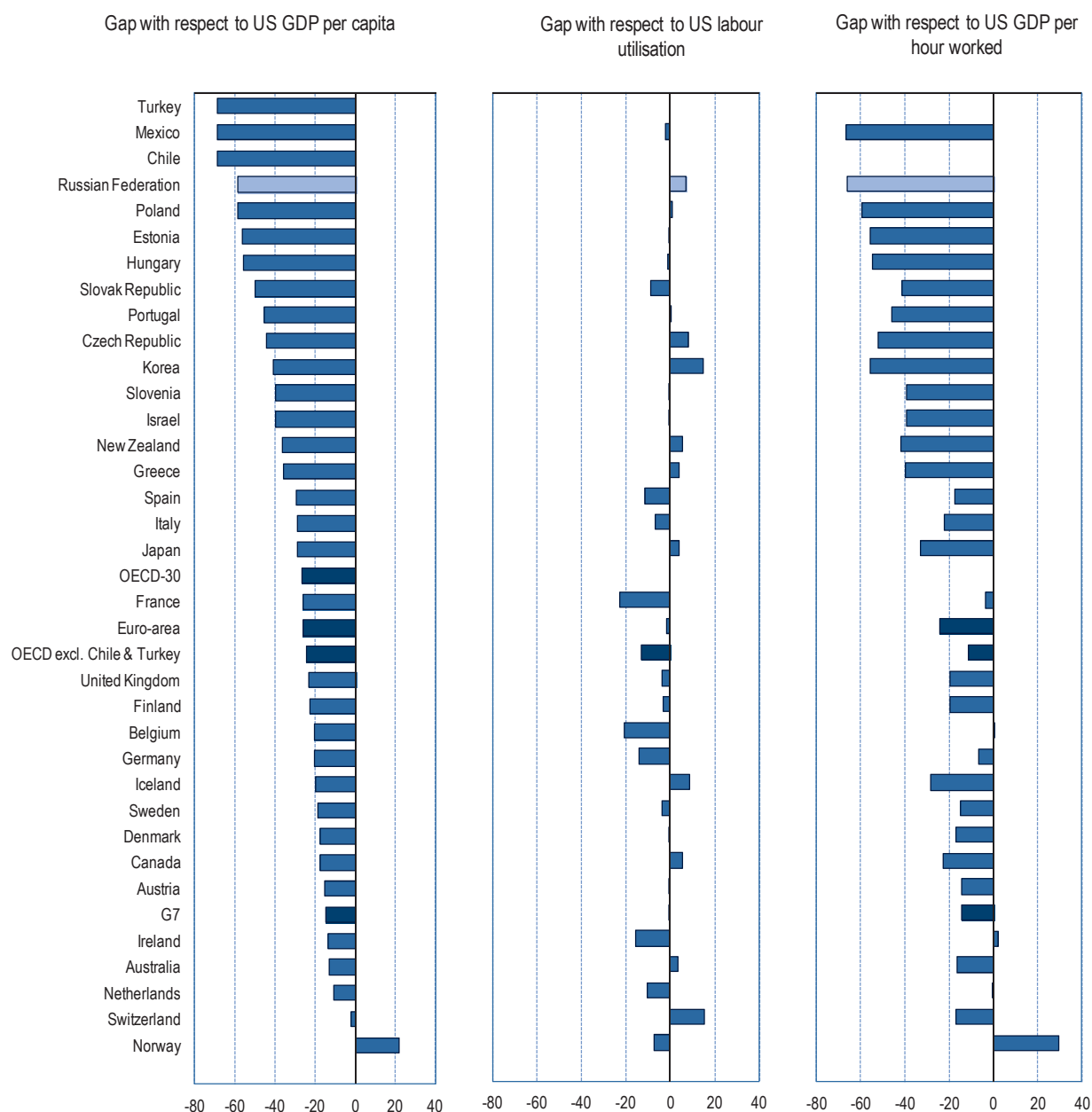
Notes: Real GDP per capita in US dollars at constant prices and constant purchasing power parities.

Source: OECD (2011a, p. 19), *OECD Economic Surveys: Slovenia*, based on OECD (2010), OECD National Accounts Statistics and OECD Economic Outlook: Statistics and Projections (databases), December, <http://dx.doi.org/10.1787/888932369011>.

While many Slovenian firms, mainly in the automotive and machinery industries, have become second-tier or third-tier suppliers of European multinational enterprises (MNEs), most have remained at the lower-medium- or medium-technology level. A smaller number of firms have found a – sometimes larger, sometimes very small – niche in higher-medium or even high-technology segments, such as instruments. Moreover, a considerable share of Slovenian firms suffer from low capitalisation, small size, a low-to-medium technology portfolio, dependence on a few big customers, underdeveloped networks with partners, suppliers, customers and knowledge producers, and finally comparatively low levels of labour productivity. During the crisis, nominal unit labour costs rose, as productivity declined sharply. Beyond the cyclical movement, unit labour costs in manufacturing have reached a high level compared to countries such as the Slovak Republic. High productivity growth is an important factor in regaining and strengthening competitiveness.

Figure 1.2. Income and productivity levels, 2009

Percentage point differences with respect to the United States

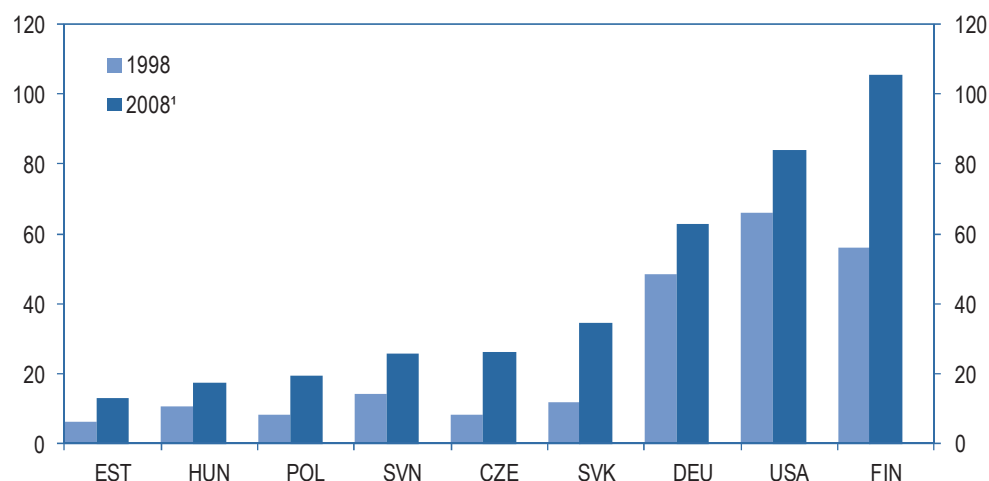


Note: Labour productivity and income levels are calculated using GDP at current prices and converted to US dollars using 2009 purchasing power parities. Labour utilisation is measured as total hours worked per capita. Labour productivity and labour utilisation level estimates for Israel, Slovenia and the Russian Federation are based on hours worked for 2008. The euro area includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, the Slovak Republic, Slovenia and Spain. France includes overseas departments.

Source: OECD Productivity Database, August 2010, www.oecd.org/statistics/productivity.

Figure 1.3. Productivity levels in manufacturing

Value added per worker in constant prices, EUR thousands

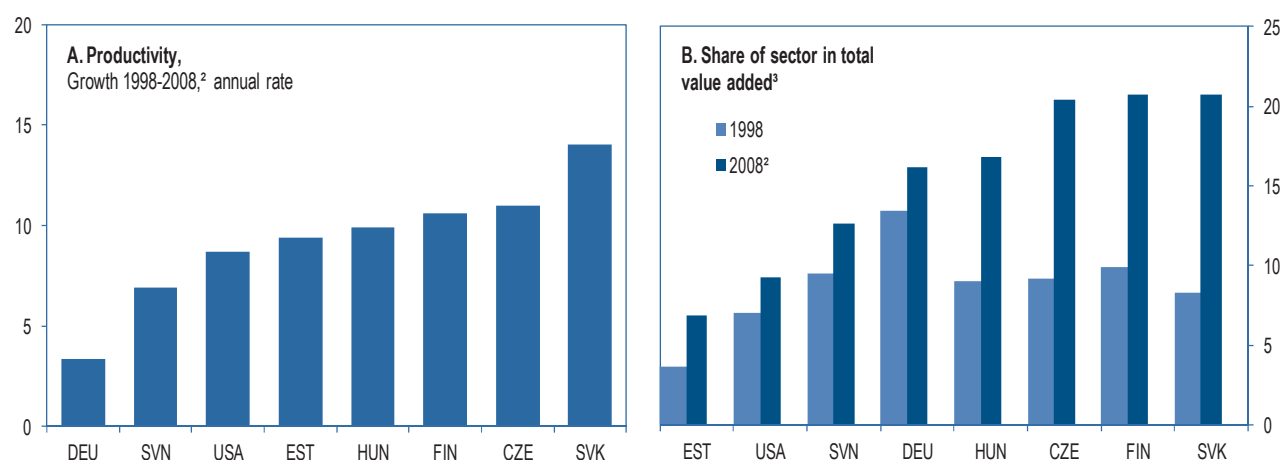


1. 2007 for the United States.

Source: OECD (2011a, p. 96), *OECD Economic Surveys: Slovenia*, based on OECD STAN Database for Structural Analysis, December 2010, <http://dx.doi.org/10.1787/8889323695>.

Figure 1.4. Productivity in high-technology sectors¹

Percentage



1. Value added in constant prices divided by total employment. Includes medium-high technology manufactures. No data available for Poland.

2. 2007 instead of 2008 for Hungary and the United States.

3. Excluding real estate activities.

Source: OECD (2011a, p. 97), *OECD Economic Surveys: Slovenia*, based on OECD STAN Database for Structural Analysis, December 2010, <http://dx.doi.org/10.1787/888932369562>.

Although Slovenia performed outstandingly during the decade prior to the crisis, it is still far from the most advanced OECD economies in terms of GDP per capita. This is almost entirely attributable to lagging labour productivity measured as GDP per hour worked (Figure 1.2), despite good productivity growth and rapid convergence towards the OECD average since the early 1990s. The most recent OECD economic survey of Slovenia finds a gap of 30% in aggregate productivity *vis-à-vis* the upper half of OECD countries. In 2008 manufacturing productivity was still only around one-third of the euro area average. It lagged far behind Finland and Germany, but also trailed, by a much smaller margin, the Slovak Republic and the Czech Republic (Figure 1.3). A comparison with the latter two indicates considerable scope for Slovenia to increase both the size and efficiency of its knowledge-intensive and higher-skill manufacturing industries. The same can be said of network industries (OECD, 2011a, p. 96ff; Figure 1.4).

While there are also other ways to boost innovation, increased inward foreign direct investment (FDI) could help to increase innovation activity and TFP. In a small country this channel should not be neglected, but it requires greater attention to the absorptive capacities of domestic firms. Other framework conditions such as efficient product and labour markets, low barriers to entrepreneurship, and enhanced competition, including in key service sectors, can also play an important role in fostering innovation and TFP growth. In the past, productivity growth varied widely across sectors of the Slovenian economy. While average productivity growth in manufacturing was over 6% a year during 1997-2007, and medium- and high-technology manufacturing grew even faster, this performance was not generally matched by the services sector. As the services sector accounts for an increasing share of aggregate employment, it will need to become more efficient if Slovenia is to maintain high productivity growth. This has immediate implications for innovation policy which is still largely oriented towards manufacturing.

1.2. International trade and foreign direct investment

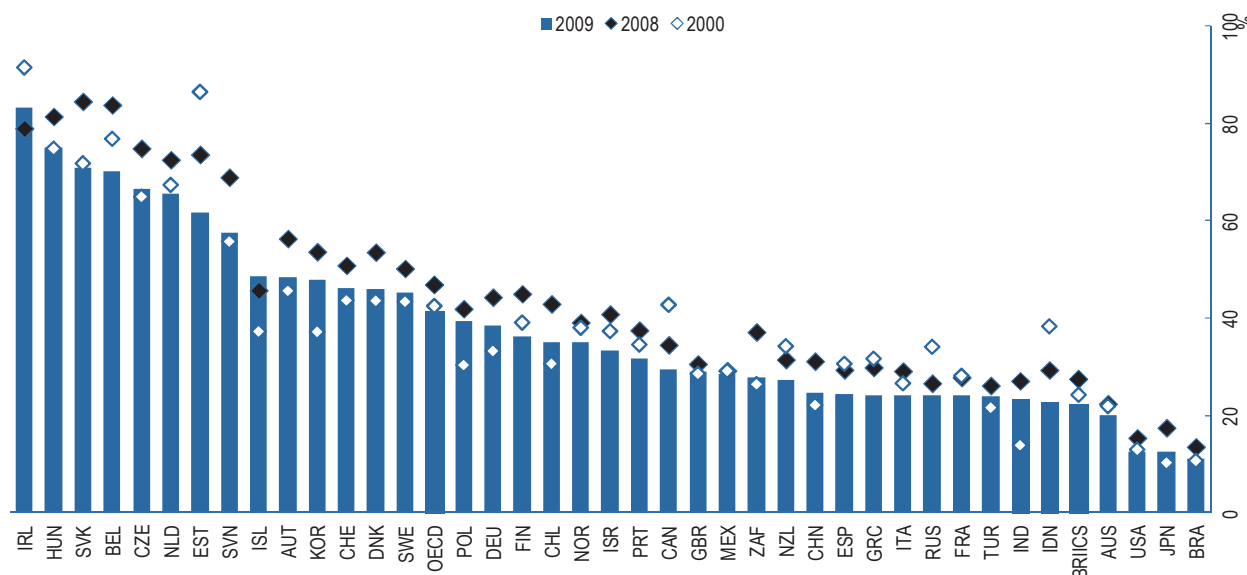
For a small and open economy, in particular one that has not reached the world technological frontier, foreign trade and cross-border direct investment flows are of critical importance for economic growth and development (Keller, 2004). The evolution of the world economy – including increasing globalisation – provides new opportunities but also requires continuous adaptation in order to stay abreast of international competition. Recent economic developments, not least in Europe's southern periphery, have highlighted the importance of maintaining competitiveness. International linkages through trade and FDI are also important for a country's innovation performance since they are channels of knowledge flows both directly as well as indirectly through the transfer of knowledge embodied in imported goods.

International trade

Over the past two decades, Slovenia has become solidly integrated in international, mostly European markets. Its economy suffered a setback at the onset of the crisis as the share of external trade temporarily dropped by about 11 percentage points, a much sharper decline than in the EU on average (IMAD, 2010). Yet, Slovenia's participation in international trade continues to be high. In 2009, exports plus imports were 57.5% of GDP, down from a pre-crisis share of close to 68.9% in 2008, but still above the 55.7% of GDP in 2000 (Figure 1.5). On this measure Slovenia is far more open than the OECD on average, and also more open than other small open economies in Europe such as Austria, Switzerland, Denmark and Sweden.

Figure 1.5. Trade openness

Average of total exports and imports of goods and services as a percentage of GDP, 2000, 2008 and 2009



Source: OECD (2011c), *Science, Technology and Industry Scoreboard*, based on OECD, National Accounts Database, June 2011; International Monetary Fund, *World Economic Outlook* and Balance of Payments Databases, May.

Foreign direct investment

Foreign direct investment has multiple effects and can play a critical role in a country's innovation performance. It can be expected to boost host countries' productivity performance through a number of channels. Some of these directly affect innovation activity in the host country. For example, firms receiving FDI often achieve efficiency gains through the transfer of technology, better organisational and management practices, improved human resources, or better integration in supply chains and international markets. In addition, "knowledge spillovers" may lead to improved efficiency in other domestic firms. This may occur in the same sector, or in upstream or downstream firms (suppliers or customers), or in regional innovation networks involving foreign-controlled firms. FDI can also stimulate innovation indirectly, *e.g.* via increased competition. Overall, the available evidence seems to indicate that FDI boosts productivity through a direct effect on enterprises that are started up or acquired rather than through indirect spillover effects.

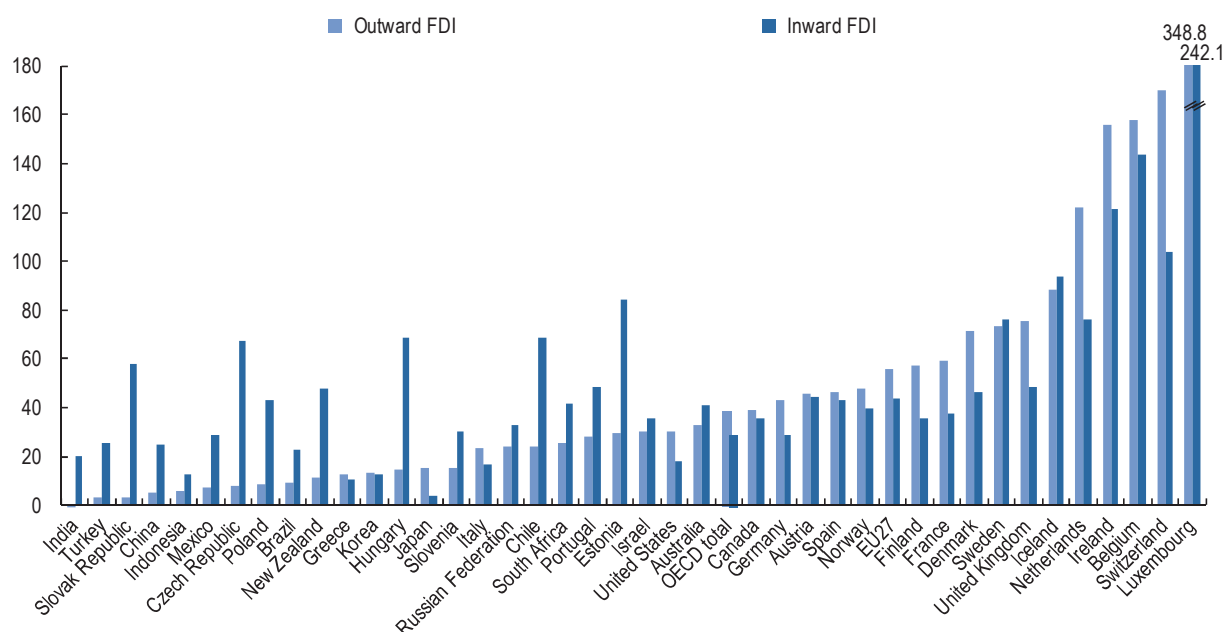
Some new EU member states, for example, have in fact developed some characteristics of a dual economy, in which highly productive subsidiaries of MNEs co-exist alongside largely low-productivity domestic SMEs which often serve unsophisticated local demand (OECD, 2008a). Success in realising positive spillover effects seems to be related to the absorptive capacity of domestic firms. For this reason, supportive measures may be needed both to enhance this capacity and to embed subsidiaries of MNEs more organically into the domestic economy. There is now a considerable amount of empirical evidence concerning spillovers from FDI to the host economy (Bijsterbosch and Kolasa, 2009; Crespo and Fontoura, 2007; Damijan *et al.*, 2008; Hanousek *et al.*, 2010; and the discussion in OECD, 2011a). Outward FDI linking the economy with knowledge centres and innovation networks abroad can also play an important complementary role in gaining access to cutting-edge information and technology.

In contrast to its high level of international trade, Slovenia has remained one of the EU countries with the lowest levels of internationalisation in terms of inward FDI, even though the stock of inward FDI to Slovenia has grown more than tenfold since the beginning of the transition process (to almost EUR 11 billion by the end of 2008).² However, having started from a position similar to that of other central and eastern European countries in the mid-1990s (with a stock in the range of about 10% of GDP), Slovenia subsequently received much less FDI. This can be partly ascribed to the absence of large-scale privatisations in network industries such as energy and telecommunications. Yet, this does not explain all of the difference, as Slovenia's share of FDI is much lower in all sectors of the economy (except for financial intermediation), including manufacturing (OECD, 2011a). In some central and eastern European countries FDI made it possible to shift production and export structures and become strongly integrated in European production networks.

Many reasons are put forward in attempts to explain weak inflows of FDI.³ Some of them indicate the need for further improvements in the broader enabling environment (OECD, 2011a). The labour market⁴ and higher education institutions seem to be critical weaknesses and affect the environment for FDI. Low contestability, *e.g.* in key network industries, also appears to deter inward FDI.

Figure 1.6. FDI stocks

As a percentage of GDP, 2010 or latest available year



Source: OECD Factbook 2011-12. Statlink: <http://dx.doi.org/10.1787/888932504158>

The past decade has seen a surge in FDI in research and development (R&D) worldwide (OECD, 2011c). In contrast to this international trend and the experience of a number of small countries in Europe and elsewhere, Slovenia does not seem to have a comprehensive approach or strategy for inward and outward investment in R&D. It could adopt measures to attract foreign R&D-related investment to complement existing innovative clusters, for example. High-quality universities and public research organisations (PROs) can play an important role in attracting investment in R&D. For outward investment, a proactive strategy might include helping domestic firms to establish an R&D foothold abroad.

1.3. Structural change: Production and international trade

Production

At 2.4% (2008) Slovenia has a higher share of agriculture in total value added than the euro zone average (1.8%) but a lower one than new EU member countries (e.g. 4.3% in Hungary). Yet, at 33.9%, the share of industry (including mining and quarrying) is high by international standards. It is only slightly lower than in formerly centrally planned central and eastern European economies such as the Slovak Republic and the Czech Republic (both with shares around 38%) and Russia (around 36%) but higher than in OECD countries that have retained a strong industrial core, such as Austria (30.7%) and Germany (29.8%). The industry shares of the latter are well above the euro zone average of 26.5%. The share of services is 63.8%, ahead of the Czech Republic and Slovak Republic (59.9% and 58.8%, respectively), but below the euro zone average of 71.7%.

Table 1.1. Value added and productivity by sector¹

	Value added per worker (% growth) ²	Share in total value added ³ %		Share in total output ³ %		Value added per worker (EUR)	
	1998-2008	1998	2008	2000	2008	1998	2008
Business sector ⁴	3.8	74	79	82	85	16 476	23 974
Agriculture	2.4	4	2	3	2	4 866	6 166
Manufacturing	6.0	27	29	39	38	14 322	25 606
High and medium-high technology manufactures	6.9	10	13	15	17	16 432	32 093
Low technology manufactures	4.8	11	8	14	10	12 467	19 886
Construction	1.6	7	8	10	12	16 322	19 103
Utilities	4.0	3	3	3	3	33 687	49 708
Post and telecommunications	3.8	2	3	2	2	32 106	46 705
Transport and storage	3.1	5	5	6	6	17 416	23 731
Wholesale and retail trade	3.6	13	13	10	11	15 422	21 929

1. Using value added and gross output in constant prices, and total employment.

2. Annual rate.

3. Excluding real estate activities.

4. Non-agriculture business sector services excluding real estate activities.

Source: OECD (2011a) based on OECD STAN Database for Structural Analysis, December 2010.

During 2006-08 value added in agriculture declined by -0.7% in Slovenia; it was nearly constant (0.3%) in the euro zone, and grew quite strongly in the Slovak Republic (5.5%) and Hungary (4.3%). Real value added in industry expanded by 6.1%, far more rapidly than in the euro zone and the OECD overall. Among new EU member states, only the Slovak Republic (11.8%), Poland (9.2%) and the Czech Republic (8.7%) performed better. The services sector expanded by 5.3%, again faster than the OECD on average (2.6%) and new member countries, with the exception of the Slovak Republic (7.8%).

From 1998 to 2008 the business sector increased its share in the Slovenian economy (Table 1.1). The increase in the share of manufacturing was accompanied by structural change; while high- and medium-high-technology manufactures expanded, shares of low-technology manufactures declined in both total value added and total output. Productivity in high and medium-high-technology industries grew by 6.9%.

International trade

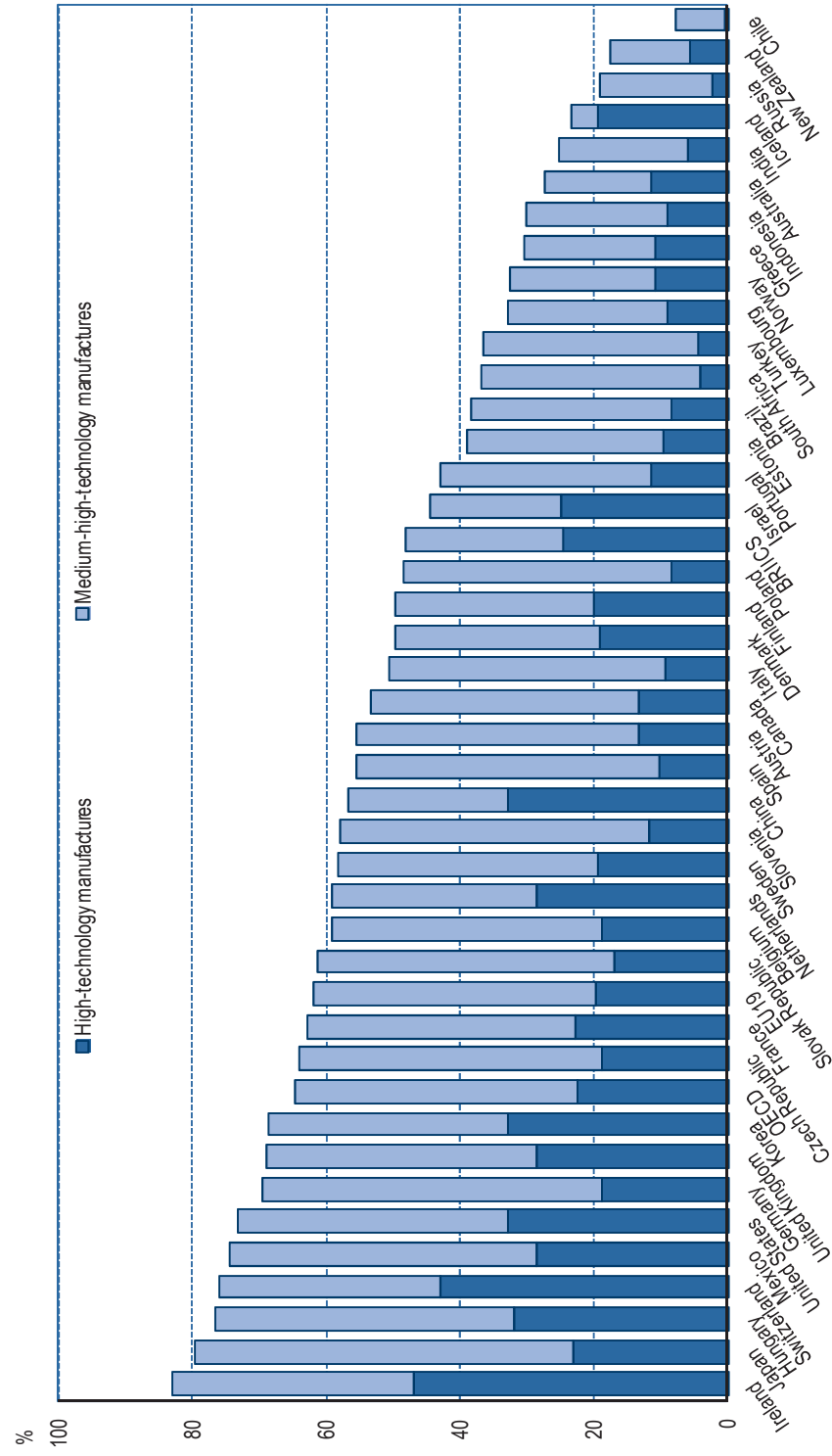
Broadly speaking, the features of Slovenia's export structure are:

- Strong concentration of medium-high-technology, followed by medium-low-technology exports.
- Relatively low high-technology exports, and shrinking but still substantial exports of low-technology products.
- A medium-term increase in export specialisation in medium-high- and high-technology exports and a decline in medium-low-technology and especially low-technology exports.

The combined share of high- and medium-high technology in Slovenia's total manufacturing exports is in the mid-range for OECD economies but below the average (Figure 1.7). The share of high-technology exports is relatively small. Slovenia's high-technology industries accounted for a slightly positive contribution to the manufacturing trade balance in 2007 (Figure 1.8). During 1998-2008, Slovenia's manufacturing exports expanded by 12.6% a year on average, compared to 8.8% for the OECD overall (Figure 1.9). However, high-technology exports grew by 16.8%, a pace much faster than the OECD average of 7.8%. Medium-high-technology exports expanded slightly less rapidly (13.7%) but still faster than the OECD average (9.3%). However, Slovenia was outperformed in these areas by the Slovak Republic, the Czech Republic, Poland and to some extent Hungary.

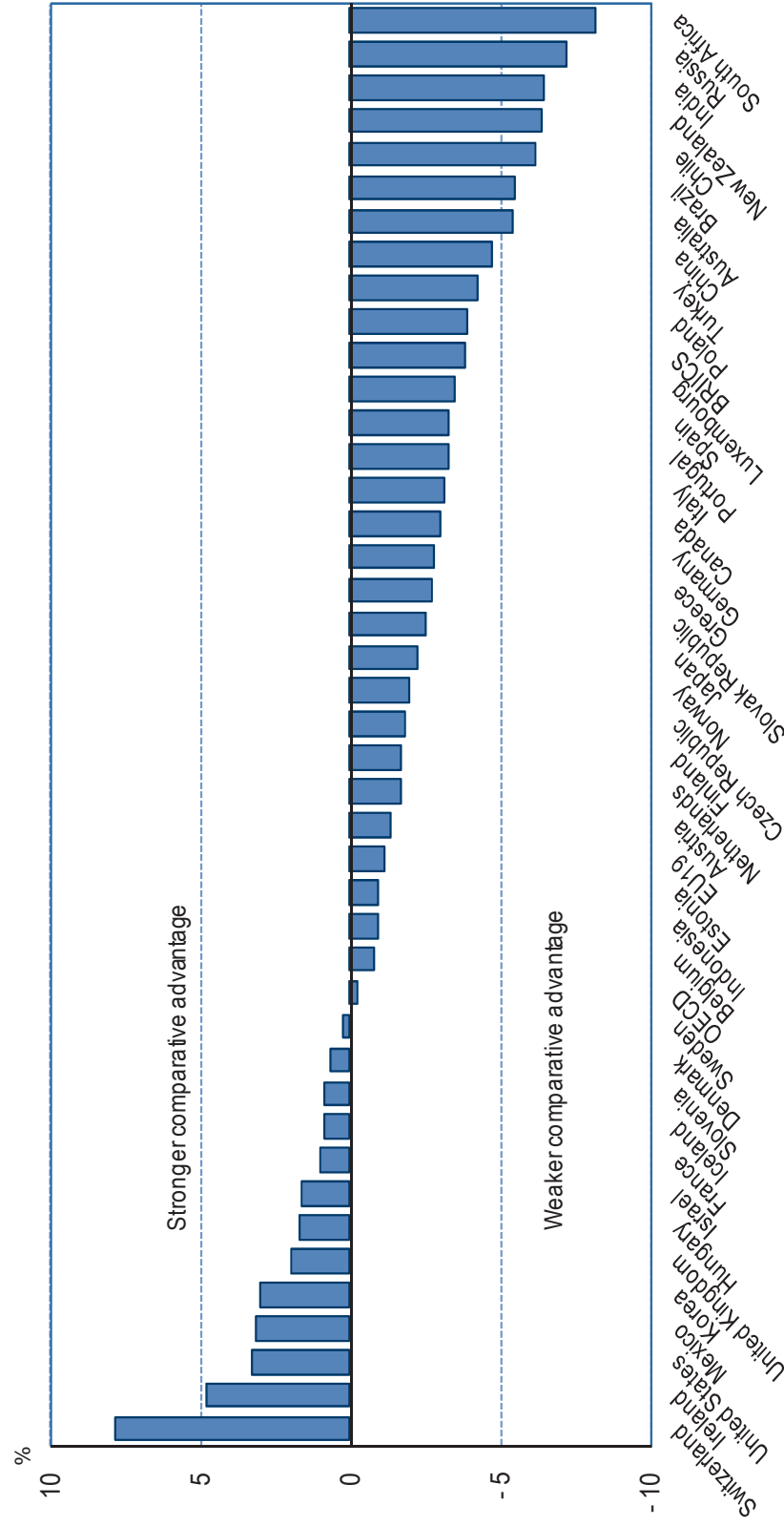
Slovenia's market shares (total exports) in the medium-high- and high-technology range increased between 1995 and 2007 (Table 1.2). In contrast, its market shares in both low-technology- and medium-low-technology exports declined. Slovenia's manufacturing export specialisation, as measured by an index of revealed comparative advantage (RCA), has also shifted since the mid-1990s.⁵ It has increased especially in the medium-high-technology segment (to a RCA index value of about 1.3 in 2007), and "underspecialisation" has decreased in the high-technology segment. Specialisation has declined most in low-technology and to a lesser extent in medium-low-technology manufactures, with both segments approaching a RCA index value of 1.0, *i.e.* the borderline between underspecialisation and specialisation. Overall, compared to other countries, Slovenia's specialisation patterns are not very pronounced in terms of technology categories but the underspecialisation in high-technology manufactures stands out.

Figure 1.7. Shares of high- and medium-high-technology manufacturing exports, 2007



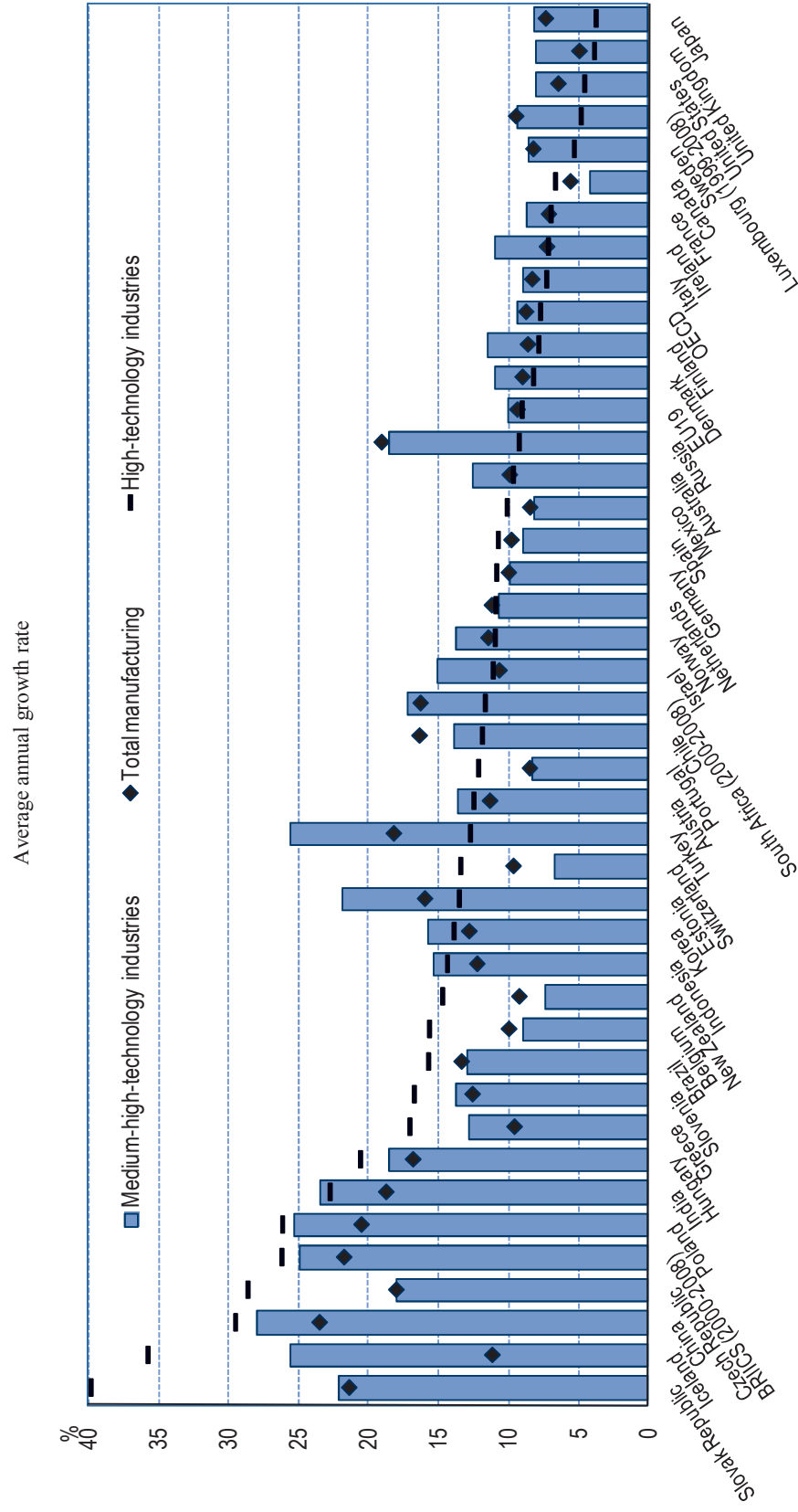
Source: OECD Science, Technology and Industry Scoreboard 2009.

Figure 1.8. Contribution of high-technology industries to the manufacturing trade balance, 2007



Source: OECD Science, Technology and Industry Scoreboard 2009.

Figure 1.9. Growth of high- and medium-high-technology exports, 1998-2008



Source: OECD Science, Technology and Industry Outlook 2010.

Table 1.2. Export market shares and revealed comparative advantage: Slovenia, 1995 and 2007

	Market share (total exports)		RCA (manufacturing)	
	1995	2007	1995	2007
High technology	0.08	0.12	0.43	0.52
Medium-high technology	0.19	0.29	1.00	1.29
Medium-low technology	0.22	0.23	1.17	1.01
Low technology	0.27	0.22	1.40	1.00

Source: CEPI/OECD.

1.4. Framework conditions for innovation

The macroeconomic framework, the general business environment, the level and quality of entrepreneurship, the intensity of competition, and product and labour market regulations all influence a country's innovation performance. Good framework conditions and a healthy business environment are key prerequisites for strong performance in innovation. There are several reasons for the importance of framework conditions:

- Innovation activity requires a medium- or long-term horizon and a sufficient degree of stability in the environment in which it is carried out. This is particularly important for R&D and more fundamental types of innovation activity.
- The regulatory framework is of crucial importance for the speed of diffusion, and in some cases also for the generation of new technologies. This was demonstrated on a global scale by the development of the telecommunications sector in recent decades.
- The quality of framework conditions has an impact on the effectiveness of innovation policies. Unfavourable framework conditions are likely to reduce the effectiveness of policy measures designed to foster innovation.

The existence of favourable framework conditions helps to enable and facilitate innovation throughout the economy. Innovation policy is unlikely to be able to compensate for fundamental flaws in these conditions. At the same time, OECD experience shows that in many cases “dedicated” policy measures are needed to address specific market or systemic failures that hamper R&D and innovation. Recent empirical OECD work indicates that both framework policies that shape the conditions for innovation and dedicated science, technology and innovation policies affect innovation performance, both separately and in combination. This work has helped to identify the policies, institutions and framework factors that provide effective means of supporting innovation (Jaumotte and Pain, 2005a, 2005b, 2005c and 2005d).

Overall, Slovenia's favourable economic performance, with its rapid catch-up in terms of per capita income and productivity over more than a decade before the onset of the global financial and economic crisis, was underpinned by a set of generally favourable framework conditions. At the same time, some aspects are likely to dampen innovation activity.

A potential source of weakness in Slovenia's innovation performance is the somewhat unbalanced internationalisation of both the economy and the innovation system, which may be linked in some aspects to prevailing framework conditions. A prominent example is the relatively small inflow of FDI, which may limit possibilities for productivity increases through the transfer of technology and management practices and associated spillovers to the domestic economy. Another example can be found in the country's science and higher education system. While Slovenian researchers participate strongly in European R&D programmes, Slovenia's science and higher education system is still remarkably closed (*e.g.* recruitment patterns at universities).

Product market competition is a driver of productivity growth (Baumol, 2002) and spurs innovation directly or indirectly, through what the economist Joseph A. Schumpeter termed processes of "creative destruction". Yet the effect of competition in product markets on innovation activity that is predicted by economic theory is somewhat ambiguous: competition among incumbents can stimulate innovation, but the possibility of gaining a certain degree of market power may also provide a strong incentive to innovate (the so-called Schumpeterian effect). Most empirical research has found evidence of a positive correlation between innovation and competition,⁶ but recent work by Aghion *et al.* (2005) suggests that the relationship is a concave ("inverted-U") one, with the Schumpeterian effect dominating at higher levels of competition.

Recent empirical work points to a negative correlation between growth in total factor productivity and concentration (Aghion and Bessonova, 2006). The effect is stronger for import-competing industries.⁷ Finally, the incentive to innovate also increases with the degree of similarity between firms in a given sector (the degree of "neck-and-neckness" in terms of their distance from the technological frontier). There is empirical evidence (OECD, 2007, based on Conway *et al.*, 2006) that competition-restraining regulations slow the rate of catch-up with the technological frontier, where labour productivity is highest. Countries with the most restrictive product market regulations, or those with the lowest productivity and hence the greatest scope to move towards the frontier, are likely to achieve the greatest improvement in productivity growth. There is evidence that better product market regulation is also associated with increased foreign investment inflows (Nicoletti *et al.*, 2003) which in turn provides opportunities to benefit from international technology spillovers.

In the Slovenian context a lack of competition in services has been identified, *e.g.* in some network industries and retail sectors, some of which are highly concentrated and stand out in terms of mark-ups (IMAD, 2011, p. 26f) with implications for productivity levels. Although progress has been made over the years in a number of areas, this issue needs to be taken seriously as the performance especially of knowledge-based service industries impacts on the performance of a broad range of downstream industries.

The regulatory system and the business environment are among the framework conditions that can stimulate or hamper innovation. A number of diagnostic tools have been developed to measure product market regulation and benchmark regulatory frameworks. One of these tools is the OECD product market indicators system (see Box 1.1).

Box 1.1. The OECD product market indicators system

The OECD's PMR indicators assess the extent to which the regulatory environment promotes or inhibits competition in markets in which technology and market conditions make competition viable. These indicators have been used extensively over the last decade to benchmark regulatory frameworks in OECD and other countries and have proven useful in encouraging countries to implement structural reforms that enhance economic performance.

The PMR indicator system summarises a large number of formal rules and regulations that have a bearing on competition. The regulatory data cover most of the important aspects of general regulatory practice as well as a range of features of industry-specific regulatory policy, particularly in the network sectors. This regulatory information feeds into 18 low-level indicators that form the base of the PMR indicator system. These low-level indicators are then aggregated. At the top of the structure, the overall PMR indicator serves as a summary statistic on the general stance of product market regulation.

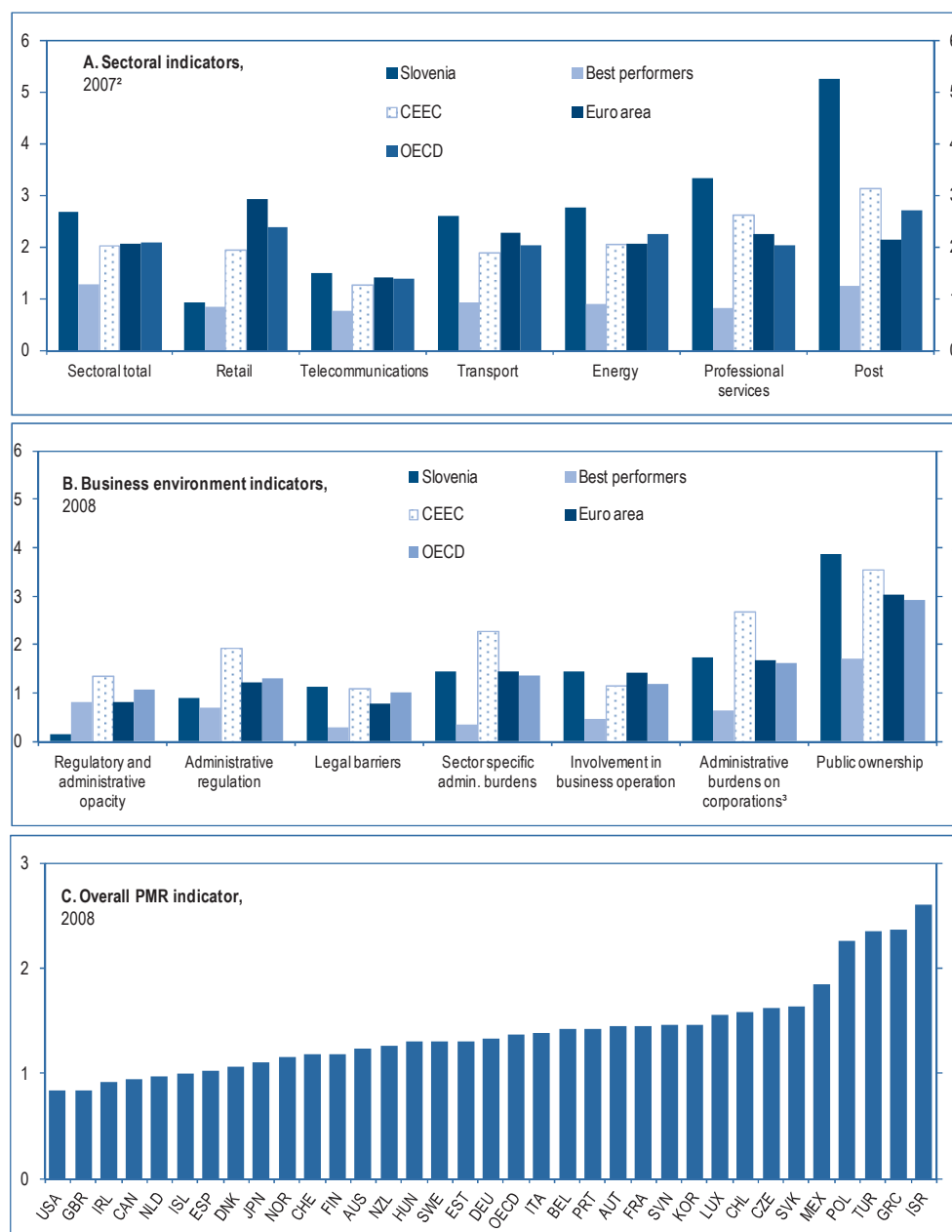
The PMR indicators have a number of characteristics that differentiate them from other indicators of the business environment. First, in principle, the low-level indicators only record "objective" information about rules and regulations, as opposed to "subjective" assessments of market participants as in indicators based on opinion surveys. This isolates the indicators from context-specific assessments and makes them comparable across time and countries. Second, the PMR indicators follow a bottom-up approach, in which indicator values can be related to specific underlying policies. One of the advantages of this system is that the values of higher-level indicators can be traced with an increasing degree of detail to the values of the more disaggregated indicators and, eventually, to specific data points in the regulation database. This is not possible with indicator systems based on opinion surveys, which can identify perceived areas of policy weakness, but are less able to relate these to specific policy settings.

Source: OECD (2009c).

The overall PMR indicator places Slovenia among the more restrictive quartile of countries covered (Panel C of Figure 1.10). However, on this account, Slovenia is closer to countries such as France and Austria than to the most restrictive group to which, for example, Poland belongs. Yet it is also still far from the group of least restrictive economies.

As regards business environment indicators, Slovenia performs better in some respects than other central and eastern European countries (Czech Republic, Hungary, Poland, Slovak Republic) and is on par with the euro area. This is the case for legal barriers, sector-specific administrative burdens and administrative burdens on corporations (and sole proprietor start-ups). Legal barriers and involvement in business operations show a similar pattern but here other central and eastern European countries perform better. In terms of regulatory and administrative opacity Slovenia performs better the comparator group of best performers. At the other end of the spectrum, Slovenia is more restrictive in terms of public ownership than all comparator groups of countries.

Among sectoral indicators, Slovenia has a restrictive stance in post, professional services, energy and transport (in descending order).⁸ In telecommunications the restrictiveness of regulations is greater than the best performers but similar to the other country aggregates. However, in retail Slovenia has a less restrictive stance and is near the best-performing groups.

Figure 1.10. Product market regulationScale of indicators 0-6, from least to most restrictive¹

Notes:

1. All aggregates are unweighted averages. Best performers are the five countries with the lowest scores (excluding those scoring under 0.2). CEEC covers central and eastern European countries that are OECD members: Czech Republic, Hungary, Poland and Slovak Republic. The euro area includes member countries prior to enlargement in 2007.

2. 2008 for professional services and retail.

3. And sole proprietor start-ups.

4. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

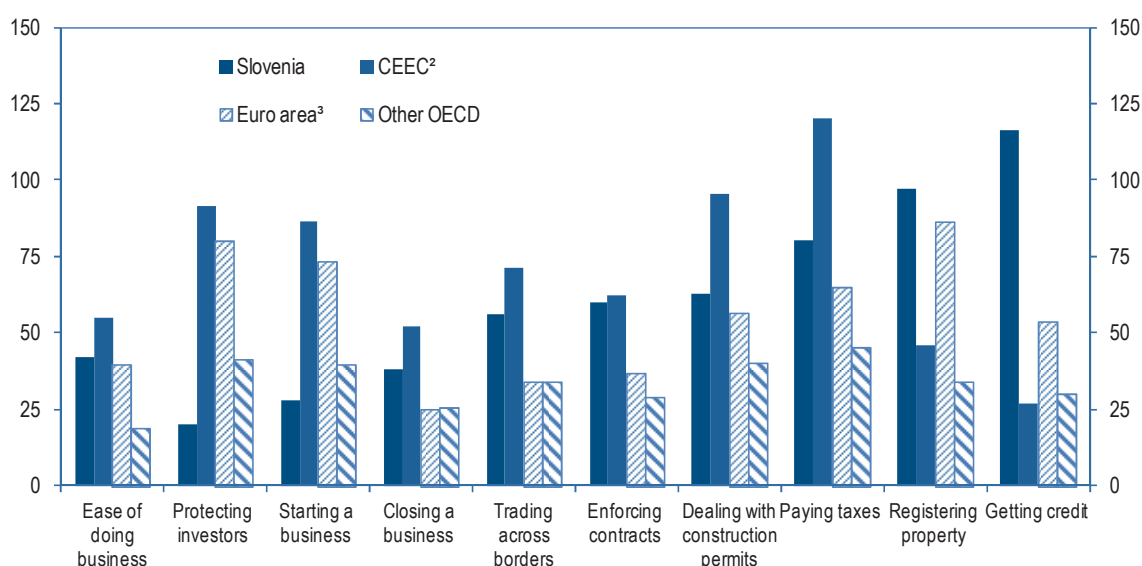
Source: OECD (2011a, p. 121), based on OECD (2009), International Regulation Database, www.oecd.org/eco/pmr, September, <http://dx.doi.org/10.1787/888932369714>.

The World Bank's Doing Business surveys – which differ in approach from the OECD PRM dataset – provide additional information on the obstacles and barriers encountered by Slovenian businesses.⁹ In the most recent of these international comparisons, Slovenia ranks 42nd out of 183 economies; it is close to the euro area's rank but has a way to go to reach the OECD's (Figure 1.11). Slovenia fares worst in “getting credit” (116)¹⁰, followed by “registering property” (97) and “paying taxes” (80). It performs well in “protecting investors” (20) and “starting a business” (28), two categories in which Slovenia outperforms the OECD area.

These results indicate that some elements of the regulatory system deserve attention and need to be further scrutinised as regards to their impact on innovation.

Figure 1.11. World Bank Doing Business 2011 rankings

Rank among 183 countries¹



Notes:

1. Economies are ranked on their ease of doing business, with first place being the easiest. The higher the bar, the more difficult the business conditions. Zone aggregates are unweighted averages of rankings.

2. Central and eastern European countries that are also OECD members: Czech Republic, Hungary, Poland and Slovak Republic.

Source: OECD (2011a, p. 109), World Bank and International Finance Corporation (2010), Doing Business 2011: Making a Difference for Entrepreneurs. <http://dx.doi.org/10.1787/888932369676>.

1.5. The role of innovation in Slovenia's future economic development

Slovenia's persistent productivity gap *vis-à-vis* more advanced economies implies considerable scope for further gains through cross-border absorption of technological knowledge. This absorption is facilitated by domestic capabilities, especially of business firms, in R&D and innovation. In the longer term, however, the sources of sustained productivity growth can be expected to shift (OECD, 2011a). Capital deepening, including through investment in infrastructure as well as in human capital – with an improved education system, including lifelong learning – can help sustain labour productivity growth into the future. However, increasing efficiency in the use of factors

of production, as measured by total factor productivity, can be expected to play an increasing role as the Slovenian economy advances and the income gap *vis-à-vis* more advanced economies – the technological frontier – narrows (OECD, 2011a).

While TFP growth needs to play an increasing role in boosting labour productivity, the sources of TFP growth can be expected to change as well as the economy matures: domestic innovation will have to play a more prominent role as a driver of TFP growth, and. To realise this scenario requires higher levels of innovation capability and performance. This can be achieved in various ways, notably by fostering investment in R&D and innovation while improving the efficiency of the overall innovation system and its constituent parts, topics discussed in detail in this review.

A forward-looking innovation policy for Slovenia will have to aim at:

- *Near-term improvements through innovation based on existing technologies* of foreign and domestic origin. These can give rise to productivity gains. Improved productivity can be achieved by applying existing knowledge to current 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 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.

Notes

1. Yet, while Slovenia's transition was very successful overall, some characteristics of the transition process resulted in some less desirable features in its framework conditions (IMAD, 2010; OECD, 2009a; OECD, 2011a).
2. In 2009, inward FDI turned negative, while investments of Slovenian companies abroad, albeit smaller, remained relatively high, so that Slovenia was a net foreign direct investor in that year (IMAD, 2010). In contrast, developments in 2010 indicate a gradual recovery and renewed increase of FDI (IMAD, 2011).
3. IMAD (2010, p. 21) quotes a survey of foreign investors carried out at the end of 2009 by the Institute of Economic Research (IER) and the Public Agency for Entrepreneurship and Foreign Investments (JAPTI) suggesting that “foreign investors see high taxes, non-payment, high labour costs, an inefficient judicial system, difficulties with dismissing employees, the smallness of the Slovenian market, ineffective competition protection and lack of properly qualified labour as the biggest problems in doing business in Slovenia. Most of these problems have become more acute since 2005”.
4. In the World Bank (2010) Doing Business Survey, Slovenia's ranking for “employing workers” was the lowest of any OECD country.
5. Values of the RCA index above 1 indicate a comparative advantage, values below 1 a comparative disadvantage. When the RCA index is above 1 the country is said to be specialised in the industry concerned.
6. The degree of concentration usually serves as a proxy for competition.
7. Import-competing industries are defined as industries in which the share of imports exceeds 30%.
8. It should be noted in this context that public ownership and control of enterprises in the market sector (including in key service sectors such as financial service, telecommunication, energy, ports, post and rail) is relatively widespread (OECD, 2011a and 2011e).
9. As noted by the World Bank (2011), the Doing Business methodology has some limitations, among them the scope of factors that are important to business and covered in the survey. For reasons of international comparability, the indicators refer to a specific type of business, generally a local limited liability company operating in the largest business city.
10. More generally, financial development is limited by a lack of depth and liquidity of capital markets which are partly related to ownership structures and a lack of an “equity culture” (OECD, 2011a).

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Chapter 2

Performance in science, technology and innovation in an international comparison

This chapter provides an overview of Slovenia's innovation inputs and outputs and compares them with other OECD and EU countries, notably the new EU member states in central and eastern Europe and more developed small economies. For inputs, the comparatively high absolute level and constant evolution of gross expenditure on research and development, with a high industrial share, ensure it a good position. The chapter also shows Slovenia's emphasis on increasing publications, and to a lesser degree patents, with some impact measures still at a low level. Finally, the overall efficiency of the Slovenian innovation system is assessed in comparison with other countries.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

2.1. Innovation inputs

Slovenia's innovation performance is varied. Some innovation inputs, notably R&D expenditure and the number of researchers per million inhabitants, are broadly on par with or even high relative to Slovenia's GDP per capita. Its overall R&D intensity (R&D expenditure as a share of GDP) was slightly below the EU27 average in 2008 (1.7% as against 1.9%) but increased to almost 1.9% in 2009 (Table 2.1), partly owing to the sharp contraction in GDP in that year (MHEST, 2010; OECD, 2011). Slovenia invests a larger percentage of its GDP in R&D than the Czech Republic, Greece, Italy, Luxembourg, New Zealand, Norway, Portugal and Spain, countries with similar or even higher levels of GDP per capita. No other country in central and eastern Europe boasts R&D intensity comparable to Slovenia's.

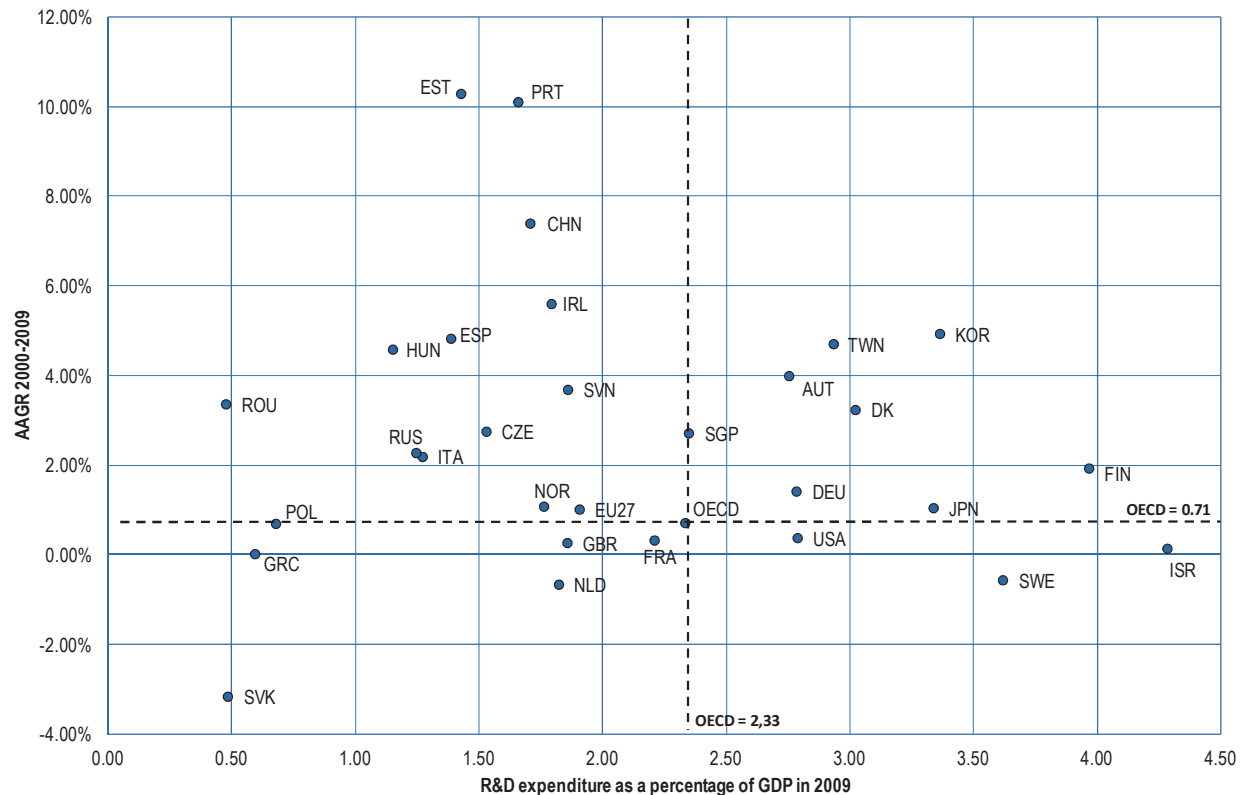
Table 2.1. Slovenia's gross domestic expenditure on R&D, current prices, 2000-09

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
In million EUR	256	310	339	320	380	413	484	500	617	657
GERD per capita	128	155	170	160	190	206.5	242	250	308	322
% of GDP	1.41	1.52	1.49	1.3	1.42	1.46	1.59	1.45	1.66	1.86

Source: OECD (2011).

The evolution of R&D expenditure differed from that of other countries in the region. Gross domestic expenditure on R&D (GERD) was slashed in most central and eastern European countries in the transitional phase of the 1990s. In the Czech Republic and the Slovak Republic GERD had fallen to a quarter of official pre-transition levels by 1995 (Meske, 2004, p. 382). Other countries experienced similar declines, aggravated by a massive brain drain as the economy contracted. In the second half of the 1990s research budgets in the region began to recover, although at a very slow pace. Levels have risen in most countries but remain far from European mainstream levels. However, Slovenia's R&D intensity has remained remarkably stable within a band of 1.3% to 1.8% over 20 years. As industrial R&D shrank in the 1990s, public expenditures were deliberately increased in order to maintain research facilities and to minimise brain drain (Bucar *et al.*, 2010, p. 31; see also Bucar and Stanovnik, 1999). The share of business R&D has rebounded strongly over the last years. Its share of GDP increased from 0.79% to 1.08% between 2005 and 2009 (OECD, 2011, p. 34).

Figure 2.1 plots selected countries' R&D intensity on the horizontal axis and the corresponding average annual growth rate (AAGR) in R&D intensity on the vertical axis along with the corresponding OECD averages. In 2009, the OECD average R&D intensity stood at 2.33%, and the average annual increase between 2000 and 2009 was 0.71%. While Slovenia's R&D intensity at 1.86% was still below the OECD average, it recorded an AAGR of 3.69%, well above the OECD average of 0.71%. Overall the average annual growth of R&D expenditure during 2000-09 was 3.7%, more than that of the Czech Republic (2.7%), Singapore (2.7%) and Finland (1.9%), similar to that of Austria (4.0%) and Denmark (3.2%), less than that of Hungary (4.6%) and much less than that of Estonia (10.3%), Portugal (10.1%) or China (7.4%) (OECD, 2011).

Figure 2.1. R&D intensity, 2009 level and average annual growth rate, 2000-09, selected countries

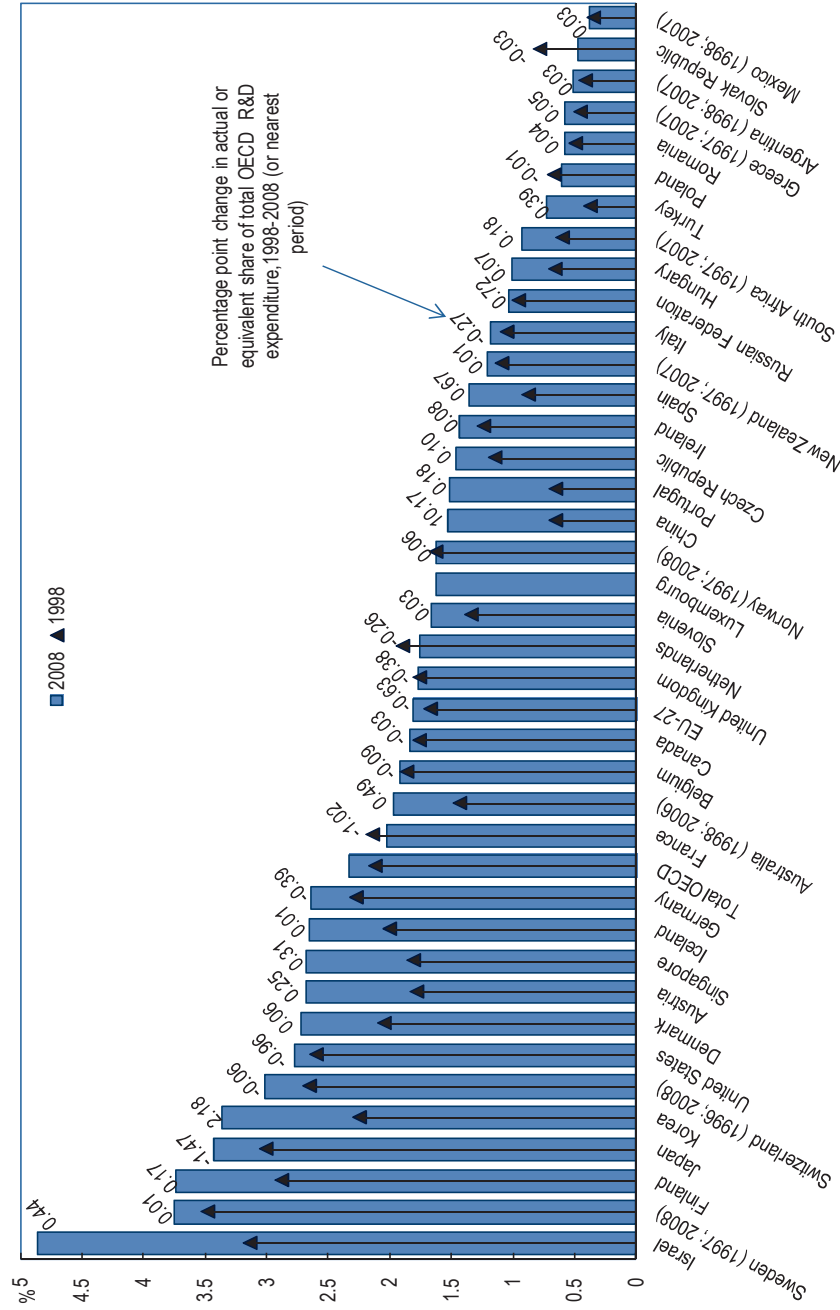
Source: OECD (2011).

The business and public sectors contributed equally to growth. However this was not enough to raise aggregate R&D intensity which stagnated during 2002-07, leaving Slovenia in a group of “trailers” (Eurostat, 2010, p. 43), with R&D intensity around or below the EU average (Figure 2.2). Slovenia is in a better position than Hungary, but was less dynamic than the Czech Republic where R&D was growing faster than GDP by 5% a year; or Estonia, which started from a much lower base but had annual growth rates in the range of 10%. Figure 2.2 further illustrates the evolution of Slovenia’s relative position over time in terms of GERD. Most OECD countries have experienced increasing R&D intensity, notably smaller and emerging economies.

Within aggregate R&D, the business sector’s contribution gained in importance in recent years,¹ at least until the onset of the crisis in 2008. At nearly 60% in 2007 and 63% in 2008 (Eurostat, 2010, p. 45; Bucar *et al.*, 2010, p. 33) business funding of R&D far exceeded the EU27 average of 55% and is thus in a range typical of more advanced innovation systems (Figure 2.3). The performance patterns are very similar to the sectoral shares in the financing of R&D. Much R&D is performed in the business enterprise sector and is concentrated in manufacturing.

Figure 2.2. GERD as a percentage of GDP, selected countries

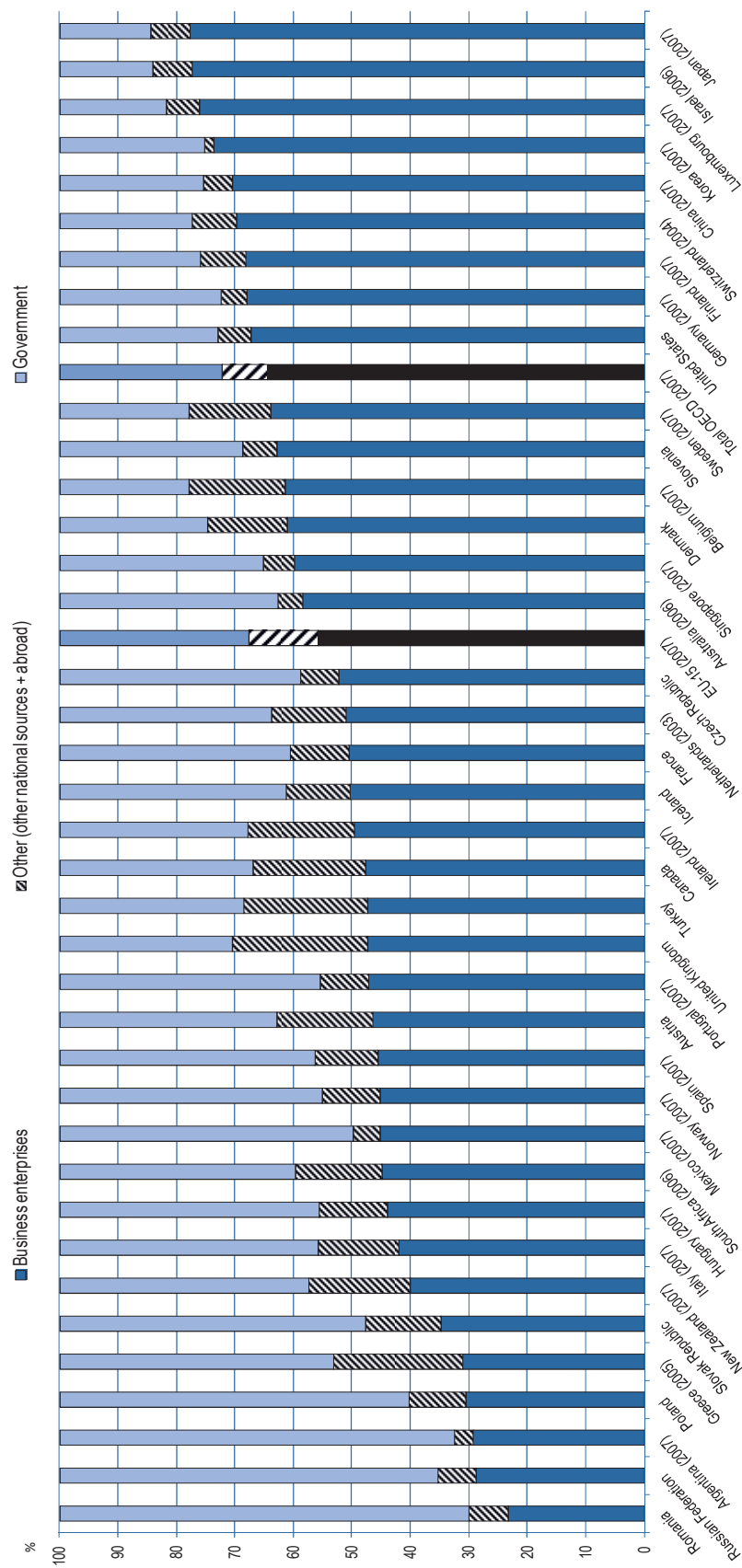
1998 and 2008, or nearest available years



Note: In Israel, defence R&D is not covered and humanities and law are only partially covered in the higher education sector. Owing to the lack of a comprehensive business register for South Africa, R&D expenditure may be underestimated by 10-15%.

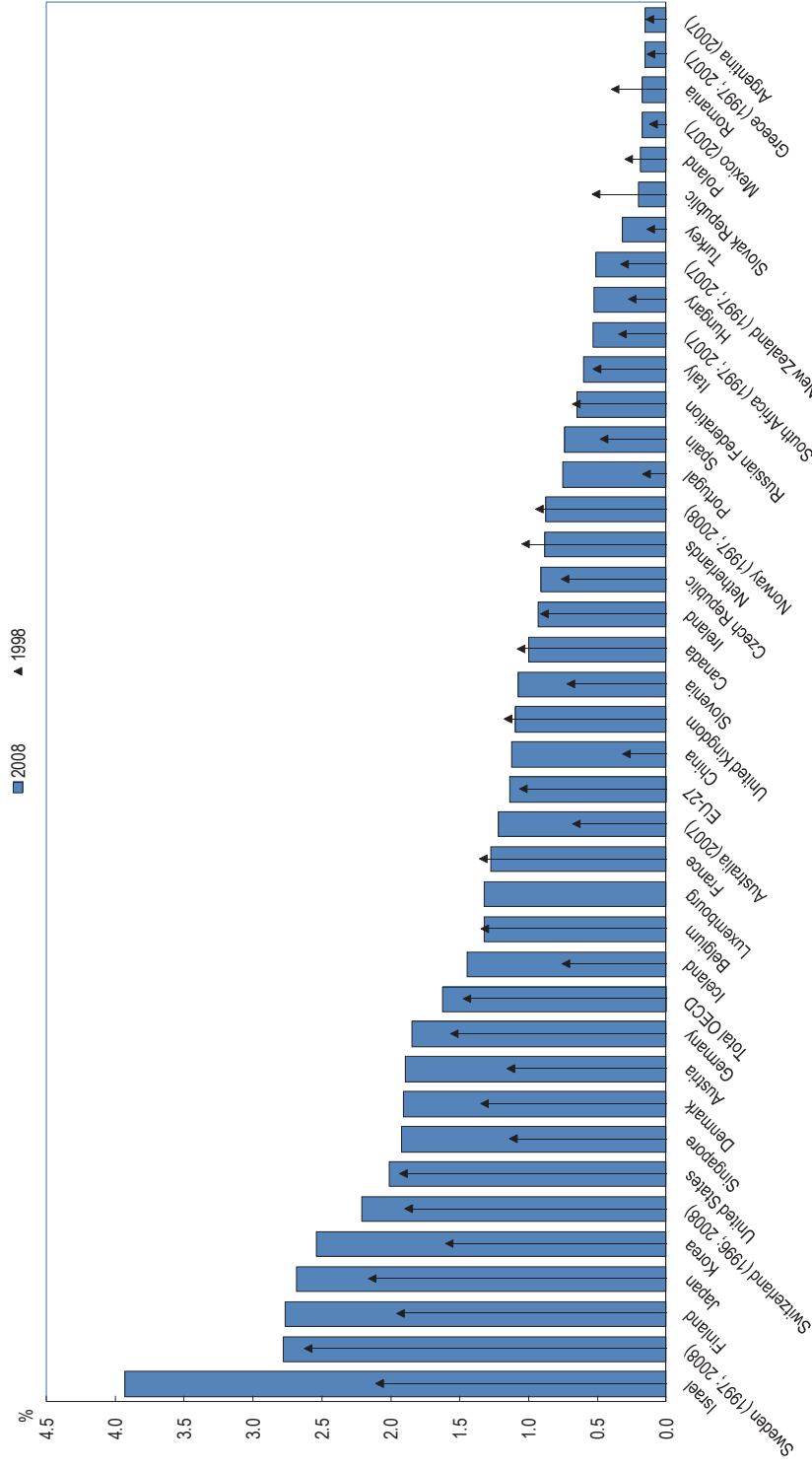
Source: OECD (2010, p. 25.), <http://dx.doi.org/10.1787/888932326266>.

Figure 2.3. R&D expenditure by source of financing, as a percentage of national total, 2008 or nearest available year



Source: OECD (2010, p. 31), <http://dx.doi.org/10.1787/888932332721>.

Figure 2.4. BERD intensity, selected countries, 1998 and 2008, or nearest available years



Note: In the Russian Federation, much R&D is traditionally performed by public enterprises, which are classified in the business enterprise sector. Owing to the lack of a comprehensive business register for South Africa, R&D expenditure may be underestimated by 10-15%.

Source: OECD (2010, p. 27), <http://dx.doi.org/10.1787/88893232664>.

Yet, while business enterprise expenditure on R&D (BERD) as a percentage of GDP (BERD intensity) is just below the EU average it still lags far behind the levels of leading countries (Figure 2.4). As in other countries, the bulk of R&D in Slovenia is performed by a rather small number of firms, led by two producers of pharmaceutical generics, one a domestically owned company, the other a subsidiary of a multinational enterprise (MNE). The business enterprise sector finances around 89% of its intramural R&D, while 8% comes from government and 3% from abroad (Eurostat, 2010, p. 49). Slovenia's industry can be described as a rather robust R&D performer when compared to other central and eastern European countries (Table 2.3).

Between 2008 and 2009, the Slovenian government “has significantly increased public sector expenditures as one of the measures to combat the economic crisis. This has raised the share of the public sector in R&D spending by 0.27 p.p. compared to 2008” (Bucar *et al.*, 2010, p. 33). This seems to be a reaction to the business sector's difficulties for maintaining its level of R&D expenditure in 2009; However, the private sector's share of GERD is still the highest of the 12 new EU member states.

As noted, the public sector's and industry's overall shares of GERD are in the European mainstream and close to the EU goal of two-thirds of GERD from private sources. Business funding of R&D in higher education institutions (HEIs) and public research organisations (PROs) represents about 6.5% of overall private expenditure (Table 2.2). This constituted around 13% of overall PRO research budgets and about 10% of university research budgets in 2008 (Bucar *et al.*, 2010, pp. 50 and 52). Table 2.2 also shows that the government's R&D budget includes a rather small share to HEIs and thus accounts for a small share of higher education R&D performance.

Table 2.2. R&D expenditure (GERD) by sector of funding and performance, 2008

Performing sector	Funding sector				Share in GERD
	Government	Business	Abroad	Higher education sector	
Higher education sector	33 %	2.1 %	27 %	100 %	13.5 %
Government research institutes	55.5 %	4.4 %	31.5 %	0 %	22 %
Business enterprises	11.5 %	93.5 %	41.5 %	0%	64.5 %
Total	100% (EUR 193 million)	100% (EUR 387 million)	100% (EUR 34.5 million)	100% (EUR 1.8 million)	100% (EUR 616.9 million)
Share in GERD	31 %	63 %	5.5 %	0.3%	100.0%

Source: Statistical Office of the Republic of Slovenia (2010), from Bucar *et al.* (2010).

Taken together, the financial engagement of industry in university research is relatively high by international standards. Germany records an industry share of 12.2%, the Netherlands 10%, Finland 8.6% and Switzerland 8.3%, while Sweden (4.5%), Norway (4%) and Denmark (2.3%) show much less industry involvement (Danish Ministry for Science, Technology and Innovation, 2009, p. 59; data as of 2006). The comparability of data across countries is limited, however, as they are affected by cultural specificities as well as differences in the relative importance of HEIs and PROs in the public research portfolio. For Slovenia this means two things. First, financing of HEIs by industry seems quite high, despite concerns expressed by various stakeholders. Second,

the large PRO sector could benefit more from private funding. In this context it would appear appropriate to discuss the PROs’ “uniform” mission, *i.e.* the fact that nearly all PROs in Slovenia are to perform basic research as well as contract research (on this point, see the section on PROs in Chapter 3).

Table 2.3. Composition of R&D by performance sectors, % of GDP

	2000	2004	2005	2006	2007	2008	2009
BERD	0.79	0.95	0.84	0.94	0.87	1.07	1.20
GOVERD	0.37	0.28	0.35	0.38	0.35	0.36	0.39
HERD	0.23	0.19	0.24	0.24	0.23	0.22	0.27
Non-profit	0.02	0.004	0.003	0.003	0.002	0.002	0.002

Source: OECD (2011).

Table 2.3 shows the change over time in the composition of GERD by sector of performance. What is most striking is the high degree of stability. The evolution of these shares – as well as the evolution of total R&D – has been remarkably smooth compared to other central and eastern European countries. The exception is the share of business-sector R&D, which fluctuated around 0.9% of GDP in the immediate pre-crisis period and rose in 2008 and 2009, a sign that the business sector did not reduce R&D activity strongly in reaction to the crisis. However, there are signs that the Slovenian government, leveraged by European structural funds, has directed more public funding into programmes that support industrial R&D – from SID Bank and Slovene Enterprise Fund (SEF) instruments to Slovenian Technology Fund (TIA) programmes. A further rise in public funding of R&D to 1% of all public expenditures by 2012 (currently around 0.75%) and to 1.2% by 2020 is envisaged (*Official Gazette of the Republic of Slovenia*, 2011, p. 3). Furthermore, GERD is expected to reach 3% of GDP in 2020 (Republic of Slovenia, 2011).

The percentage of GERD financed by sources from abroad varies strongly across European and OECD countries more generally. This is due to differences in the structural features of national innovation systems and to differences in their openness. In EU member countries funding from abroad generally consists of a (usually smaller) share of EU funding and a (typically larger) share of funding from multinational enterprises. Slovenia, which has fared well in attracting EU funding, had an overall share of around 6% of GERD financed from foreign large firms in 2009 and earlier years (OECD, 2011). This is rather low for a small open economy and may be due to the ownership structure of industry and perhaps a preference for in-house solutions.

Public and private funds can be used for different kinds of R&D activities. In a sample of 20 European countries Slovenia ranked last in 2006 with a share of just 12% of GERD devoted to “basic research”. Hungary, Estonia and the Czech Republic allocate twice as much, while Ireland and Switzerland also spend much more of GERD on basic research. At 20%, Slovenia also ranked lowest with respect to the share of “experimental development”; most other countries record shares of 30-45%. Consequently, more than two-thirds of total R&D expenditure in Slovenia is for “applied research” (Eurostat, 2010, p. 51). This pattern cannot be explained simply by the share of industrial R&D. But it is consistent with the uniform “catch-all” mission of the PRO sector mentioned above. To a certain extent such an approach is also encountered at the universities.

Table 2.4 gives the share of BERD performed in selected industries over 2000-08. While the electronics industry's share declined from 14.8% to 8.5% in 2008, the pharmaceutical industry saw an increase from 25.7% to 34.7%. The instruments industry recorded a slow decline with minor fluctuations during this period from 5.1% in 2000 to 4.4% in 2008. The services industries, however, saw a steep decline from 19.3% in 2000 to a record low of 5.4% in 2003, and have since recovered to a share of 13% in business expenditures for R&D in 2008, still well below the 2000 level.

Table 2.4. Percentage of Slovenia's business R&D performed in selected industries

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Electronics industry	14.8	15.9	12.2	16.1	13.1	14.4	11.4	10.2	8.5
Pharmaceuticals industry	25.7	28.0	30.8	39.7	41.2	31.2	36.3	37.2	34.7
Instruments industry	5.1	5.1	6.3	5.5	4.7	5.2	4.2	4.8	4.4
Service industries	19.3	15.1	13.7	5.4	6.3	8.2	8.8	9.2	13.0

Source: OECD (2011).

The pharmaceuticals industry not only accounts for the highest share of BERD, it also has the highest export market share: it grew from 32% in 2000 to 45% in 2009 (Table 2.5).² It also had a significant increase in the export/import ratio from 1.58 in 2000 (USD 397.5 million in exports and USD 251.5 million in imports) to 2.13 in 2009 (USD 2 109.9 million in exports and USD 989.5 million in imports). Both the electronics and instruments industry instead recorded a decline in their share of BERD and a stagnating export market share.

Table 2.5. Export market share in selected industries, 2000-09

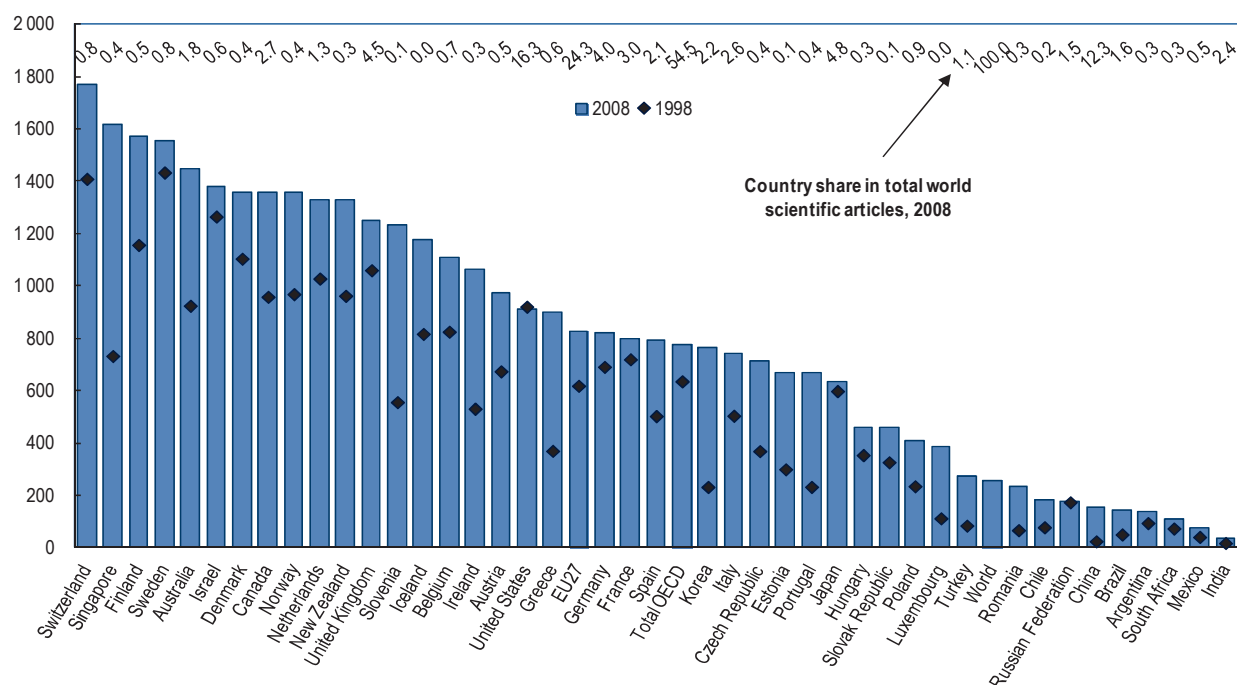
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Electronics industry	0.04	0.05	0.05	0.05	0.04	0.03	0.03	0.03	0.04	0.04
Pharmaceuticals industry	0.32	0.32	0.34	0.42	0.41	0.39	0.44	0.49	0.51	0.45
Instruments industry	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.12

Source: OECD (2011).

2.2. Innovation outputs

Slovenia's innovation output is varied. Scientific output, as measured by the number of scientific articles per million population, is high by international standards, reflecting a solid science base. It has grown rapidly since the 1990s (Figure 2.5), owing, among other things, to the emphasis on bibliometric indicators for the evaluation of research. The average annual growth rate of publications from 2002 to 2006 was 8%. The relative impact factor of Slovenian scientific publication has risen even faster over the last years, at an average annual rate of 16% in most disciplines. Natural sciences account for most of the papers with higher citation rates. Overall impact, however, still considerably lags the OECD and EU27 averages (Bucar *et al.*, 2010, p. 39). The world share for papers is 0.19% and for citations 0.1% (FWF, 2011, p. 76).

Figure 2.5. Scientific articles per million population, 1998 and 2008

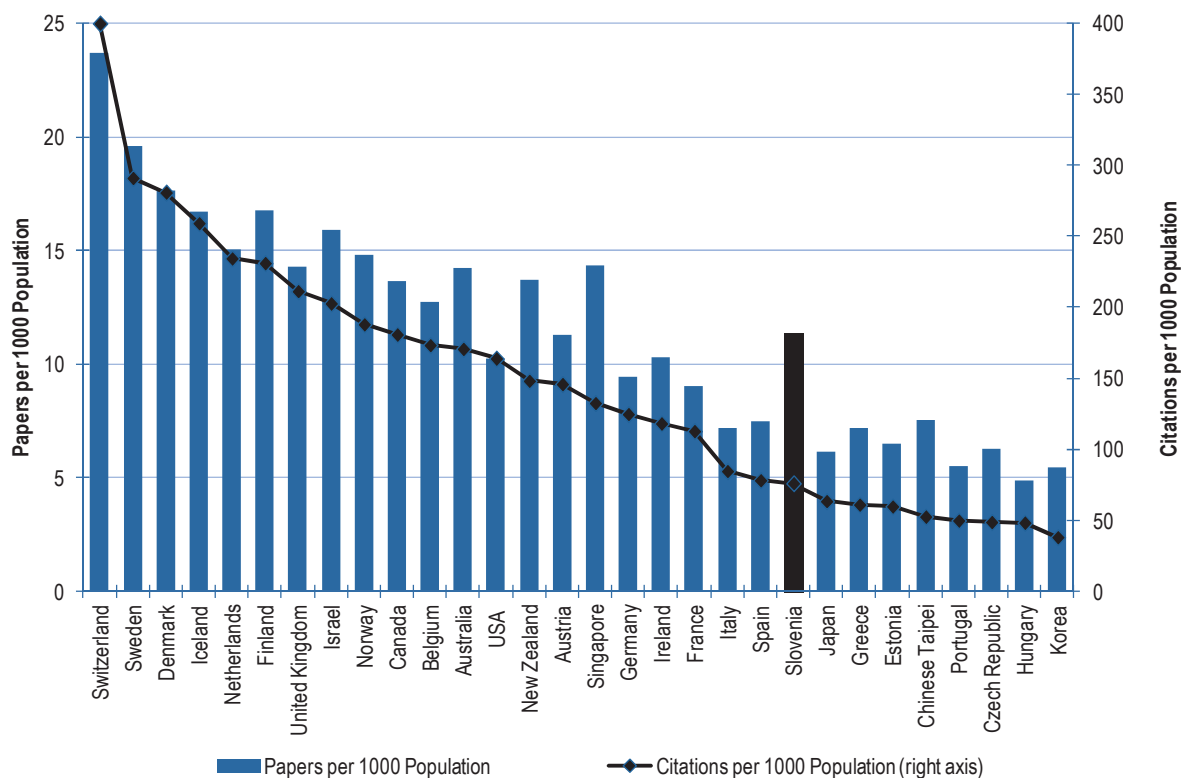


Note: “Scientific articles” are sourced from journals and conference proceedings and include: articles, reviews, conference papers, conference reviews and notes. Calculations based on the address of the institution to which authors belong, and fractional counts. For Brazil, Chile, Estonia and India, population data come from the International Monetary Fund, World Economic Outlook Database, April 2010.

Source: OECD (2010, p 50), <http://dx.doi.org/10.1787/888932332854>.

A comparison of bibliometric data for 2000-10 shows additional interesting features (FWF, 2011, p. 76). First, Slovenia ranks 22nd among the world’s top 30 countries in terms of citations normalised by population (Figure 2.6) and leads among new EU member states (Estonia ranks 25th, the Czech Republic 28th and Hungary 29th). At 76.2 citations per 1 000 population, however, Slovenia still has considerable scope for catching up: Switzerland leads the global list with an impact ratio five times higher (399.8), followed by Sweden (291). The potentially encouraging message relates to country size: the next four top positions behind Switzerland and Sweden are held by relatively small countries: Denmark, Iceland, the Netherlands and Finland, while Israel, Norway, Belgium, New Zealand and Austria are among the top 15. This suggests that ambitions can be set high as there appears to be no small country disadvantage. However, to improve Slovenia’s position will require a long-term effort and greater dynamism. Slovenia’s two-year citation growth is 13.1%, but the range for all top 30 countries is 11-15%.

Figure 2.6. Intensity of scientific output and impact, selected countries, 2000-10

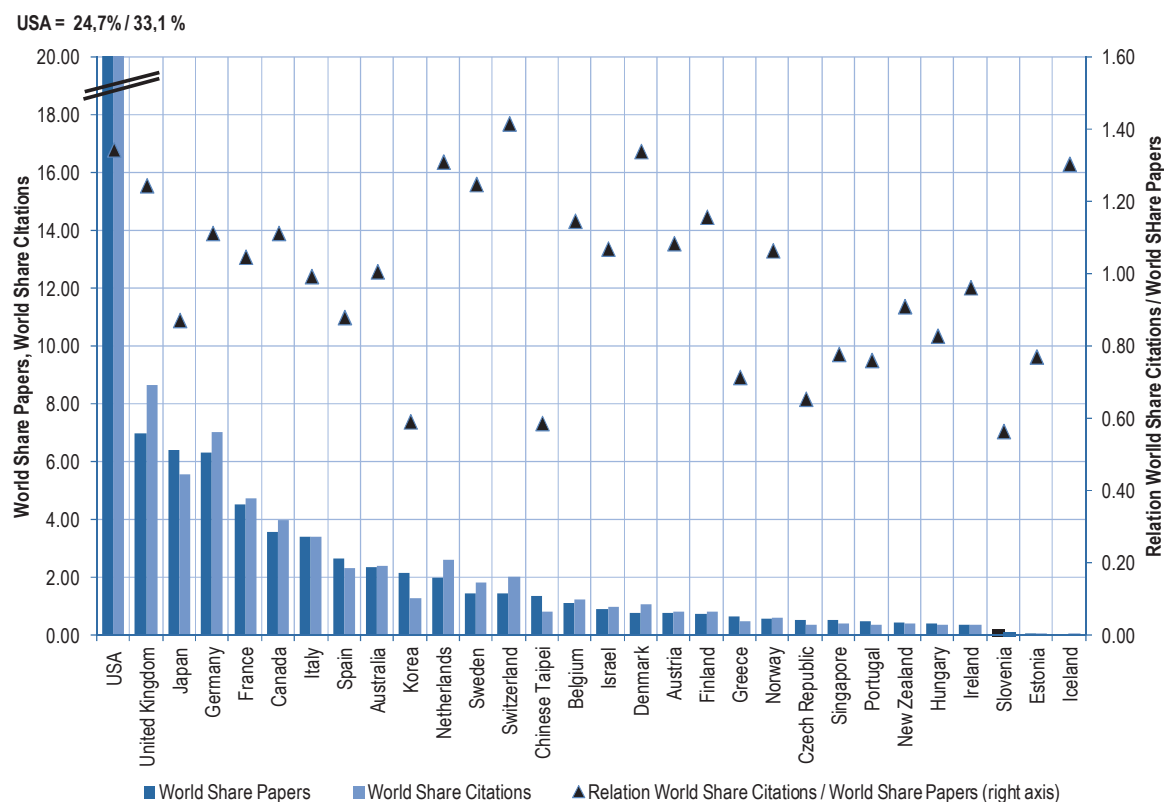


Source: BMWF, BMVIT, BMWFJ (2011), Austrian Research and Technology Report 2011, based on ISI, calculations by Joanneum Research.

There is undoubtedly room for improvement in citations: at 6.7 citations per paper Slovenia ranks last among the top 30 countries (Table 2.6), an indication that its scientific output is not very visible in the international scientific community. Moreover, in terms of the relation of world share of papers to world share of citations (Figure 2.7) Slovenia stands last (0.56), slightly behind other new EU member states such as the Czech Republic (0.65) and Estonia (0.77). The clear leader in this ranking is once again Switzerland (1.42), followed by the United States (1.34), Denmark (1.34), the Netherlands (1.31), Sweden (1.25) and the United Kingdom (1.24) all of them with a ratio well above 1.

This issue has received more government attention in the new RISS strategy (*Official Gazette of the Republic of Slovenia*, 2011, p. 8; MHEST, 2011). The impact factors – IF 3.09 and 22nd position in the EU at 61% of the EU average – are considered relatively poor. However, there seems to be a thin layer of top scientists who account for a relatively high number of adequately to highly cited publications.

Figure 2.7. World share of scientific papers and citations, selected countries



Source: BMWF, BMVIT, BMWFJ (2011), *Austrian Science and Technology Report 2011*, based on ISI, calculations by Joanneum Research.

Nearly all of the top 30 countries boast at least some ISI highly cited researchers (HCR). While the absolute number of highly cited researchers is highest for the United States (4 143), Switzerland leads in terms of HCR per million population with 15.5, while the United States has 14.1. Switzerland and the United States clearly lead this ranking, followed by Israel, Sweden, the Netherlands, Canada, Australia and Denmark, all of which have more than five but fewer than eight HCR per million population. Among the top 30 countries only four currently have no HCR: the Czech Republic, Estonia, Iceland and Slovenia. Among the new EU member states Hungary is a positive outlier with seven HCR. For Slovenia this can be worrying, as the existence of highly cited researchers is not correlated to country size. There is some hope that the quality-enhancing policies and instruments of the Ministry of Higher Education, Science and Technology (MHEST) and the Slovenian Research Agency (SRA) will contribute to a gradual improvement over time. However it can be argued that there is some correlation between Slovenia's current position and both the organisational set-up of the PRO and HEI sectors and the characteristics of some incentives provided by funding (for details, see Sections 3.2, 3.3 and 4.2).

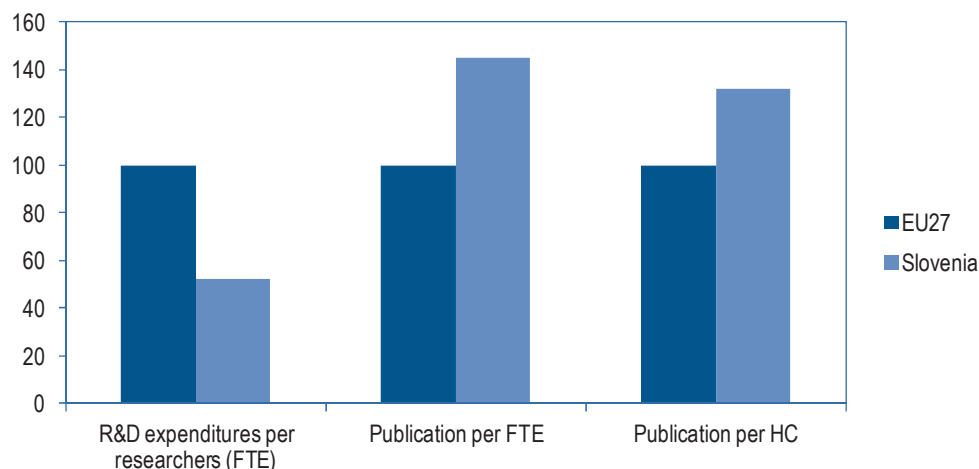
Table 2.6. Bibliometric data of the top 30 countries (ranked by citation per 1 000 population), 2000-10

Country	Papers (thousands)	Citations (thousands)	Population (millions) (2000-09)	World share papers %	World share citations %	Citation per paper	Papers per 1 000 population	Citations per 1 000 population	2 yr citation growth %	ISI HCR	HCR per million population
CHE	176	2 970	7	1.4	2.0	16.9	23.7	399.8	11.5	115	15.5
SWE	177	2 632	9	1.4	1.8	14.9	19.6	291.0	11.3	65	7.2
DNK	95	1 521	5	0.8	1.0	15.9	17.6	280.8	11.7	31	5.7
ISL	5	77	0	0.0	0.1	15.5	16.7	259.2	13.3	0	0.0
NLD	244	3 813	16	2.0	2.6	15.6	15.0	234.4	11.8	105	6.5
FIN	88	1 213	5	0.7	0.8	13.8	16.8	231.2	11.4	20	3.8
GBR	853	12 648	60	7.0	8.7	14.8	14.3	211.4	11.4	115	1.9
ISR	110	1 407	7	0.9	1.0	12.7	15.9	202.7	11.3	50	7.2
NOR	69	870	5	0.6	0.6	12.7	14.8	188.0	12.2	14	3.0
CAN	439	5 814	32	3.6	4.0	13.2	13.7	180.9	11.7	196	6.1
BEL	133	1 817	10	1.1	1.2	13.7	12.7	173.4	12.1	39	3.7
AUS	290	3 482	20	2.4	2.4	12.0	14.2	170.8	12.1	122	6.0
USA	3 018	48 299	295	24.6	33.1	16.0	10.2	164.0	11.1	4 143	14.1
NZL	56	607	4	0.5	0.4	10.8	13.7	148.3	12.0	20	4.9
AUT	93	1 198	8	0.8	0.8	12.9	11.3	146.0	11.9	20	2.4
SGP	62	570	4	0.5	0.4	9.3	14.3	132.6	14.7	4	0.9
DEU	776	10 277	82	6.3	7.0	13.2	9.4	124.9	11.4	262	3.2
IRL	43	488	4	0.3	0.3	11.5	10.3	118.3	12.5	8	1.9
FRA	551	6 875	61	4.5	4.7	12.5	9.1	112.9	11.3	166	2.7
ITA	417	4 930	58	3.4	3.4	11.8	7.2	84.8	11.8	85	1.5
ESP	322	3 372	43	2.6	2.3	10.5	7.5	78.3	12.5	24	0.6
SVN	23	152	2	0.2	0.1	6.7	11.3	76.2	13.1	0	0.0
JPN	781	8 110	128	6.4	5.6	10.4	6.1	63.6	11.0	263	2.1
GRC	80	678	11	0.7	0.5	8.5	7.2	61.1	13.5	6	0.5
EST	8	78	1	0.1	0.1	9.2	6.5	59.8	12.7	0	0.0
TWN	166	1 159	22	1.4	0.8	7.0	7.5	52.7	13.5	19	0.9
PRT	58	523	10	0.5	0.4	9.1	5.5	49.9	14.0	1	0.1
CZE	65	503	10	0.5	0.3	7.8	6.3	48.9	13.0	0	0.0
HUN	50	489	10	0.4	0.3	9.9	4.9	48.4	12.1	7	0.7
KOR	261	1 835	48	2.1	1.3	7.0	0.0	0.0	14.1	-	-

Source: FWF, 2010, p. 76 and ISI database 7/2011.

According to Bucar *et al.* (2010) Slovenia spends comparatively little per researcher but researchers seem to be more productive than the EU average (Figure 2.8).

Figure 2.8. Selected R&D output indicators



Source: Eurostat database, MHEST internal data; from Bucar *et al.* (2010).

In terms of other measures of innovation output, the picture is also somewhat mixed. The number of high-technology firms in manufacturing and services is relatively small, falling short of levels in the Czech Republic and Hungary. High-technology and service exports have remained low in international comparison (Bucar *et al.*, 2010, p. 105; see also Chapter 1). Patent data show a pattern that lends itself to multiple interpretations: Slovenia currently lags behind the EU average in patent applications per million population by a significant margin, but performs better than almost any other new EU member state. The number of European Patent Office (EPO) applications has been rising steeply (Eurostat, 2010, p. 185). Table 2.7 presents the number of European patent applications filed with the EPO per million population for Slovenia and the EU27 average. In 2000 Slovenian inventors filed only one-seventh of the EU27 average number of patent applications, but in 2009 it files almost half of the EU27 average, an impressive growth in the application rate.

Table 2.7. European patent applications filed with EPO per million population, 2001-10

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU27	102.8	101.6	110.4	114.7	118.5	121.4	125.2	130.9	123.5	132.6
Slovenia	14.6	15.5	23.0	27.0	43.5	44.3	57.0	63.8	58.3	65.9

Source: EPO, www.epo.org/about-us/statistics/patent-applications.html.

Still, while the number of Slovenian patent applications more than quadrupled from 2000 to 2009 (the EU27 average recorded only a 30% increase), the number of patents per million inhabitants granted by the EPO only doubled to one-third of the EU27 average in 2009 (Table 2.8). Thus, this pattern resembles the one for scientific publications: while absolute numbers increase, acceptance rates (citations, patents granted) still lag behind.

Table 2.8. European patents granted by the EPO per million population, 2001-10

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
EU27	31.1	43.3	53.6	52.1	46.6	53.1	45.3	51.5	44.3	48.5
Slovenia	8.0	8.0	10.0	12.0	12.0	10.5	8.4	16.3	13.7	16.1

Source: EPO, www.epo.org/about-us/statistics/granted-patents.html.

EPO statistics list 35 technological subfields in chemistry, electrical engineering, instruments, mechanical engineering and other fields, but up to 64.1% of all Slovenian patent applications filed with the EPO in 2008 were in just two chemistry subfields, namely “organic fine chemistry” and “pharmaceuticals” (Table 2.9).

Table 2.9. European patent applications filed with the EPO 2001-10, total, organic fine chemistry and pharmaceuticals

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Total	29	31	46	54	86	89	115	128	118	117	813
Organic fine chemistry and pharmaceuticals	9	2	7	12	38	53	60	82	69	56	388
Share	31.0%	6.5%	15.2%	22.2%	44.2%	59.6%	52.2%	64.1%	58.5%	47.9%	47.7%

Source: EPO, www.epo.org/about-us/statistics/patent-applications.html.

During 2001-10 Slovenia was granted patents in 35 different technological fields (EPO online). The leading fields are pharmaceuticals (31), organic fine chemistry (25), civil engineering (21) and electrical machinery, apparatus and energy (20). Next are biotechnology (15), other consumer goods (14), machine tools (12), mechanical elements (10) and medical technology (10). Technical fields in which Slovenia did not have a single EPO patent during 2001-10 are food chemistry, macromolecular chemistry and polymers, micro-structural and nanotechnology, IT methods for management, semi-conductors and telecommunications. One-quarter of all EPO patents granted to Slovenia are in organic fine chemistry and pharmaceuticals (Table 2.10).

Table 2.10. European patents granted to Slovenia by the EPO. 2001-10, total, organic fine chemistry and pharmaceuticals

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Total	16	16	20	24	24	21	17	33	28	33	232
Organic fine chemistry and pharmaceuticals	1	1	5	6	6	3	4	11	6	13	56
Share	6.3%	6.3%	25.0%	25.0%	25.0%	14.3%	23.5%	33.3%	21.4%	39.4%	24.1%

Source: EPO, www.epo.org/about-us/statistics/granted-patents.html.

EPO data for 2005 show an extremely low share of high-technology patent applications from Slovenia. The EU average share of high-technology patent applications in total EPO patent applications is 18.7%. The Czech Republic (15.9%) and Hungary (17.6%) come close to this level, but Slovenia lags far behind at 4.5%, with extremely low absolute numbers (Eurostat, 2010, p. 195). As regards triadic patent families, the country's poor record is shared with many other countries, including all the other new, and some longstanding, EU members (OECD, 2011).

The PRO sector is the most important source for patent applications, while industry and universities show a less impressive record. The application rates of the newly started centres of excellence are encouraging (Table 2.11).

The recent increase in business sector R&D may be a harbinger of further improvements.³ Several recent initiatives by PROs to enlarge their technology transfer offices (TTOs) and the highly entrepreneurial start-up ethos that permeates the Ljubljana Technology Park, for example, are indicative of awareness and commitment to increased levels of technological innovation. However it will take time for a small country with an established industry structure to change patterns.

Trademarks and design form another, softer category of innovation-relevant intellectual property. Here Slovenia shows a strong catch-up performance, albeit from a low base. According to the Innovation Union Scoreboard (European Commission, 2011, p. 51), the number of Community designs is around half the EU average and trademarks around 70%. Such a catch-up process is typical of the new EU member states.

Table 2.11. Patents and patent applications according to sector of applicant, 2008 and 2009

	2008		2009	
	Patents	Patent applications	Patents	Patent applications
Business sector R&D	80	78	77	73
HEIs	73	59	87	98
PROs	96	33	61	132
Centres of excellence	26	7	7	41
Total	249	170	225	303

Source: Bucar *et al.* (2010), based on data IZUM-SICRIS (2010) data.

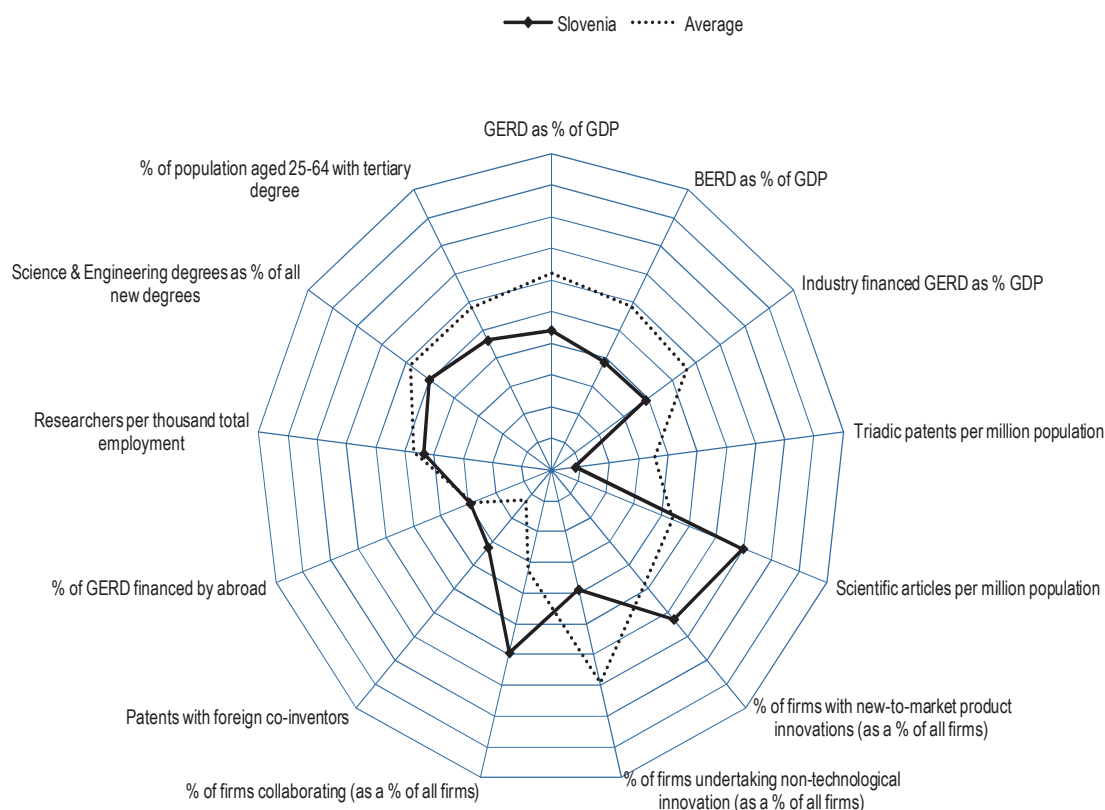
2.3. International benchmarking of the system

OECD benchmarking

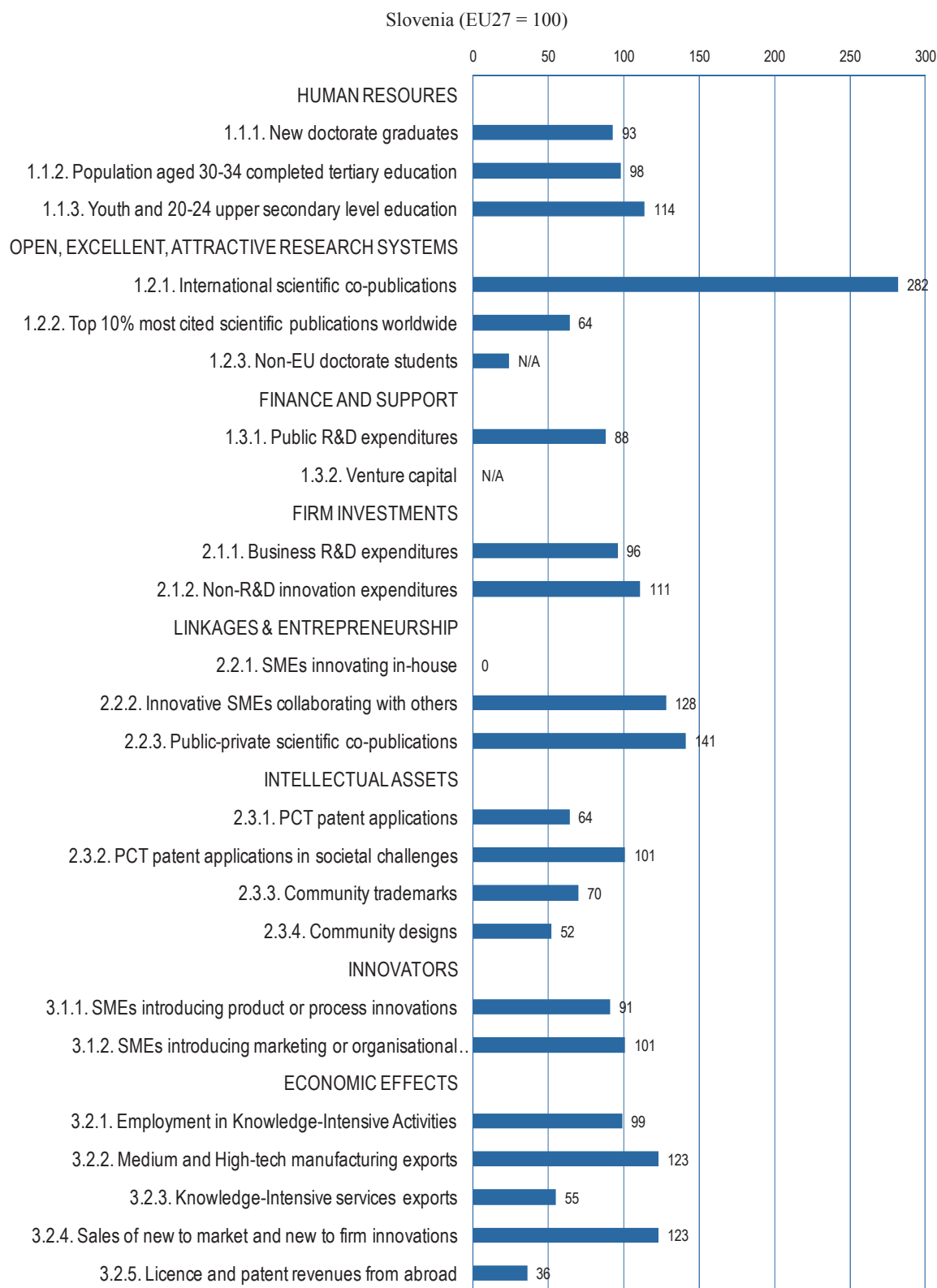
Each OECD country displays a specific pattern of strengths and weaknesses as regards innovation inputs and outputs. Such patterns are reflections of historical trajectories and past decisions. Change takes time and requires customised approaches, as policy mixes based on uncritical imports of “best practices” are unlikely to yield satisfactory results. Yet it is necessary to compare, to build on strengths and to try to eliminate weaknesses. Industrialised countries in Europe find a solid basis for such benchmarking in OECD and EU comparisons.

Figure 2.9 benchmarks Slovenia against the OECD average for a set of indicators (OECD, 2010, p. 219). The comparison shows Slovenia as performing above average in several dimensions, notably in scientific output on a per capita basis, but also in aspects of business innovation and co-operation. As a small open country Slovenia can benefit from collaboration, *e.g.* in creation of intellectual property. However, in other indicators Slovenia ranks below the OECD average. Relative weaknesses relate to aspects of the human resource base and R&D expenditure and patents. Slovenia ranks above the average in only in four of the thirteen indicators.

Figure 2.9. Science and innovation profile of Slovenia, input and output dimensions



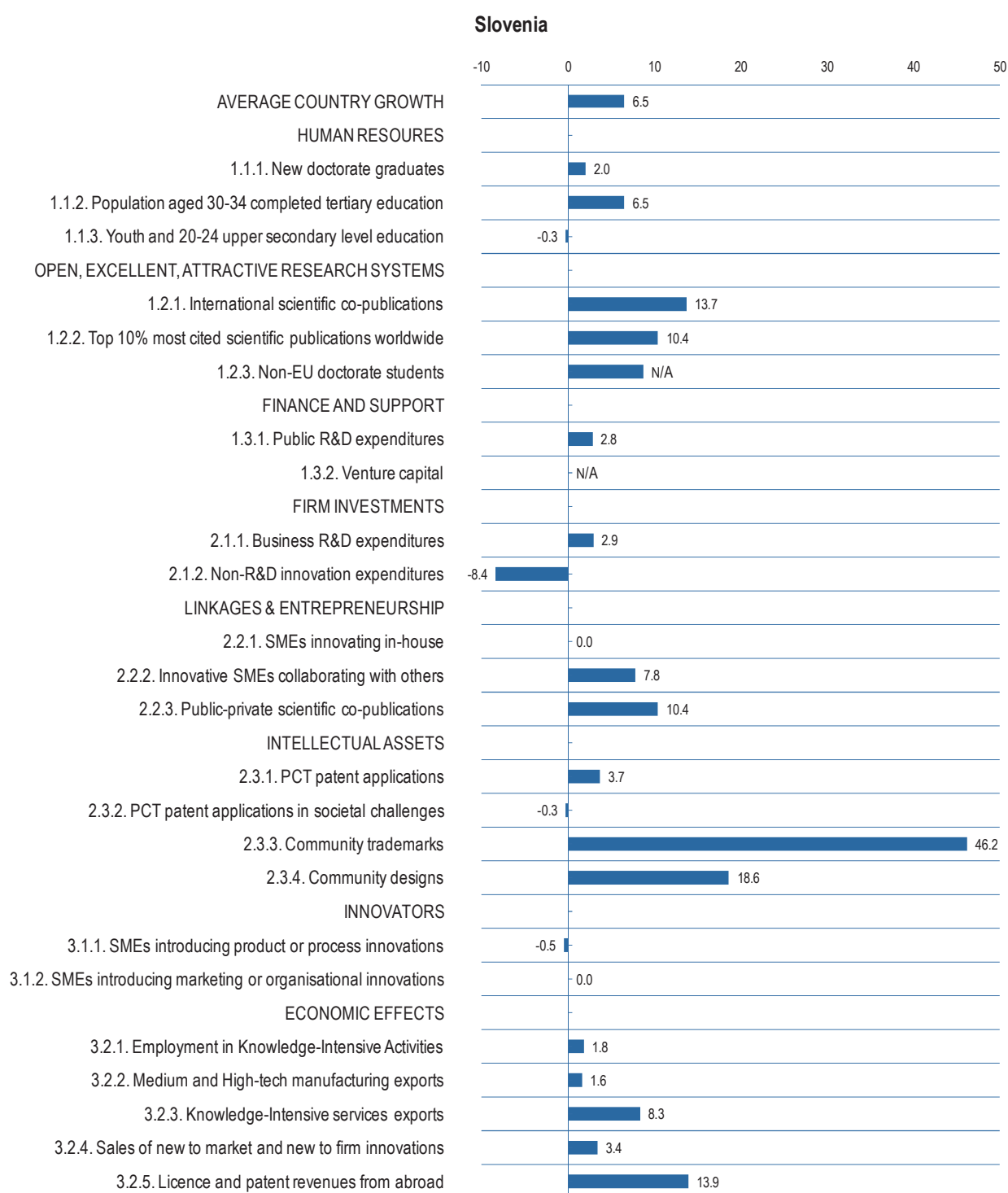
Source: OECD (2010, p. 219), <http://dx.doi.org/10.1787/888932334906>.

Figure 2.10. Innovation Union Scoreboard 2010: Slovenia's indicator values relative to the EU27

Source: European Commission (2011).

Figure 2.11. Innovation Union Scoreboard 2010

Slovenian indicator values, annual growth per indicator and average annual growth



Source: European Commission (2011).

Innovation Union Scoreboard benchmarking

Overall, Slovenia is described as an “innovation follower”, *i.e.* as a country whose performance is close to that of the EU27 average in the 2010 Innovation Union Scoreboard (IUS) (European Commission, 2011). Among the group of “innovation followers” (Austria, Belgium, Estonia, France, Ireland, Luxembourg, the Netherlands, Slovenia), Estonia and Slovenia are the growth leaders (European Commission, 2011, p. 14). The IUS captures 25 different indicators of three main types (enablers, firm activities and outputs) that cover eight dimensions of innovation (human resources; open, excellent and attractive research systems; finance and support; firm investments; linkages and entrepreneurship; intellectual assets; innovators; economic effects).

Figure 2.10 illustrates Slovenian indicator values relative to the EU27. These indicator values translate into the following rankings (European Commission, 2011, p. 16): in enabler indicators, for human resources Slovenia (rank 11) is above the EU27 average (set to 100) but for open, excellent and attractive research systems (rank 14) and finance and support (rank 12) it ranks below the EU27 average. In firm activities indicators, Slovenia (rank 11) is above the EU27 average in firm investments and in linkages and entrepreneurship (rank 11), but for intellectual assets (rank 14) it is below the EU27 average. In the outputs indicator category, Slovenia ranks below the EU27 average for both the innovators (rank 15) and economic effects (rank 14) dimensions. Tables 2.10 and 2.11 show the indicator values for Slovenia relative to the EU27 in terms of current standing and of average annual growth per indicator and average country growth (European Commission, 2011, p. 51).

In terms of the 25 indicators used for the Innovation Union Scoreboard (Figure 2.10), Slovenia has relative strengths in human resources, with young people aged 20-24 with upper secondary level education above the EU27 average of 100 (114), but the number of new doctorates (93) and the population aged 30-34 that completed tertiary education (98) is slightly below the EU27 average. However, as shown in Figure 2.11, there is slow growth in new doctorates (2%) and faster growth in the population aged 30-34 having completed tertiary education (6.5%). This shows that Slovenia is converging to the EU27 average in the human resources dimension. While international scientific co-publications are far above the EU27 average (282), the number of top 10% most cited scientific publications worldwide (64) and non-EU doctoral students (24) are significantly below the EU27 averages (Figure 2.10). All three indicators show rather good growth rates: international scientific publications (13.7%), top 10% most cited scientific publications worldwide (10.4%), and non-EU doctoral students (8.7%) (Figure 2.11).

While the above-mentioned *enabler* indicators show good performance overall, the *firm activities* indicators show relative weakness, with a significant decline in non-R&D innovation expenditures (-8.4%). While business R&D expenditure (96), Patent Cooperation Treaty (PCT) patent applications (64), Community trademarks (70), and Community designs (52) are below the EU27 average, Community trademarks (46.2%) and Community designs (18.6%) show high growth. However, slow growth of business R&D expenditure (2.8%) and PCT patent applications (3.7%) indicate that it may take Slovenia a long time to catch up.

The *output* indicators show a mixed picture of Slovenian innovation. While medium and high-technology manufacturing exports (123) and sales of new-to-market and new-to-firm innovations (123) are above the EU27 average, knowledge-intensive service exports (55) and licence and patent revenues from abroad (36) are significantly below the EU27 average. In this set of indicators the highest growth rate is in licence and patent

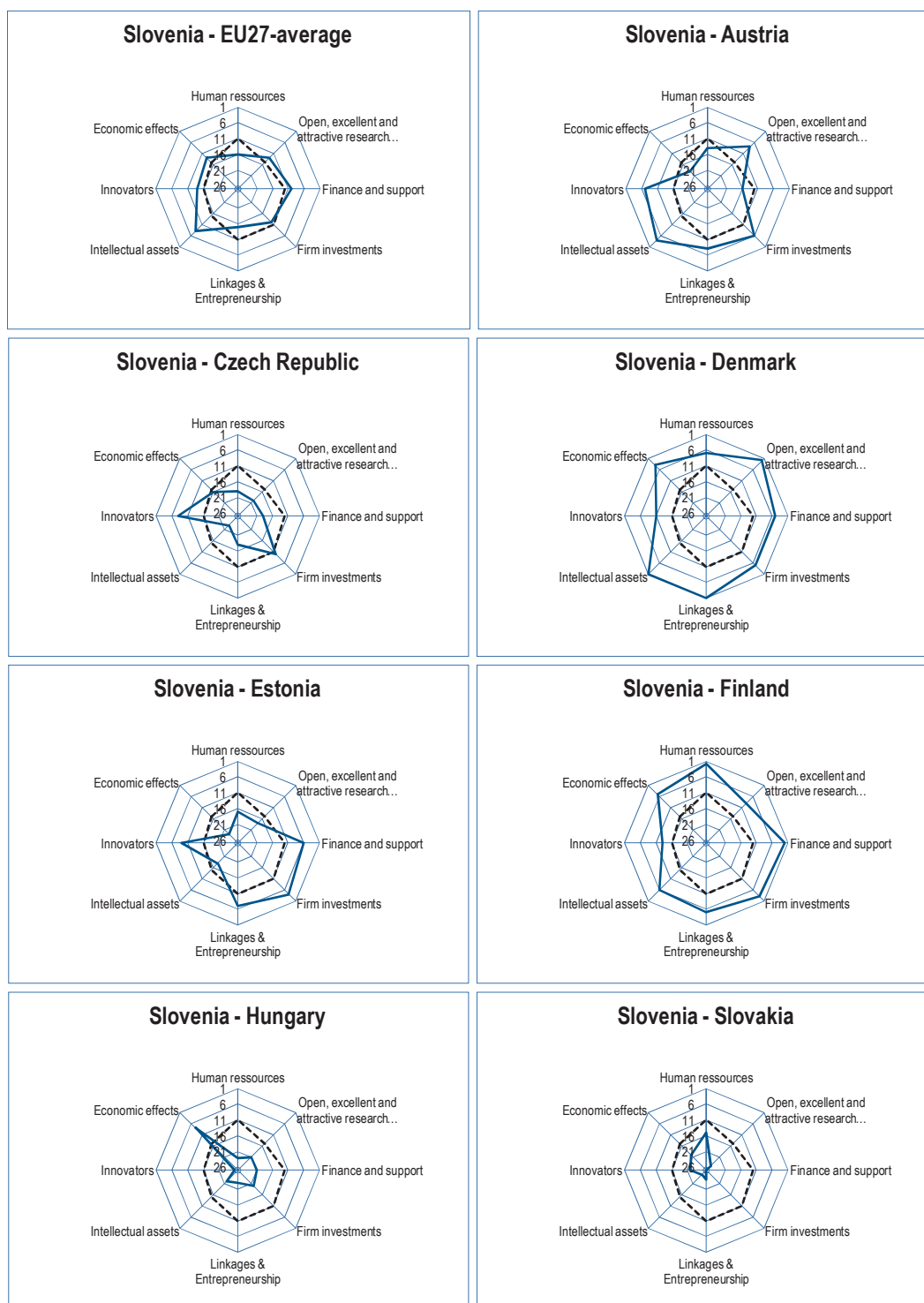
revenues from abroad (13.9%). SMEs currently do not show any increase in innovation activities, either for introducing product or process innovations (-0.5%) or for introducing marketing or organisational innovations (0%).

Figure 2.12 shows bilateral comparisons of Slovenia with selected smaller EU countries and the EU27 average in the eight IUS indicator dimensions. Slovenia already is above the EU27 average in three dimensions (human resources, linkages an entrepreneurship, firm investments) and close to the EU27 average in four more (open, excellent and attractive research systems, finance and support, innovators, economic effects). The strongest catch-up effort is required in the intellectual assets dimension. Slovenia clearly outperforms other new EU members such as the Czech Republic, the Slovak Republic and Hungary and seems to have much more balanced strength in the eight indicator dimensions than Estonia (as mentioned, Slovenia and Estonia are the “growth leaders” among the innovation followers). This more balanced strength is also visible at a higher level in innovation leaders such as Denmark and Finland, while another innovation follower, Austria, is below Slovenia in three dimensions (economic effects, human resources, finance and support) and shows a more unbalanced distribution across the eight dimensions.

Overall – and recognising a number of impressive examples and its performance among former transition or new EU members – Slovenia does not perform particularly well in terms of new firm formation or transfer of technology. Early entrepreneurial activity in Slovenia cannot be described as dynamic, and the same applies for the SME sector more generally. Concerns have been raised about the economy’s ability to convert findings from research into technological innovations. Results from past innovation surveys show little change in innovation activity in the manufacturing sector and only a gradual increase in services. As in other countries, the innovation policies of Slovenia are biased towards the promotion of technological innovations relevant to the manufacturing sector (Stare and Bucar, 2009). Insufficient attention is given to promoting innovations in the services sector, in spite of the increasing share of services in GDP.

As discussed in more detail in other parts of this review, these shortcomings in Slovenia’s innovation system are due to several mutually reinforcing factors. These include weak incentives for academic faculty who receive national research funds to consider the potential relevance of their work to business sector users and the apparent lack of interest in cutting-edge production processes and practices among many SMEs, the dominant type firm in terms of output and employment. A lack of innovativeness threatens firms’ competitive position, especially in internationally contested markets. In past innovation surveys companies cite a lack of financial resources as the most common reason for not engaging in innovation activity. A consequence is what might be described as a “low-level equilibrium”, with some larger companies reported still to be suffering from former buy-outs and low capitalisation. Another partial explanation for the observed weaknesses in innovation output, noted above, is the small inflow of foreign direct investment (FDI) when compared to Slovenia’s strong integration into international goods markets and the FDI to other central and eastern European countries. Slovenia’s potential for receiving best-practice technology through inward FDI is not fully realised.

Figure 2.12. Bilateral comparison of Slovenia with selected EU countries in the eight IUS-indicator dimensions



Note: Slovenia dashed line, other country solid line.

Source: European Commission (2011).

Recognition of the need to address these shortcomings permeates recent national policy documents. Indeed, the proposals in these plans – to build on complementary initiatives by universities and PROs to expand, rationalise and professionalise their technology transfer capabilities, especially in the areas of patents, licences and start-up firms – are intended to spur and redirect activities towards such a path. Slovenia has a strong focus on building an effective national innovation system (NIS) and has also adopted many best practices from other countries.

Notes

1. R&D was an important activity in a number of Slovenian firms before 1991.
2. Export market shares are defined as the industry's total exports relative to total aggregate exports of the declaring countries in the STAN Bilateral Trade Database, which covers about 95% of world trade.
3. According to European Innovation Scoreboard 2010 data, Slovenia is making slow but continuous progress in its innovation performance, attaining membership in the group classified as *moderate innovators*. However, while activities and investments are significant, there is a significant gap between innovation outputs and inputs/enablers that reveals structural problems in the Slovenia innovation system.

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Chapter 3

Innovation actors

This chapter describes the main actors in the Slovenian innovation system, their linkages and the main challenges. The business sector includes a number of internationally well integrated, dynamic industries, many of them part of European supplier networks. Overall the Slovenian economy faces challenges as regards innovation leadership, productivity and resilience. The university sector, with a comparatively small number of organisations and share of gross domestic product, has many successful individual research groups. Public research organisations have a traditionally strong position, with a high degree of devolution of powers and a general tendency to integrate basic and industry-oriented research. Transfer and collaboration patterns are influenced by the organisational set-up of the public research sector; there are many dedicated transfers institutions and programmes. Finally, human resources for research and innovation are analysed.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

3.1. The business sector

Slovenia's industry is dominated by a number of – mostly – export-oriented manufacturing sectors (see Chapter 1). Major industries include cars and car components, pharmaceuticals and chemistry, electrical industry and electronics, information and communication technology (ICT) and metal and machinery, with a number of firms involved in more than one sector. Key figures for 2009 include:

The car and car components industry (GTAI, 2011; JAPTI, 2011) includes more than 200 firms with nearly 15 000 employees and a turnover of around EUR 3 billion of which EUR 2.5 billion in exports. The product portfolio ranges from cars (Renault operates a large facility) to various car components, tyres and special tools for the car industry. Recently, efforts have been made to enter the emerging e-mobility market. Firm ownership is partly in the hands of multinational enterprises (MNEs) such as Renault, Goodyear, Johnson Controls and Hella, while another part including some successors of the ISKRA conglomerate are held by Slovenian owners. Some firms faced serious difficulties during the recent economic crisis, which led, *e.g.* to the liquidation of the traditional bus and truck company TVM. The car / and car components industry received special government assistance during the crisis with special loans from SID Banka with European Investment Bank (EIB) involvement. Nearly all are part of international supplier networks. This industry has good links with the universities of Ljubljana and Maribor. The Slovenian Automotive Cluster (ACS) has 60 partners and is the main player in the business and university sectors. A Centre of Excellence for Low Carbon Technologies has recently been established (MHEST, 2011a).

The pharmaceuticals and chemical industry (JAPTI, 2011; MHEST 2010a) covers over 700 firms with more than 26 000 employees and turnover of EUR 4.2 billion, of which EUR 3 billion in exports. The sector includes a large number of producers of chemicals, including petrochemical products (tyres, plastics, etc.), paint, coatings, pesticides and fibres. The two main players in innovation, however, are in the pharmaceuticals sector. LEK and Krka are the two leading manufacturers of generic drugs in central and eastern Europe. Krka has Slovenian owners and is controlled by two semi-public funds (OECD, 2011a, p. 114); LEK has become an affiliate of Novartis. Together they employ 7 800 people, with a large share of scientists and engineers. Both firms have high R&D expenditures and strong quality management. Pharmaceuticals account for no less than 37% of Slovenia's BERD (Table 3.2). Both have affiliates abroad, a rare feature in Slovenian industry. The universities of Ljubljana and Maribor and in particular the National Institute of Chemistry have strong links with the sector (MHEST, 2010a). In addition there are now a number of centres of excellence (CoEs) and competence centres (CCs) in this field, including protein chemistry and biology, polymer research, analytic infrastructure for biotech and pharma, biomedical engineering and biotechnological development (MHEST, 2011a).

The electrical and electronics industry (JAPTI, 2011; MHEST 2010a) employs more than 30 000 in more than 550 companies, with turnover of EUR 3.2 billion, of which EUR 2.3 billion in exports. This sector accounts for 17% of Slovenia's exports. Affiliates of multinationals such as (Bosch-) Siemens are complemented by a large number of domestically owned firms such as Gorenje, a producer of household appliances. The industry's broad product spectrum consists largely of electrical and electronic parts for the international car, household electrics and machinery industries. There are some outward investments involving foreign affiliates of Slovenian firms and close

relationships with the relevant faculties of the universities in Ljubljana and Maribor and with the public research organisation (PRO) IJS. A centre of excellence in space technology and a competence centre for efficient energy use have recently been established to strengthen science-industry links (MHEST, 2011a).

The ICT sector (JAPTI, 2011) with more than 21 000 employees and EUR 3.1 billion in turnover is more domestically oriented, with only EUR 0.7 billion in export revenue. Key elements are telecommunication equipment and services and IT products and services. It has large telecommunication firms and affiliates of multinational technology providers, but smaller firms dominate, both in lower-end service provision and in high-technology start-ups, as demonstrated by the dozens of young ICT firms in TPL, the vibrant Ljubljana technology park (JAPTI, 2011; TPL, 2010). There exist a number of links to the main relevant university and PRO research groups. The country has a good ICT infrastructure, with a number of indicators among the top global 25 (MHEST, 2010a, using WEF data). Corresponding competence centres deal with cloud-assisted services and open communication platforms for integrated services (MHEST, 2011a).

The metals and machinery industry (JAPTI, 2011; MHEST, 2010a) shows some overlaps with other branches, notably the automotive industry. This is a very large and well-established part of the Slovenian economy, with over 2 400 companies (including many small metalworking companies), over 50 000 employees and revenues of EUR 4.9 billion, of which more than half from export activities. This sector accounts for more than a quarter of the country's exports. Slovenia boasts a record of high quality in machinery and tool making. Clustering (with and without public support) and co-operation with academic partners such as the University of Maribor are well established. Slovenian-owned firms such as Trimo or Litostroj are successful in interesting niches. CCs and CoEs cover advanced control technologies, non-metal material sciences and nanotechnology (MHEST, 2011a).

These sectors, together with logistics and transport and a few others, are the competitive backbone of Slovenian industry. The network industries and banking seem to have a high degree of protection, local ownership and – in the case of the banks – undercapitalisation. This leads to credit shortages and vulnerable business conditions, including for export-oriented industries (OECD, 2011a, pp. 96ff). Another issue is cost competitiveness. In 2008, the ratio of value added to labour costs in Slovenia's manufacturing sector was the lowest among central and eastern European countries (OECD, 2011a, p. 23). The evidence indicates that technological restructuring was not sufficient in the boom years before 2008.

Overall, as shown by the last Community Innovation Surveys in 2004-06 (European Commission, 2009) and in 2006-08 (Eurostat, 2011), the Slovenian business sector is quite innovative. This survey measures innovative firm behaviour across Europe, including product, process, organisational and marketing innovations. As regards the innovation rate, Slovenia performs about average: 50.3% of responding Slovenian firms report innovative activities (the EU average is 51.6%) (Table 3.1). Germany leads with nearly 80% of innovative (responding) firms. According to this survey, Slovenia is at the same level as Finland, France and Sweden. New EU member countries usually remain well below this level: Poland reports 27.9%, Hungary 28.9% and the Slovak Republic 36.1%. The rates in the Czech Republic and Estonia are much higher at around 56% of respondents.

Table 3.1. Innovation in firms, selected EU countries

Poland	Hungary	Slovak Republic	Slovenia	EU27	Czech Republic	Estonia	Germany
27.9%	28.9%	36.1%	50.3%	51.6%	56%	56%	80%

Source: Eurostat (2011).

Slovenian innovators were active both in manufacturing (54.6%) and in services (around 46%). A comparison of CIS4 (2004) and CIS 2006 results shows that the number of innovating firms has grown dynamically¹ (Eurostat, 2010a, pp. 172ff.) from less than 30% to 35% (and 76% of all responding larger firms), and now close to 50%. However, statistically observable changes in innovation activity tend to derive from the services sector; increases in manufacturing have been very gradual. This is a reflection of two factors: on the one hand, the survey has become more encompassing and the questions more sophisticated as regards softer forms of innovation (such as marketing or design); on the other hand there appear to be some obstacles to a rapid restructuring of Slovenia's economy. It seems that too few new manufacturing firms enter the economy and the share of innovators in existing firms has not grown strongly enough. Further, as a new EU member state Slovenia shares with other European transition countries a bias towards technical innovations in manufacturing and comparatively undervalues the services sector. However, there are some encouraging signs as regards non-technological innovation in newer surveys with a broader definition of innovation. Still, about 90% of BERD is performed by the manufacturing sector (Bucar *et al.*, 2010, pp. 44 and 47).

In other words, Slovenia's dominant manufacturing sector has many innovative firms, but new entrants are rare and technology-led growth difficult to achieve (Bucar *et al.*, 2010, pp. 43ff.). Smaller firms still seem mainly to find their niches without innovative activities: a little more than 40% are innovators (CIS 2008), while 90% of large firms innovate.

Slovenian firms have a comparatively higher propensity to co-operate on innovation than the European average: 48% of innovators report external collaborations (EU average: 34.2%). Slovenia has the highest rate of European collaborations on innovation in the EU27 sample (35% compared to an average of 11.2%). This difference can be only partly explained by the strong participation of Slovenian actors in EU Framework Programmes (SORS, 2010, p. 1; Eurostat, 2010b, p. 2) and by the supplier status of most Slovenian firms.

As noted in Chapter 2, in 2008 business expenditure for R&D (BERD) amounted to EUR 387.5 million, or 63% of gross domestic expenditure on R&D (GERD).² According to the Statistical Office of the Republic of Slovenia (SORS, 2010, p. 1), EUR 205 million are spent by large enterprises, around EUR 50 million by medium-sized firms and around EUR 40 million by small firms. Of the overall amount, EUR 294 million is reported to be intramural and around EUR 73 million extramural. Overall innovation expenditures amount to EUR 902.2 million, of which EUR 422.2 million for the acquisition of new machinery. The Slovenian Statistical Office has counted around 2 300 innovative firms in Slovenia. Manufacturing dominates, as 86% of BERD comes from this sector, while services only account for 13%. Ratios are similar in Germany, Finland or Switzerland, whereas the Baltic countries report a two-thirds share of services sector R&D in BERD (Eurostat, 2010c, p. 30). Table 3.2 shows that pharmaceuticals account for nearly 40% of overall BERD with all other categories accounting for much smaller shares.

Table 3.2. Business R&D by sector of performance, 2007

	EUR (thousands)	Manufacturing 2007 (%)	In total business R&D (%)
Pharmaceuticals	111 314	42.1 %	37.2 %
Fabricated metal products, equipment etc.	118 358	44.8 %	39.5 %
<i>Radio, TV and communication equipment</i>	30 149	11.4 %	10.1 %
<i>Electrical machinery and apparatus</i>	23 745	9.0 %	8 %
<i>Medical, precision and optical instruments</i>	13 672	5.2 %	4.6 %
<i>Motor vehicles, trailers and semi-trailers</i>	7 070	2.7 %	2.4 %
Other	-	13.1 %	11.6 %
Total manufacturing	264 163	-	88.3 %

Source: Bucar *et al.* (2010) based on SORS (2009).

Also indicative of a strengthening of Slovenia's innovation system is the steady increase since 1995 in (full-time equivalent) researchers per thousand employees in industry. In 1995 the ratio was at 1.8, considerably below the EU27 average of 2.8, but it is now on par with 4.1 (OECD 2011c, p. 52; see also Table 3.3). However, only a small fraction of Slovenian PhDs are employed by industry; 90% work in government or higher education (Republic of Slovenia, 2011, p. 18).

Table 3.3. Business enterprise researchers in full-time equivalent per thousand employment in industry, selected countries

	1995	2005	2006	2007	2008	2009
Austria	..	6.1	6.1	6.5	7.0	7.1
Czech Republic	1.2	2.5	2.7	2.9	3.1	3.0
Denmark	3.7	9.5	9.3	9.6	11.5	11.3
Estonia	..	1.9	1.8	1.9	2.4	2.8
Finland	4.6	13.1	13.3	12.5	13.5	13.8
Hungary	0.9	1.5	1.9	2.1	2.5	2.9
Slovak Republic	1.3	1.2	1.1	0.9	0.9	1.0
Slovenia	1.8	2.6	3.0	3.2	3.7	4.1
Singapore	2.9	6.8	6.6	6.5	6.2	6.0
Total OECD	4.8	6.4	6.5	6.4	..	..
EU27	2.8	3.8	3.9	3.9	4.0	4.1

Source: OECD (2011c).

Box 3.1 describes international good practices in fostering productivity improvement, technology infrastructure and manufacturing modernisation.

Box 3.1. Productivity improvement, technology infrastructure and manufacturing modernisation

Slovenia's need to close gaps in both its aggregate and sectoral shortfalls in productivity requires an expanded view of a national innovation strategy. In particular, while continuing to promote the generation and adoption of new products and processes, including nurturing the development of new firms, it also must work to improve the competitive economic performance of existing firms.

In many countries, this is viewed as improving the productivity performance of small and medium-sized manufacturing firms, with the mainstream solution taking the form of what are referred to as industrial extension or manufacturing modernisation programmes. These were used long ago by the United States to modernise its manufacturing base. The need for such programmes exists in Slovenia, but it also needs a broader strategic perspective as well, which includes the services sector, broadly defined to encompass financial services, transport and retail trade. It also needs to look beyond technology development and technology transfer programmes, necessary as these activities are to the building of a "technology infrastructure" that provides for continuous learning, adaptation and modernisation of existing production processes and keeps firms attuned to changing market needs and opportunities. Technology infrastructure is understood as the set of consulting, technical assistance and network development services for suppliers and customers along with continuing education.

Such a strategy needs to be flexible in terms of the design of services to be offered, the choice of organisations to deliver these services and the funding arrangements. International experience with manufacturing modernisation programmes indicates, for example, that they are best seen not as a means of transferring the latest technologies from universities or PROs to SMEs but as ways of moving such firms up the technology ladder from marginal practice to average practice and then to best practice. Moreover, technology encompasses all of a firm's production techniques: plant layout, upgrading of labour force skills, accounting and financial practices, and more; in short, its full range of business practices. These services can be delivered by a diverse array of organisations. These include specialised units created specifically to deliver these services either through the use of in-house staff or contractual relationships with other service deliverers, such as consultants, trade associations or universities or outreach units appended to institutions such as universities, technical institutes, or PROs.

The need to tailor the services offered by such units to the needs of the private sector also lends itself to regionalisation, with local authorities and potential service deliverers better positioned to assess the needs of firms in their region and to build essential working relationships.

3.2. Universities (higher education institutions)

The university system, strengths and weaknesses

Slovenia has three public universities funded by the government: the University of Ljubljana, the University of Maribor and the University of Primorska. There is a recently established private-public university (University of Nova Gorica) and another new university, the Euro-Mediterranean University, formed as an international network of universities, with members from 37 countries. A large number of independent HEIs in Slovenia are listed MHEST (2011b, pp. 36-39). The number of students has been growing steadily from a little over 38 000 in 1991/92 to nearly 115 000 in 2009/10 (Table 3.4).

Table 3.4. Number of enrolled students, selected years

Academic year	Number of enrolled students		
	Undergraduates	Postgraduates	Total
1991/92	36 504	1 647	38 151
2005/06	73 967	8 344	82 311
2009/10	98 973	15 900	114 873

Source: MHEST (2011b).

Of these institutions, the University of Ljubljana (UL), established in its current form in 1918, with an estimated enrolment of 64 000 and a share of about 60%, is by far the largest in Slovenia, and indeed ranks among the largest in Europe. Out of approximately 6 000 employees, 1 000 are dedicated researchers, making it also the largest research performer in Slovenia. As of 2010, the university had 23 faculties and 3 institutes in a wide range of fields of science, engineering, humanities and professional studies. In the 2008/09 academic year, UL offered nearly 200 undergraduate programmes (MHEST, 2011b, pp. 19-25).

The University of Maribor (UM), established in its current form in 1975, was developed from a number of existing colleges. Owing to its bottom-up structure, UM locations can be found all over Maribor and in nearby cities, including a Faculty of Energy Technology near the site of the Krsko nuclear power plant. It has 17 faculties, spanning broad fields of study, with special achievements in the physical sciences. UM constitutes a second large HEI in this small country, with 24 000 students, 1 800 employees and an annual budget of EUR 90 million (MHEST 2011b, pp. 26-29).

Primorska University, with four faculties and around 5 000 students, has existed in its present form since 2003. It is located in the Slovenian seaport of Koper. An interesting feature is the integration of dedicated research institutes in the university structure (MHEST, 2011b, pp. 30ff). In 1995 the Nova Gorica Municipality, the Jožef Stefan Institute and the Scientific Research Centre of the Slovenian Academy of Sciences and Arts founded the first private – and internationally oriented – postgraduate school in Slovenia, the Nova Gorica Polytechnic. This school became the fourth Slovenian university in 2006. It provides courses in many scientific fields. A number of research centres complement its teaching functions (MHEST, 2011b, pp. 33ff). Finally EMUNI, the Euro-Mediterranean University, is linked to the EU Mediterranean policy and is a higher education node for specialised and cross-institutional postgraduate studies in the region.

Consistent with its remit, the focus of this review is the role of research in the higher education sector. Viewed more broadly in terms of the contribution to the strength of Slovenia's national innovation system, it also takes note of concerns raised in the most recent *OECD Economic Survey of Slovenia* concerning the low share of science and engineering graduates by international standards. At 10.7 per 1 000 inhabitants aged 20-29 this is significantly lower than the EU average of 13.9 (in 2008). Moreover, according to the survey “there are few signs of this gap closing” and “considering that a greater share of engineering and science graduates is associated not only with a greater innovative and technology absorption capacity of the economy but also with human capital spill-overs and economy wide productivity gains, boosting the number of graduates from these fields is a priority” (OECD, 2011a, p. 61).

The level of research in the Slovenian HEI system also reflects the existence of a large PRO sector, which absorbs 60% of overall public funding for public research (see Chapter 2 and Section 3.3). Apart from outliers such as Luxembourg or Cyprus, this composition is a typical inheritance from the past in the central and eastern European region. The pattern is similar in the Slovak Republic, the Czech Republic, Hungary and Poland. As a result, higher education spending on R&D in Slovenia, at 0.27% of GDP (2009), not only ranks low in an EU or OECD comparison (2009: 0.46%) but is below the level of 0.42% it had reached in 1995 (OECD, 2011c). While historical patterns differ, there seems to be some correlation between overall R&D expenditure and the relative strength of the university sector in small European countries: Austria, Denmark, Finland, the Netherlands, Sweden and Switzerland are all in a bracket between 0.65 and 0.9% of GDP (OECD, 2011c). For a number of comparable countries see Table 3.5. Larger countries with strong PRO sectors such as France, Germany and to some extent the United Kingdom spend two times more on R&D (relative to GDP) than Slovenia. This raises additional concerns regarding the degree of financing and the relative position of the Slovenian university sector.

Table 3.5. Higher education expenditure on R&D (HERD) as a percentage of GDP

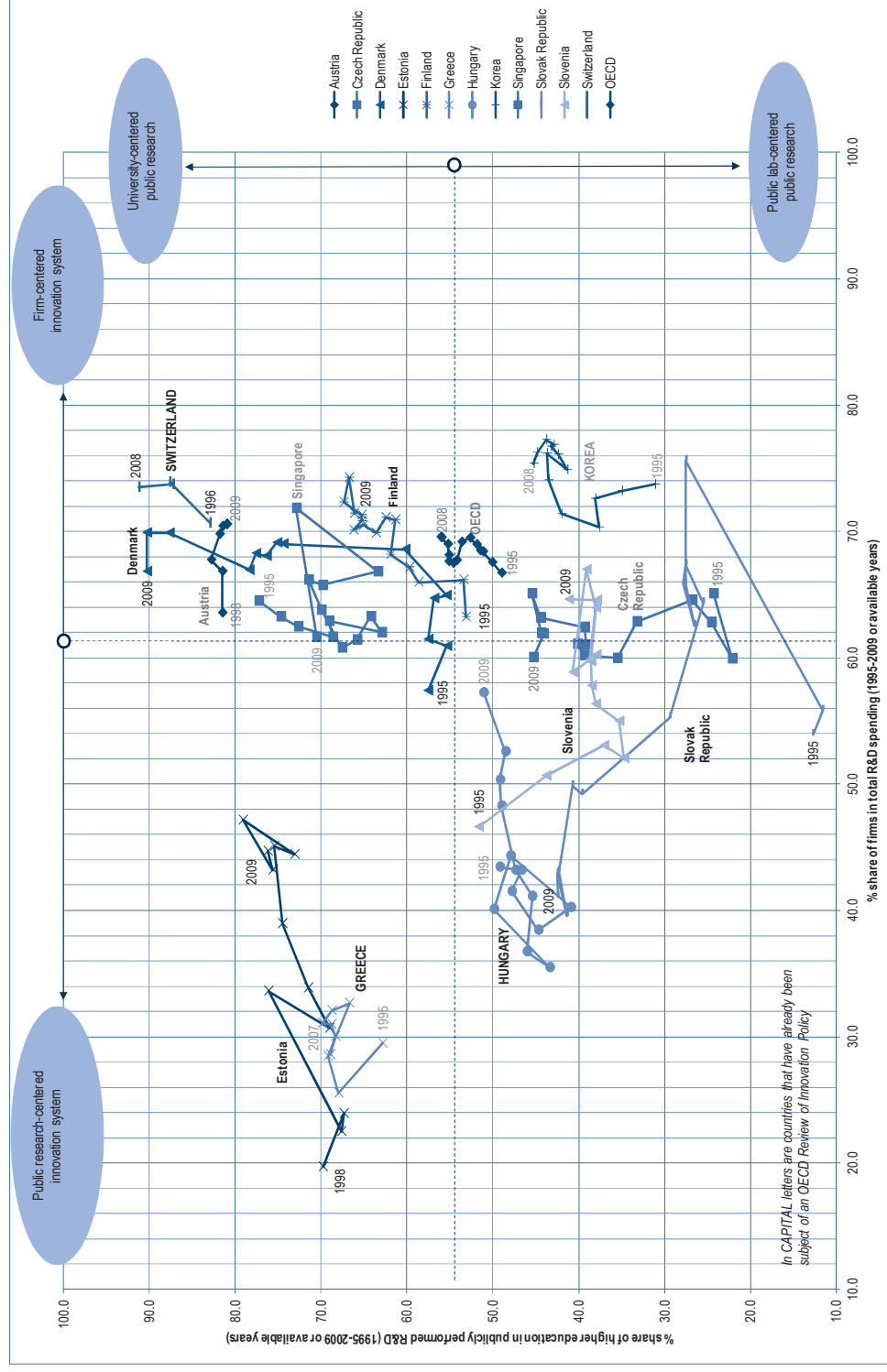
	1995	2005	2006	2007	2008	2009
Austria	..	0.61	0.59	0.60	0.64	0.66
Czech Republic	0.08	0.23	0.25	0.26	0.25	0.28
Denmark	0.45	0.60	0.64	0.68	0.78	0.90
Estonia	0.16	0.39	0.46	0.46	0.55	0.60
Finland	0.44	0.66	0.65	0.65	0.64	0.75
Hungary	0.18	0.24	0.24	0.23	0.22	0.24
Slovak Republic	0.05	0.10	0.12	0.11	0.11	0.12
Slovenia	0.42	0.24	0.24	0.23	0.22	0.27
Singapore	0.31	0.55	0.54	0.52	0.55	0.63
Total OECD	0.33	0.39	0.38	0.39	0.40	..
EU27	0.34	0.39	0.40	0.40	0.43	0.46

Source: OECD (2011c).

Figure 3.1 shows the evolution of selected innovation systems for 1995-2009 (or nearest available years). A country's position on the horizontal axis indicates whether its innovation system is centred on public research or firms and the vertical axis shows whether public research is centred on public labs or universities. Innovative countries such as Switzerland, Finland, Denmark and Austria are typically found in the upper right quadrant, *i.e.* they have an above-average firm-centred innovation system and above-average university-centred public research. The general OECD trend line goes from the bottom left corner to the top right corner. Transition countries typically started the reform process from a position close to the origin.

Among the new EU member states Estonia is the only one that moved in a somewhat stable way up and right at the same time, yet it is still in the upper left corner. The Czech Republic moved up but slightly to the left from 1995 to 2009, Hungary moved to the right but not up, Slovak Republic moved up but further to the left. Slovenia moved to the right, which indicates improved innovativeness in firms, but also down, which indicates a decline in university-centred public research. This is further evidence that research in HEIs needs more attention in the overall innovation system.

Figure 3.1. Types of innovation systems and their evolution, 1995-2009 or nearest available years



Source: OECD (2011c).

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The strengths of the academic research system are the rigorous competitive selection process at project level employed by the SRA for awarding academic research grants, the upward trend in bibliometric measures of performance, such as publication counts, citations and impact factors, the impressive reliance on international competitive mechanisms for research awards, and the above-average performance in terms of publications per capita when benchmarked against other EU member states (SRA, 2010; FWF, 2011; see also Chapter 2). This review, however, confirms earlier assessments that the strengths of Slovenia's academic research have not yielded commensurate increases in innovation and productivity growth, and that this gap is attributable to some extent to the continuing influence of pre-transition funding patterns, organisational arrangements, and institutional and faculty priorities.

Apart from these factors, specific funding patterns seem to have a strong impact on the Slovenian university system. The first interesting property is the separation of funding streams for research and education. This system relies on two pillars regarding teaching: one is a block grant and the second one is an indicator-based allocation. As regards the latter, universities receive funding according to the number of students enrolled and the number of graduates. Six different "tariff groups" apply, depending on the cost of studies, the number of staff employed and the number of programmes (see also OECD, 2011a, p. 62f; Bucar *et al.*, 2010, p. 50). HEI research budgets are mainly allocated via the SRA Research Group Programme. This separation of funding streams weakens the link between the opportunities and needs of research programmes and the training of - undergraduate and graduate – students in areas of need in the economy and society. It may also create unnecessarily artificial barriers in the allocation of university resources- (staff, space, equipment) to educational and research activities. However, the separation has also positive aspects as different funding streams for research and teaching give the former a stronger position because of the greater transparency and clear earmarking of the funds. In many OECD countries the share of research in universities' general university funds (GUF) may be overestimated, or research funds may be used to co-finance teaching needs so that the picture is not clear. For the main structures and legal provisions of the Slovenian Higher Education system see MHEST (2011b, pp. 11ff).

For research funding there is the research group programme already mentioned which is further described in Chapter 4. Research is funded by the SRA and its grants tend to perpetuate an emphasis on small group undertakings. This creates disincentives for participation in the larger collaborative, multi-disciplinary projects that are increasingly the model for leading research in many fields. It also hinders the competitiveness of Slovenian faculty in EU and other transnational research calls for larger, more strategic proposals. Moreover, the selectivity of the SRA review process can be questioned; the reported 90% success rate of research group applications led a previous assessment to describe it as a "system of soft funding" (CREST, 2010, p. 18).

The question is also whether the financing model also creates disincentives for faculty to co-operate with industry or to engage in the transfer of know-how to commercial entities (CREST, 2010, p. 17). A mixed picture emerges from the review. The percentage of higher education expenditure on R&D financed by industry, at 9.2% (2009), is above the EU27 average (7.0% in 2008). This suggests workable and internationally comparable R&D relationships between firms and higher education institutions (Table 3.6). In addition the share of basic research in Slovenia is extremely small (only 12% of GERD; see Section 2.1); most R&D seems to fall into the category of applied research. The low share of basic research contrasts with perceptions of a lack of usefulness of research funded by public sources. While this could be taken as an argument in support of the

current funding approach, the fact is that organisations cannot act strategically and the system is governed by a multitude of weak signals, so that it achieves neither academic excellence nor industry relevance satisfactorily. This problem is aggravated by the excessive compartmentalisation and corresponding mindsets in the academic system. Industry claims to sometimes meet with disinterest in more structured forms of industry-oriented research.

Table 3.6. Percentage of higher education expenditure on R&D (HERD) financed by industry

	1995	2005	2006	2007	2008	2009
Austria	..	..	5.0	5.7	..	..
Czech Republic	2.0	0.8	0.7	0.7	0.6	1.1
Denmark	1.8	2.4	2.5	2.1	..	4.4
Estonia	9.1	5.2	5.0	5.6	4.4	4.3
Finland	5.7	6.5	6.6	7.0	7.2	6.4
Hungary	2.1	11.8	13.0	13.7	14.7	15.5
Slovak Republic	1.0	0.7	4.7	6.8	2.5	2.1
Slovenia	3.2	9.0	9.5	10.6	10.1	9.2
Singapore	2.7	1.7	1.9	1.9	1.3	..
Total OECD	6.1	6.1	6.3	6.6	6.4	..
EU27	6.0	6.5	6.6	6.9	6.7	..

Source: OECD (2011c).

Reliance on funding research groups rather than research organisations limits the ability of central university administrators to steer the university's research agenda or to redeploy institutional resources quickly to newly emerging areas. The review team's interviews with university officials confirmed earlier assessments that "directors of institutes and university heads are not in a position to strategically manage these organisations, as research group leaders are de facto in charge of personnel policy" (CREST, 2010, p. 18). An especially discouraging sign, in the review panel's view, was what appeared to be passive acceptance that there was little prospect of changing the current arrangements.

Slovenia's entry into the EU, its increasing participation in trans-European education and research programmes, and the internationally competitive arena in which its universities seek to gain acceptance for its graduates and research publications requires it to heed international trends or be left behind. This OECD review, like earlier reviews, highlights several structural issues in the organisation, funding and behaviour of Slovenia's universities that impede their performance, in terms both of the aspirations of their faculty, students and administrators and their contribution to national objectives, and, in the context of this review, to innovation and economic growth.

Several different approaches to the reform of Slovenia's universities are possible. None is without its social, financial, institutional or political costs. Presented here is a general overview of the nature of the reforms being conducted elsewhere in Europe, as well as in other OECD countries that can be of use to Slovenia as it considers needed reforms. This report takes note of other studies (CREST, 2010; OECD, 2011a) but also

the “Audacious Slovenia” initiative to formulate long-term plans and to start fundamental reform processes with the RISS (research) and NPHE (tertiary education) planning documents. Note also that the 2010 OECD Overall Assessment and Recommendations in the context of this report have fed considerably into the RISS process.

A number of factors, in Slovenia as elsewhere, influence the public discourse around and main topics of reform. These include governments’ increasing difficulties for maintaining the current financing of higher education; the increased costs of maintaining, and even more improving, research capacity in science and technology fields; the greater recognition that the performance of a nation’s universities in instruction and research are prime drivers of its long-term economic competitiveness and growth; the growing calls for and acceptance by universities of “third mission” responsibilities to contribute to national and regional economic growth; and a growing body of proof-of-concept evidence that increased engagement with industry and related technology transfer activities are not only compatible with excellence in research and instruction but may also contribute to the attainment of these goals.

Relations to society and stakeholders

Strength in academic research *per se*, while indispensable and a valid indicator of excellence, is not necessarily a measure of or contributor to the performance of a national innovation system. It contributes only when the processes or products made possible by new knowledge add to the performance of economic sectors and/or help public, not-for-profit and private initiatives to achieve societal and personal objectives. This contribution can take several forms. Research findings can lead to new or improved public policies and programmes, new products and processes manufactured by existing firms, the creation of new firms to commercialise these findings, the training of skilled personnel at multiple educational levels, from post-secondary to post-doctoral, who bring new skills and perspective as employees or owners of existing and newly established firms. It may take place through formal channels, such as research contracts, patents and licences and consulting arrangements; through informal relationships, such as shared identification of research priorities, service by industrial representatives on college advisory committees; or through hybrid arrangements, such as the movement of researchers among academic, industrial and public research organisations.

There is a palpable disconnect between the performance of Slovenia’s academic research system and other knowledge-generation and economic sectors, despite many individual linkages and projects. Not only does this disconnect exist – a fact well recognised by government, university and industry representatives – it seems to be reinforced by resistance to change in parts of the research community and other obstacles. Addressing this disconnect is a major strategic objective of the “Audacious Slovenia” documents (RISS and NPHE), which include proposals specifically directed at fostering linkages between the university sector, public research institutes and industry.

This review seeks to emphasise the seriousness of the problems caused by this situation, primarily for Slovenia’s ability to generate and sustain long-term economic growth in increasingly knowledge-based global competition, but also for the long-term performance and visibility of its academic and public sector research institutes. The current situation is complex and seems laden with history: before 1991, some HEIs and PROs seem to have been strongholds of industry-related research; on first glance, many clusters of research strength today appear to derive from decisions taken two to four decades ago. In itself, this is a normal development, as scientific trajectories tend to span a long time period.

At issue however in the discipline-based structure of Slovenia's universities, with their ready access to SRA funding, is the emergence of new fields. The combination of past strengths, guild-style recruiting and current small-group/project-based funding hinders the development of new fields of science and technology and indeed threatens Slovenia's future research and innovation performance. At the level of individual research groups, there are marked differences in openness and co-operation, with various personal and institutional incentives and disincentives operating at the same time. Finally, both supply and demand as regards academic know-how seems to be disproportionately concentrated on domestic academics and customers. In such a situation, a "low-level equilibrium" could result, where low levels of both demand and supply impede the start of a virtuous circle. The present tendency to keep the academic research sector separate from the Slovenian economy appears to stem from an overly restrictive view of a "Republic of Science" or of autonomy, understood as the complete freedom of the individual professor/principal investigator. This view conflates desirable, indeed essential, precepts about the independence of scientific inquiry (in all institutions) from state-imposed ideological dictates and the value of transparent, competitive, peer-reviewed processes (augmented as appropriate by bibliometric indicators) for the selection of research projects and performers on the one hand, with the political realities of democratic nations operating in globally competitive environments, on the other. In such a setting, academic research supported by the public sector is based, on a *de facto* and sometimes *de jure*, social contract, in which "government promises to fund the basic science that peer reviewers find most worth of support, and scientists promise that the research will be performed well and honestly and will provide a steady stream of discoveries that can be translated into new products (or) medicines" (Guston and Kenniston, 1994, p. 2). The contract is entered into because it benefits all parties. Because the capacity of the public sector to finance academic research depends on the strength of the economy, university researchers have a stake in undertaking activities that contribute to the nation's overall economic performance. At the same time, across democratic societies, demands for the accountability of all those receiving public sector support, including researchers in universities and public research institutes, is becoming the norm.

There appears to be a dichotomy in Slovenia between "pure" academic science and "business"-oriented applied research,³ but this is a dated stereotype that impedes a productive search for new forms of collaboration. Many countries have found the different ways in which "virtuous circles" of productive university-industry-government relationships are possible. OECD reports and other studies of the governance of higher education systems in Europe, Asia and the Americas have highlighted a trend towards reduced (national and regional) government control over the internal operations of universities in matters such as admissions, employment contracts, fees, purchases, and related matters in exchange for documented evidence of academic performance above and beyond bibliometric measures (Whitley and Glaeser, 2007; Paradeise *et al.*, 2009). EU countries have seen a shift over the last 20 years – although with notable national specificities – towards more autonomous and at the same time more accountable universities. Pending Slovenian proposals for increased university autonomy reflect emerging EU policies.

Box 3.2. Changes in the European university set-up

The European university landscape has undergone a fundamental change over the last 20 years. For centuries the continent's universities were powerhouses of learning and innovation and a model for non-European countries' higher education institutions (such as the German influence on US HEIs in the late 19th century; Stokes, 1997, pp. 34ff.). However in the second half of the 20th century most (mainly continental) European countries encountered some serious challenges.

Mass education and the growing importance of additional goals and tasks fundamentally transformed the universities. The choices of stratification of the system and specialisation within it as potential answers proved difficult in countries with a more egalitarian approach, with a strong public role in the university system and/or with a more decentralised, federal political system. Moreover many European states face difficulties for financing their higher education sector adequately and organisational change proved very difficult.

Studies show that top universities outside (continental) Europe often have much higher output and impact, with most top-cited researchers working in the United States or elsewhere (see Table 2.6 on academic impacts). Efforts to explain the difference have focused on structural differences in organisation and governance (for examples, see Bonaccorsi, 2007; Herbst *et al.*; 2002, Hollingsworth, 2003). Global rankings show that many European universities are squeezed between the large and vibrant US institutions and a growing number of strong (mainly) Asian universities that are determined to rise to the top league.

Within Europe there are more than 40 individual HE systems and legislations. Owing to legal and cultural traditions each system has its own characteristics. At the same time, there are important mainstreaming exercises. Bottom-up initiatives include umbrella organisations such as the European University Association (EUA) or the League of European Research Universities (LERU), as well as intergovernmental initiatives. The most important change under way is the Bologna process to allow students to change from one country to another and the general introduction of the Bachelor and Master system. Top-down movements are weaker but growing: the performance of universities is a key aspect of the creation of a European Research Area (ERA) and the advent of the European Research Council (ERC).

The long-term process of change within Europe relies on national governments' efforts to reform their university systems. While "authority relations" (Whitley, 2010) between the state and the universities differ, as do HE funding systems (Ferlie *et al.*, 2008; Geuna and Martin, 2003; Himanen *et al.*, 2009; Jongbloed, 2009; Lepori *et al.*, 2007), there are a number of common reform agendas in Europe. In the last 20 years (see Paradeise *et al.*, 2009, pp. 247ff.) national systems and authority relations in general seem to have changed in the following ways: *i*) increasing university autonomy; *ii*) overall funding arrangements shifting from undirected basic funding to models based on performance and criteria, while allowing the organisation as a whole to plan and to respond; *iii*) increased emphasis on management and executive functions such as strong rectors or presidents; *iv*) external boards often with a more important role; *v*) more professionalised, active and international recruitment procedures; *vi*) greater tendency to measure and reward quality of research; *vii*) adoption of key elements of the Anglo-Saxon university structure: doctoral schools, broader departments, tenure track as career path. However it should always be taken into account that universities cannot be directly compared to top-down organisations and neither can nor should fully follow such a path; their necessarily decentralised elements make them a special kind of expert organisations (Whitley, 2008).

If there is one key message among the many different trajectories, it is this: in continental Europe, governments, stakeholders and key academics are making universities more autonomous, more active organisations, with the university leadership empowered to manage and steer the universities.

An agenda for a better internal university set-up

University autonomy *and* accountability means more flexibility for universities to hire people, to structure their employees' careers (employees are the university's and not the state's employees), to be free in the organisation of teaching, to have the authority to use block funds according to their strategies, to structure their boards and to elect their leaders, to own their premises, etc. These elements are not always part of an "autonomous" university in all countries. This freedom *vis-à-vis* the state has to be

complemented by certain internal structures and safeguards to make the system work. An autonomous university needs strong leadership, well endowed with budgetary and organisational competences, and it needs overall policies for recruitment and co-operation with industry. Further it should have an up-to-date administration in terms of accounting, human resources, technology transfer, etc. It needs to be an organisation, not just a loose envelope around a large number of academics who are entirely free to choose their paths. This does not contradict the necessity of core individual academic freedom regarding what to teach and which scientific field to pursue. It is also important that the specific nature of universities – which by necessity implies features of decentralisation and bottom-up modes of operation – is duly taken into account in any significant reform project (see Box 3.2).

In Slovenia leading academics and other key stakeholders have begun discussing the lack of power of university (or PRO) leaders and the confusion created by university autonomy in the absence of organisational rules and central leadership. An overly decentralised structure, a strong bias towards certain funding models, and the reported lack of links with industry and PROs put academic research at risk. Current funding and organisational arrangements limit the scale and scope of the research faculty can propose, such as the formation of interdisciplinary research teams and access to expensive, specialised facilities and instrumentation, both of which are increasingly important in international competition for research funds. These self-imposed restrictions, along with several others that negatively affect Slovenia's attractiveness as a place for foreign students and faculty to study and do research, are likely to confine Slovenian academic researchers to niche research areas and subordinate roles in international research projects. This is apparent in a major new European funding instrument; it is not (or not only) due to its size that up to 2010 Slovenia was unable to attract an ERC starting or advanced grant, or a have a grantee use ERC money to come to Slovenia.

The higher education strategy plan 2011-20 (NPHE) contains many desirable objectives and calls for a number of necessary reforms. It should become over time – perhaps through sub-strategies – more specific and implementation-oriented, especially given the likelihood of opposition from existing institutions. The main point is that in a highly decentralised university system like Slovenia's more is needed than a declaration of autonomy. It may seem paradoxical, but if autonomy is to result in better outcomes a framework of legal and organisational structures and active ministry governance are essential. Such legal and organisational provisions should provide for workable board structures, budgeting structures, frameworks for developmental plans, internationally open and active personnel recruitment and career tracks, evaluation principles, etc. In short the policy level has to define tasks and to enable the universities, via framework conditions and norms, to fulfil these tasks and become effectively autonomous.

The NPHE has a number of basic requirements. The funding system must introduce more block grants for universities plus a new developmental part of funding, *i.e.* a kind of incentive-based extra block funding element. This is to be accompanied by a higher degree of autonomy for universities: HEIs are to “independently manage their tangible assets, autonomously prepare study programmes, set academic standards, select staff and students and form their own organisation, management and financial decision-making ... (and) have more influence on the selection of students, particularly for the second and third study cycle” (MHEST, 2010b, p. 9). Furthermore the strategy calls for a new career system, which delinks academic qualifications such as the *Habilitation* from job qualifications, thereby allowing universities' greater freedom for career development. This report endorses the NPHE's long-term perspective.

Box 3.3. Austrian university reform

Austria, one of Slovenia's neighbours, fundamentally transformed university law and governance a few years ago. With a long tradition – the University of Vienna is nearly 650 years old – the university sector has grown considerably over the last decades. Austria now has a dense population of 22 public universities of all sizes (the University of Vienna is one of the largest in Europe) and specialisations, plus 21 universities of applied sciences and 13 smaller private universities. The latter two categories are often substantially backed by the nine provincial governments. There are more than 310 000 students, of whom over 250 000 in the university sector and more than 35 000 at universities of applied sciences. As regards public-sector research, the overall majority of research staff are located at universities. The PRO sector is smaller than in many other OECD countries.

The Austrian university system faced difficult times in the 20th century. After 1918, public funds dried up and affected its earlier strong academic record. The period from 1938 devastated Austrian universities which were unable to revive in the post-war period. Low quality, inbreeding and under-financing and an increasingly out-of-date organisational model gave individual professors in small departments full individual autonomy without full responsibility or accountability. When the Austrian academic community began to recover and to return to the quality track in the 1980s, it was not supported by the underlying organisational model (see Grandner *et al.*, 2005; Pechar, 2005).

Over 20 years, research policy gradually began to change the organisational structure: While the 1975 *University Act* (UOG 75) brought more codetermination of academic staff and students, the 1993 *University Act* (UOG 93) allowed the universities to structure their internal organisation and gave them rights and obligations as regards industry contracts, etc. After the 1993 reform, the universities still had no real leadership, little power to change the organisational set-up and could not act as legally independent entities. A strong ministry and Senate and strong individual professors or subunits were in charge (and practically negotiated the budgets). Rectors were weak and supervisory boards non-existent. The result was a lack of strategy, problems for managing change and largely missing substantive centres of excellence.

To overcome these problems and to make the Austrian universities more independent, the 2002 *University Act* (UG 2002) – after long discussions – fundamentally changed the situation. The reform had a number of objectives: to raise effectiveness, efficiency and attractiveness of the Austrian universities; and to implement management principles, quality assurance and adapt to European developments, namely the Bologna process. To achieve these objectives, the universities were made fully autonomous, with the ministry stepping back from day-to-day management. The relationship between the government and the ministry now focuses on negotiating budgets in the form of three-year performance agreements on the basis of a developmental plan. Over the years the budget has included a small but growing competitive element with performance criteria as part of the “global budget” formula. The main difference as regards budgets, however, is that the general university fund allocation can now be influenced to some extent by university leadership. For the first time there is an opportunity to redirect funds, to create new fields or to give incentives to those who perform better. Overall the universities as distinct public entities have full legal capacity within the UG 2002 framework. They now manage externally funded projects much more actively and try to develop structured intellectual property (IP) and spin-off policies.

The executive and the board functions have been strengthened. Strong rectors and their teams now head the universities and have considerable power to change organisational plans and budgetary arrangements, and they have a say in the still largely bottom-up recruiting processes. The Senate has lost part of its influence and the university council (board) gives external persons, both stakeholders and academics, a strong co-decision and control mandate.

Austrian universities can now act as independent organisations and pursue a structured quality policy. They can better develop their priority fields and sharpen their profiles (though not all do so). The Austrian system is still a little less driven by change and dynamism than that of other countries. However change has started and will transform the university landscape over the next decades.

This report does not touch upon plans to create a second layer of technical colleges/universities of applied sciences, as evidence is scarce. However this issue needs to be more strongly addressed by Slovenian policy makers. European countries such as Switzerland, Germany and Austria have had very positive experience with this type of HEI over the last decade or two and have managed to build up a new, industry- and needs-oriented layer in tertiary education. Technical colleges and universities of applied sciences in these countries even manage to build small labs for experimental development and to pursue collaborative projects, mostly with SMEs. Switzerland and Austria have created specific public funding programmes for this kind of co-operation.

3.3. Public research organisations (PROs)

PROs as strong actors in the Slovenian innovation system

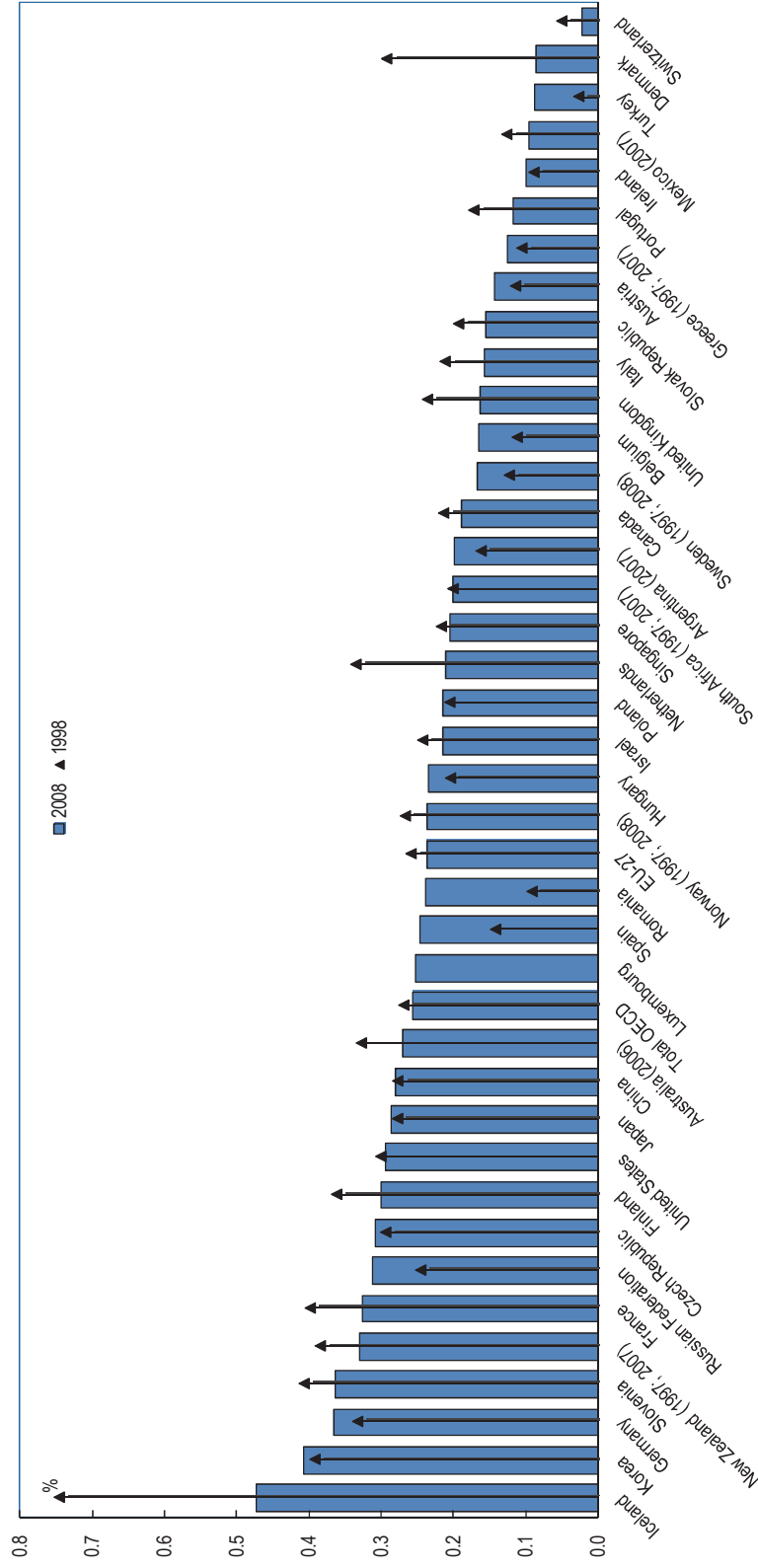
The PRO sector forms an important pillar of Slovenia's innovation system. The share of public R&D funds allocated to this sector exceeds that of all but a few countries, and is rising as a share of GDP, from 0.36% in 2008 to 0.39% in 2009 (see Table 2.3; for 2009, see OECD 2011c, p. 76). PROs have nearly 50% more funds available for research than HEIs. As noted in Section 3.2, such a pattern is typical of a number of new EU members in central and eastern European countries. In contrast, Finland, France and Germany fund both the universities and the PRO sector similarly and Switzerland and Austria mainly rely on universities. There is also a recent Danish initiative to merge universities and to integrate PROs in larger HEI structures. Figure 3.2 shows the exceptional position of Slovenia as regards HE shares.

The role of PROs is rooted in the post-1945 period, when the State of Yugoslavia sought to build its research capacities. Before 1918 Slovenia as part of the Austro-Hungarian empire was not endowed with a research infrastructure of its own. Moreover, Slovenia was an economic heartland of Yugoslavia after 1945. In contrast to many central and eastern European countries, the PRO sector did not evolve mainly under the umbrella of a powerful National Academy of Sciences⁴ but in a more decentralised and flexible form. Some of the PROs show highly specific trajectories, often as mono-disciplinary research institutes combining elements of basic and applied (contract) research. Within Yugoslavia many of them had a specific Slovenian governance structure and co-operation patterns with local firms.

Overall, the focus of each PRO largely appears to be the result of individual political decisions dating from before 1991. The background report lists “47 research institutes in the government sector, employing 2 157 researchers in 2008” (Bucar *et al.*, 2010, p. 51), which added up to around 30% of all researchers in Slovenia. The sector grew in the last years; in 2005 it employed around 1 600 researchers (OECD, 2011c, p. 79).

Figure 3.2. Research performed in public research institutes, 1998 and 2008

As a percentage of GDP



Note: In Romania and the Russian Federation, much R&D is traditionally performed by public enterprises, which are classified in the business enterprise sector.

Source: OECD (2010, p. 30), <http://dx.doi.org/10.1787/88893232702>.

For purposes of this assessment, attention focuses on the 15 PROs that have the Republic of Slovenia as their owner (and institutions of the former Yugoslavia generally as their founder) and are eligible for institutional funding. This structure was created by the 1992 *Law on Research and Development*. Overall, the most important PROs receive 79% of their funding from the national government through a combination of “institutional” funds, mainly research group grants, and project-based awards. Most institutes and most activities within the institutes mainly follow a scientific rationale; other goals, such as collaboration with industry, may be important but are secondary activities. There was more focus on applied research and firm partnerships before 1989.

According to Bucar *et al.* (2010, p. 52), the main institutes are:

- Agricultural Institute of Slovenia
- Educational Research Institute
- Geological Survey of Slovenia (GeoZS)
- Institute of Economic Research (IER)
- Institute of Hydraulic Research
- Jozef Stefan Institute (IJS)
- Institute of Metals and Technology (IMT)
- Institute for Ethnic Studies (INV)
- Institute for Contemporary History (INZ)
- National Institute of Chemistry (IC)
- National Institute of Biology (NIB)
- Slovenian Forestry Institute
- Urban Planning Institute (UI)
- National Building and Civil Engineering Institute (ZAG)
- Scientific Research Centre (ZRC SAZU) of the Slovenian Academy of Sciences (SASA).

The bulk of research funds, as for universities, are delivered through the SRA Research Groups programme, 13% comes from industry, and 6% from abroad, including EU grants. The institutes are primarily engaged in physical, biological, chemical, agricultural, engineering fields of research, with some coverage of the humanities and social sciences. A number of institutes occupy important intermediary positions between universities and industry, with a strong potential to enhance this position. Others mainly serve the needs of specific sector policies. Overall the PROs are of different types and have different tasks, even though some are under one organisational umbrella.

The largest PRO is the Jozef Stefan Institute (IJS), with more than 850 employees – around 40% are PhDs – and a strong record as regards publications and patents. Starting in 1949 with research in physics to support the Yugoslavian nuclear energy programme, IJS’s coverage of fields has broadened considerably over the last decades. In the late 1960s nuclear research was omitted from the institute’s name. During the same period the Slovenian government took over more responsibility and co-operation with the University of Ljubljana was strengthened. Today IJS research groups specialise in physics, chemistry

and biochemistry, electronics and information science, nuclear technology, energy utilisation and environmental science (see www.ijs.si). IJS like other Slovenian PROs have strong links to Slovenian universities (*i.e.* faculties and research groups), especially with the University of Ljubljana. Many IJS key researchers have affiliations with this university, where they are actively involved in doctoral study courses. On the other hand IJS has considerable industrial partnerships and a certain record of technology transfer and entrepreneurship. The institute was one of the founders of the Technology Park Ljubljana (TPL), with first pioneering activities as early as 1992.

In addition to IJS, there are a number of other research institutes engaging in the area of investigator-driven natural sciences. The National Institute for Chemistry (IC) with close to 300 employees is the second-biggest PRO, also founded shortly after World War II. In the first decades of its existence, regional pharmaceutical, chemical and engineering companies had strong ties to IC and had a strong role in the institute's governance structure. Now IC has a strong focus on scientific excellence but still closely collaborates with a number of firms, notably in the pharmaceutical industry (like LEK or Krka), and with a number of foreign companies. From a financial point of view, this kind of co-operation represents 20% of the income of the Institute (www.ki.si).

The National Institute of Biology (IB, www.nib.si) was founded in 1961 by the University of Ljubljana to enter larger-scale basic and applied biological research. IB has since become a national Institute and focuses on molecular and environmental biology. With a staff of 120, IB like IJS or IC is also highly active in European research programmes.

These three institutes – IJS, IC and IB – seem to be strongholds of scientific research in Slovenia with a considerable number of competitive groups, international linkages and academic and applied outputs. They each also are increasingly engaged in the filing of international patents. Furthermore a number of government institutes serve both a scientific and a government mission, in fields like economic research, urban planning, forestry, geology, agriculture or education. Finally a number of institutes have been created with a focus on humanities and social sciences. Six of them (some listed above) belong to the 15 national institutes, with the Scientific Research Centre of the Slovenian Academy of Sciences by far the biggest. In general the size of SSH research groups both in universities and PROs is described as being small, the whole sector as being fragmented and organisationally relatively untouched by the big political changes in the early 1990s (European Commission, 2010, p. 2, and pp. 11 f. with examples for the small scale SSH research).

In a national perspective, the institutes engaged in physical, biological, chemical, agricultural, engineering fields of research, but also in the humanities and social sciences, occupy important intermediary positions between the universities and industry. The share of industry funding in GOVERD is quite considerable when compared to a number of other small countries (Table 3.7). However, it is important to have a clear picture as regards the functions of PROs within an innovation system.

Table 3.7. Percentage of government intramural expenditure on R&D (GOVERD) financed by industry

	1995	2005	2006	2007	2008	2009
Austria	..	..	6.8	9.3	..	..
Czech Republic	11.3	13.8	10.5	13.7	11.3	9.8
Denmark	3.5	2.1	1.0	0.6	..	1.9
Estonia	14.5	0.0	0.0	0.0	1.3	1.9
Finland	11.9	12.4	12.7	13.7	14.2	13.6
Hungary	15.1	10.3	14.3	12.3	13.3	12.6
Slovak Republic	32.6	8.5	13.5	13.4	15.7	14.4
Slovenia	12.8	12.1	14.2	13.1	12.7	11.7
Singapore	0.7	2.3	2.6	2.1	2.9	..
Total OECD	3.2	3.7	3.9	4.0	3.8	..
EU-27	6.2	8.3	8.8	8.8	8.4	..

Source: OECD (2011c).

Increasing the contribution of PROs

However, the institutes' intermediary role has yet to be fully exploited through a structured policy and clear distribution of tasks. There are already many examples of active co-operation between PROs and universities, as in the case of the joint institute-university appointments of members of IJS. Similarly, IJS, IC and others have R&D contracts with industrial enterprises, hold a number of patents, and have or are launching their own technology transfer offices (TTO). These two institutes, along with other institutes and partners, also spearheaded the establishment of the Ljubljana Technology Park (TPL, see Section 3.4), a major and apparently successful regional initiative to support start-up and spin-off firms.

Paradoxically, these strong links co-exist with equally strong disincentives to co-operate. The many double affiliations of professors and group leaders do not seem to translate into cross-organisational co-operation or career tracks. For example, PROs do not seem to be engaged in doctoral programmes or to contribute more generally to university education goals (apart from the dual role of key people in university and PROs). There are reportedly some individual arrangements for PhD training and somewhat fragile efforts by individual PROs to create their own doctoral school.

One problem for the PROs, especially the larger ones, is the lack of steering instruments, such as meaningful central budget lines for investments or the launch of new fields. The lack of organisational power is even more astonishing than in the university sector, and the arguments less understandable. Even more than in universities, their decentralised structures lead to compartmentalisation, impede the emergence of new fields and hamper the development of a strategic focus. The lack of strong central governance on both sides also seems to contribute to the lack of meaningful co-operation between PROs and universities. A number of the reforms needed in higher education are also needed in the PRO sector.

Slovenian government strategies such as the RISS call for: *i)* more autonomy and stronger leadership of PROs; *ii)* stronger links between universities and PROs; and *iii)* a functional segmentation of the PRO sector, with some focused on scientific research and others more strongly engaged in pure applied, contract research. This report strongly supports the first and second goals. The third may also be sound but should be more closely examined by the Slovenian government. More functional differentiation is generally a characteristic of larger European mainstream countries and this path should be chosen cautiously. In any case, something should be done to remedy the apparent strategies of all major Slovenian public research actors “to do it all”.

3.4. Interactions and linkages

Innovation linkages of the business sector

Interactions between different organisations and types of organisations are key to a functioning innovation system (OECD 1999, 2001a, 2001b and 2002). Though intramural R&D and innovation are still highly important for many firms’ success in mastering innovation and gaining market shares, the use of external know-how and co-development processes allow firms to successfully grow, to change behaviour and to come forward with more ambitious new products, processes and services. Thus, while companies have traditionally tried to retain their core capabilities (in technology and markets) and develop them internally to the greatest extent possible, “open innovation” (OECD, 2008a) has been emerging – at least to some extent – as an alternative to in-house development, particularly when the objective is to diversify in terms of technology and/or markets (OECD, 2010). The trend of open innovation shows that even large corporations with strong in-house R&D strategically use many kinds of external know-how in structured partnerships. Over the OECD area, various policy instruments have been developed and disseminated in the last 15-20 years to increase and professionalise linkages and co-operation (OECD, 2004).

More generally, companies source external knowledge in various ways (OECD, 2010): partnerships with external parties (alliances, consortia, joint ventures, joint development, etc.); or acquisition or sale of knowledge (contract R&D, purchasing, licensing). Companies also increasingly use venturing to find external partners for commercialising innovations that are not used internally (divestment, spin-out, spin-off). This more open approach to innovation, however, is not without transaction costs (e.g. sourcing and processing of new knowledge) and even financial costs (e.g. purchasing of knowledge). The degree of openness in innovation differs across firms and industries (OECD, 2008b).

As a small open economy Slovenia has a special need both to foster co-operation and to link up to external knowledge. This is true for the firm sector as well as for academia and for the linking up of both sectors. A general view on interactions and linkages in Slovenia shows a mixed picture, with many actors already professionally participating in innovation collaborations:

- Slovenian firms have strong ties both with suppliers and customers, as many of them are closely integrated into international supply chains as second-, third- or fourth tier suppliers. Around 40% of all innovating enterprises reported such co-operation patterns in CIS 2006, around 5% more than in CIS4 in 2004 (Bucar *et al.*, 2010, p. 62). For 2008 a comparison is difficult to draw, as data analyses are

still insufficient and many new firms have entered the CIS sample owing to an increased emphasis on organisational and marketing innovations. For technological innovation in a stricter sense, more than one third of process innovations are developed with another company (34.9%), while 48.4% are developed mainly in-house and 16.7% have only a subordinate role (Eurostat, 2011). Product innovations show a different pattern: 66.6% of innovations are developed mainly in-house, 27.4% in co-operation, the rest again play a subordinate role (Eurostat, 2010b).

- International co-operation has grown and is very strong. Overall the Slovenian business sector is among the top five in the EU27 in this respect: 48% of all innovating firms according to CIS 2008 (sample: 2 310 Slovenian firms, Eurostat 2010b) co-operate with external partners in innovation related activities. Moreover, Slovenia leads in terms of co-operation with European partners. In this context, its impressive quantitative participation in the EU Framework Programme is an additional sign of the strong outward orientation of Slovenian firms and other actors (see Section 4.5.2).
- In quantitative terms, science-industry co-operation plays a slightly less important role for industrial innovation. However, more than 20% of all innovating firms report co-operation with HEIs and 15% with PROs for 2006, an increase in both cases from 2004 (Bucar *et al.*, 2010, p. 62). This pattern is similar for many European countries and therefore not worrying. The Slovenian government has a number of programmes and organisational solutions, discussed elsewhere in this report, to raise the number of substantial science-industry linkages further: technology centres and comparable innovation infrastructures, competence centres, development centres and similar large-scale programmes, and joint development-investment projects. This list includes many programmes with European Structural Funds financing. However institutional barriers in both the HEI and PRO sectors and a plethora of public innovation infrastructures with overlapping missions and mixed records create challenges to be overcome. Another similar funding programme would be of little additional value. It would be more important to tackle seriously the structural and organisational bottlenecks described in the sections on universities and PROs.

Technology transfer and entrepreneurship

Slovenia has a wide variety of instruments that focus on the innovation system. Leaving aside the government executing and funding agencies SRA, TIA, JAPTI, SEF and SID (described in Section 4.2), they can be grouped according to their main tasks (Bucar and Stare, 2006): *i*) bridging institutions (technology centres, technology platforms, centres, clusters); *ii*) technology, innovation, entrepreneurship support institutions (technology parks, business and university incubators, technology transfer offices, one-stop shops points, regional development agencies); *iii*) financial intermediaries (venture funds, business angel associations, etc.); and *iv*) interest organisations (Chamber of Commerce and Industry with regional branches, Chamber of Craft and Small Business of Slovenia). These activities are mainly directed at transferring research findings from universities and PROs to medium and larger firms and at spawning start-up and spin-off firms. This emphasis, in the main, makes sense. Knowledge transfers at universities – technology transfer offices (TTOs), spin-off strategies and increased mobility for young researchers – should be further professionalised in line with the RISS strategy.

In 2009 an informal network of Slovenian experts for technology transfer was created (SI.TT). This is a useful development but may require further development and the formalisation of alliance and network structures as in the TTOs in more developed, such as CONNECT (United States), MaRS (Canada) and TTN (Singapore).

IJS and IC have established independent units for technology transfer. The University of Maribor has its TechnoCentre, the University of Primorska has a University Incubator, and the University of Ljubljana has an Office/Service for Research, Development and Intellectual Property. The Ljubljana Technology Park (TPL) was established at the end of 1995 following two years of experience in the IJS Technology Park. Its founders were IJS, IC, IB, the City of Ljubljana and firms such as LEK or ISKRATEL. The purpose of these technology parks is to create an environment in the immediate vicinity of the participating PROs, universities and industry that encourages and enables the formation and development of technologically advanced companies. The strategies of these parks differ. TPL is more active in terms of the portfolio of companies being incubated and the programmes offered to assist the start-ups than the incubator at the University of Ljubljana. With 35 000 m² of office and lab space, it has more than 260 incubated and associated companies with a strong IT and services focus (TPL, 2010).

One problem seems to lie with the system as such. As noted in the RISS document there is a manifest lack of a co-ordination of actors at systems level (MHEST and ME, 2010, pp. 11 f). The Background Report (Bucar et al., 2010, p. 60) also notes that the current level of decentralised management at the larger universities, *e.g.*, UL, where much of the decision-making in relation to research is left to the level of individual faculty makes the position of the TTOs rather problematic and “fluid”.

Another issue for concern is the sheer number of organisations. While the TTOs and related organisations mentioned above already constitute a large number for a small country, regional actors are also active in this field (OECD, 2011b). Some others dating back to earlier phases of innovation policy making, seem to live a shadow life. Finally, a few funding agencies directly apply (entrepreneurship) support instruments that are also offered by TTOs and other intermediaries. These issues – as governance – will be discussed further in Chapter 4.

At the same time, some functional properties are missing. Slovenia would need what is termed elsewhere “manufacturing modernisation” activities that are designed to apply mainly off-the-shelf knowledge to the production processes and practices of existing firms, typically SMEs, with a view to improving their productivity (Box 3.1). Many organisational models and funding arrangements to provide such services exist: outreach/extension units of universities or PROs; a regional development authority or other non-governmental organisation; new or expanded services offered by a trade or craft association or chamber of commerce and industry. To be avoided are arrangements, in which a funding agency gives subsidies to intermediaries like technology parks or incubators and at the same time offers similar services *e.g.* in the field of consulting or entrepreneurship to the same target group of enterprises or individuals as the subsidised intermediary does itself with the funding money. Other critical elements that are missing in Slovenia are serial entrepreneurs, sources of funds for start-ups and low-key productivity measures, according to the start-ups and incubators interviewed by the review team. In addition, many university graduates are reported to prefer the less risky work available in government agencies and large companies. This is likely due to an environment which is not conducive to start-ups and entrepreneurship. The RISS

document (MHEST and ME, 2010, pp. 29ff.) notes the need to establish an environment that is conducive to start-ups.

In general, Slovenia could consider three variants of technology transfer models that are being practised globally in various degrees of intensity, namely:

- *Start-up friendly technology transfer model.* Technology transfer in the United States tends to follow this model which requires significant venture capital (VC) and easy access to a large market to facilitate a start-up's rapid growth. The Bay Area and Boston offer such an environment. Countries that lack such elements will have to tap into other finance hubs and markets for their start-ups to be viable. Start-ups in Israel and Chinese Taipei, for example, raise capital and exploit markets in the United States. As Slovenia has a shortage of VC and business angels and has a small domestic market, this approach could be relevant.
- *Industry-driven, industry-sponsored research model.* Japan, Korea, Finland and Germany have a large amount of industry-driven and industry-sponsored research. This model requires a strong presence of locally based medium to large industry in order to capture value in the local economy. Smaller firms can tap into larger companies as part of a supply chain. Start-ups, where present, would normally exit by being bought out by the larger companies.
- *Open-source, public good model.* Economies that lack the elements needed for the two preceding models can consider a more open-source, public-good model that makes the benefits of government-funded research easily available to private industry players. Industry consortiums are established to determine the research direction for each specific focus. This model is widely present in Chinese Taipei.

Box 3.4. The case of Singapore

Singapore, like Slovenia, is a small country, with a population of 4.6 million. Given its commitment to building a knowledge-based economy, it has developed some interesting features over the past decade:

The Agency for Science, Technology and Research (A*STAR) has 14 research institutes, with 7 in the life-sciences and 7 in the physical sciences. A*STAR has more than 2 200 full-time researchers, whose activities are co-ordinated by two councils, the Biomedical Research Council (BMRC) and the Science and Engineering Research Council (SERC). A*STAR had a budget of SGD 5.4 billion for 2006-10. More than 65% of researchers are expatriates from the United States, Europe, Australia, New Zealand, China and India. A*STAR research institutes are concentrated around the Biopolis and Fusionopolis facilities within a radius of 1 km to encourage multidisciplinary research collaboration.

The National Research Foundation (NRF) has a budget of SGD 5 billion for 2006-10 and funds research in higher education institutions and research hospitals. NRF also funds the establishment of incubators, early-stage venture capital and translational R&D projects.

The Technology Transfer Network (www.TTN.sg) has more than 45 institutional members from the United States, Canada, the United Kingdom, Germany, Turkey, Korea, Australia, New Zealand and Singapore. Its aim is to establish Singapore as a technology commercialisation hub in the region.

The Standards, Productivity and Innovation Board (SPRING) has extensive programmes to fund start-ups and to encourage SMEs to adopt and exploit technologies for growth.

A final important issue concerns social entrepreneurship and social innovation. It is often stated that Slovenia is a “transition economy” and that entrepreneurship and Slovenia’s socialist heritage create conflicting dynamics. However, the fact that Slovenia is a “transition economy” puts it in a unique position to explore emerging concepts related to “social entrepreneurship” or “social innovation”, in which the benefits of a market economy and social-communal development are compatible. In recent years, the concept of “bottom of the pyramid” innovation, “triple bottom-line” and social innovation have gained traction. The Social Enterprise Alliance (SEA), based in the United States, defines a “social enterprise” as “an organisation or venture that advances its primary social or environmental mission using business methods”.

3.5. Human resources for S&T and innovation

As with other facets of Slovenia’s overall comparative standing among its EU27 peers, there are clear strong points in its approaches to nurturing the nation’s supply of human resources for S&T and innovation. Total expenditure on education as a percentage of total public expenditures for all levels of education at 12.9% in 2006, were slightly above the EU27 average of 11%, but slightly below the OECD average of 13.3% (Bucar *et al.*, 2010, p. 104). In 2007, Slovenia ranked second among the EU27 in the proportion of the 20-29 age cohort enrolled in tertiary education. Slovenia’s share of 40.5% ranked only below Finland’s (46.7%) and well above the EU27 average of 28.6% (Eurostat 2010c, p. 49).

The share of students enrolled in science and technology fields (9% of this age cohort) is near the top of the EU27, following Finland (17.1%), Greece (12.2%), and Lithuania and Sweden (both 9.6%). The average annual growth rate of enrolments in S&T was 4.1% over 2002-07, again above the EU27 average of 3.5%. Slovenia’s growth rate is similar to those of Hungary, the Slovak Republic and Estonia, all of which are also above the EU27 average (Eurostat, 2010c, Table 4.1; Table 3.8). This increase is attributed to recent Slovenian government initiatives to “encourage enrolment in science and technology fields by offering better scholarship options to S&T students as well as limiting the enrolment in the most popular programmes (law, economics, social sciences...)” (Bucar *et al.* 2010, p. 110). The downside to these statistics is that the share of S&T tertiary students has increased only modestly and that a high percentage of cohort enrolments in tertiary education appears to be attributable to the social benefits granted to students enrolled in tertiary education, who often progress slowly towards completing degrees.

The annual average growth rate of human resources in science and technology (HRST) is 4.2%, above the EU27 average of 3.3% and more than twice the annual average growth rate of the total Slovenian labour force (Eurostat, 2010c, p. 55). The picture is similar in most EU countries. Bulgaria is an outlier as the total labour force grows about 1.8% faster than human resources in science and technology which grow by only 0.3%. Estonia is among the leaders, with both HRST (6.7%) and the total labour force (about 2.7%) growing much faster than the EU27 average.

Table 3.8. Students participating in tertiary education, total and in science and engineering (S&E), 2007

Total and as a percentage of population aged 20-29 and AAGR 2002-07, EU-27 and selected countries

	Total			Science and engineering		
	Total in thousands	As a % of population aged 20-29	AAGR 2002-07	Total in thousands	As a % of population aged 20-29	AAGR 2002-07
Austria	261	24.7	-1.6	64	6.1	-2.3
Czech Republic	363	23.9	5.0	83	5.5	0.0
Denmark	232	37.3	3.5	44	7.0	2.2
Estonia	69	34.0	2.5	16	7.8	4.5
Finland	309	46.7	1.7	113	17.1	1.4
Hungary	432	30.2	4.0	79	5.5	4.4
Slovak Republic	218	24.1	7.4	54	5.9	4.9
Slovenia	116	40.5	3.2	26	9.0	4.1
EU27	18 877	28.6	4.5	4 638	7.0	3.5

Source: Eurostat (2010c).

A theme repeated in the National Higher Education Master Plan, statements of industry representatives and background documents is that tertiary education in Slovenia lags and “does not suffice for the ambitious projections of the needs of (Slovenia’s) society” (MHEST, 2010b, p. 4). In particular, there is concern about the low, if slowly increasing, share of students enrolled in science and technology fields (Figure 3.3, Table 3.9). Implicit in the national plan and explicit in industry statements is the need to increase the number of students in technical faculties and to orient graduate students and young faculty towards collaborating with industry and/or seeking employment in the industrial sector. Recent policy initiatives along these lines, such as the Programme for Young Researchers, are reported to be operating successfully (Bucar *et al.*, 2010, p. 90), but may require some refinement.

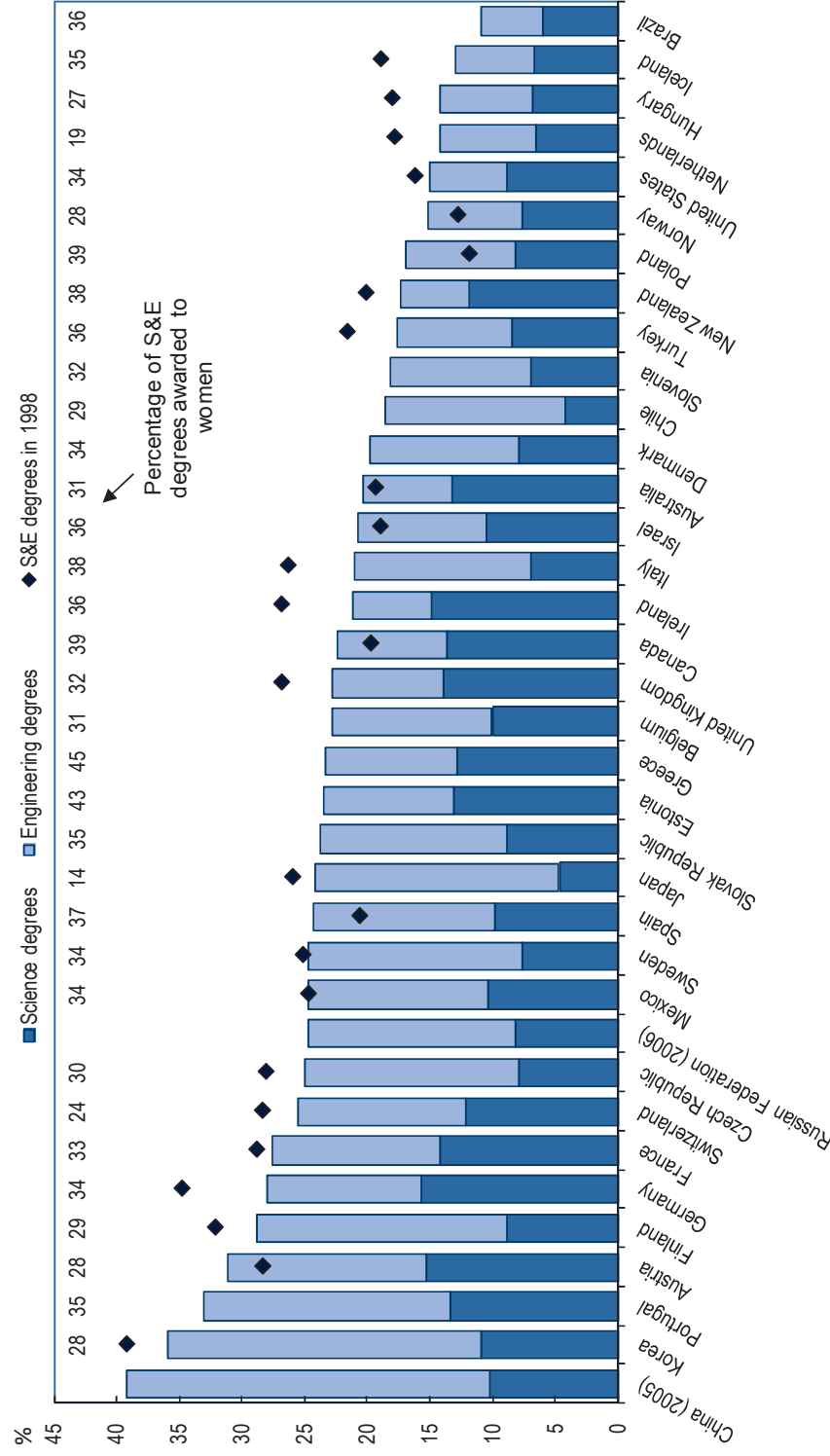
Table 3.9. Number of S&T graduates of tertiary education in Slovenia, all levels, 2009

Study field	All graduates	1st level	2nd level	3rd level*
All	18 103	9 817	6 802	1 484
Natural science and mathematics	803	231	413	159
Technical and engineering studies	2434	1449	801	184
% of S&T in total	17.8%	17.1%	17.8%	23.1%

* Includes doctoral and specialisation programmes.

Source: SORS, June 2010 (www.stat.si/novica_prikazi.aspx?ID=3199) cited in Bucar *et al.* (2010).

Figure 3.3. Science and engineering degrees as percentage of total new degrees, 2007



Note: Data include tertiary type-A degrees and advanced research programmes (ISCED 5A and 6). A breakdown by gender is not available for China and the Russian Federation.

Source: OECD (2010, p. 43), <http://dx.doi.org/10.1787/888932332759>

The Higher Education Master Plan provides a bridge between the diagnosis of the shortcomings of Slovenia's higher education system and the projected needs of a knowledge-intensive economy and society. It aims to: redefine the requirements for the establishment and operation of different types of higher education institutions; enable, within the new framework for higher education institutions, fully autonomous decision making as regards institutions' internal organisational structure; enhance co-operation between higher education institutions and public research organisations; and enhance co-operation between higher education institutions and the economic and public sectors. Among the specific steps proposed to achieve these goals are provisions for the reciprocal mobility of staff among higher education institutions and public research institutes and harmonisation of the wage system and conditions of advancement for non-administrative staff at higher education and public research institutes. Pursuit of these goals would help to harmonise Slovenia's higher education system with those evolving across EU and other market-oriented economies and to ensure that Slovenia has the human resources required to become a high-performing, knowledge-intensive society.

Far reaching as it is, the Higher Education Master Plan needs to be more specific about means and ends. It should be more uncompromising about two-way internationalisation, although the "Audacious Slovenia" document (MHEST, 2011c) includes some measures that go in the right direction. It does not clearly address the nation's need for technically trained personnel below the PhD level, and it does not identify means for improving collaboration between universities and industry. It does not specify the respective roles of the polytechnics and the universities in this regard. Competition for "mission" (and thus resources) occurs frequently whenever major national higher education reforms are proposed. More specific guidelines in the plan would likely not eliminate competition, but at least would point to the intended outcome.

Moreover, despite the attention to closer collaboration between Slovenia's higher education and industrial sectors, few specifics are provided on whether public universities are to undertake formally a "third mission" and engage in economic development and other outreach activities. There are few provisions in the plan for consulting with industry regarding the portfolio of technical, managerial, communication or other skills they seek in university (and polytechnic graduates). Here, as elsewhere in Slovenia's innovation system, the missing elements appear to be formal or informal "bridges" between universities and industry. The questions of lifelong learning, improvement of skills and return to education for a second or third study cycle after some years on the job could be discussed in greater detail. The burning issues for Slovenia are: *i*) the upcoming human resource shortage; *ii*) the need to raise industrial productivity; and *iii*) the need for many Slovenian firms to climb the innovation ladder.

In general, the greater the number of channels of communication and the denser the social networking among individuals and institutions in different sectors, the greater is the contribution of a nation's research organisations to achieving its societal objectives.

Total researchers in full-time equivalent per thousand employment have risen from 5.3% in 1995 to 7.7% in 2009. This is slightly above the EU27 average (Table 3.10), though well below Finland (16.6%) and Denmark (12.3%). Moreover, out of the approximately 5 000 industrial R&D employees only a few hundred seem to have a master's degree or even a PhD. The vast majority have a BA or less (Bucar *et al.*, 2010, p. 37). This fits well into the overall picture of a low level of innovativeness in many Slovenian enterprises and could be a sign of an overestimation of research activities in some corners.

Table 3.10. Total researchers in full-time equivalent per thousand total employment

	1995	2005	2006	2007	2008	2009
Austria	..	7.3	7.3	7.8	8.4	8.5
Czech Republic	2.3	4.8	5.2	5.3	5.6	5.5
Denmark	6.1	10.2	10.2	10.4	12.1	12.3
Estonia	..	5.5	5.4	5.6	6.1	7.2
Finland	8.2	16.6	16.6	15.7	16.2	16.6
Hungary	2.6	3.8	4.2	4.2	4.5	5.0
Slovak Republic	4.6	5.2	5.5	5.7	5.6	6.1
Slovenia	5.3	5.7	6.3	6.5	7.1	7.7
Singapore	4.3	10.3	10.0	10.0	9.4	10.2
Total OECD	5.9	7.5	7.6	7.6	..	..
EU27	4.8	6.2	6.4	6.4	6.6	6.9

Source: OECD (2011c).

There is the further question of the nation's investments and strategies for strengthening its human resource capacities for S&T outside of tertiary education and the PROs. The limited scope of the field interviews and background documents available to the OECD assessment team permits only a general impression: Slovenia may not be paying enough attention to pre- and post-tertiary mechanisms for building and maintaining competencies in S&T fields. Ambitious and relevant as are recent ministry reports for addressing the human resource aspects of Slovenia's effort to improve innovative performance, they tend to focus on the university and PRO systems. The documents available to the assessment team do not systematically address the potential for strengthening S&T capabilities in secondary education and technical institutes. Also not clearly addressed is the need for lifelong learning to maintain the proficiency required of S&T personnel, or the design of policies and programmes to support such learning (see also OECD, 2011a).

Notes

1. However, the inclusion of non-technological, marketing and organisational innovations in the last survey increased the number and share of innovative firms in all countries.
2. Even in the recent crisis there was some growth in BERD (OECD, MSTI, p. 48).
3. But not always in the numbers, as noted in Chapter 2.
4. Note that the *Slovenian Academy of Sciences* was strongly involved in the creation of a number of important PROs in the post-war era (history site of www.ijs.si, www.ki.si, etc.)

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Chapter 4

The role of government

This chapter surveys the various public activities that influence the Slovenian innovation system. It traces the rather steady and incremental development of policy over time. It describes the governance structure in some detail: the budgeting, advisory and steering functions as well as the main actors at ministerial and agency level. Analysis of their interactions leads to a number of policy conclusions and recommendations for improved governance mechanisms. Next the chapter considers the large array of funding programmes at both the national and European levels. The chapter concludes by drawing together main findings of this review regarding major functions an innovation system has to perform. It points at scope to strengthen the framework conditions for innovation, maximise the benefits from the internationalisation of R&D and strengthen the human resource base for science and innovation. Further it addresses possible improvements of the governance of the innovation system and measures to foster innovation in the business sector, to achieve critical mass, excellence and relevance of public research and to strengthen the links in the innovation system.

4.1. The evolution of Slovenia's science, technology and innovation policy

The main institutions of the Slovenian innovation system are comparatively young. Until 1918, no strong scientific institutions were created in this part of the Austro-Hungarian empire. Only some predecessors of faculties are reported to date back to the 18th century (MHEST, 2011b, p. 4). 1919 saw the foundation of the University of Ljubljana. The bulk of Slovenia's research institutions were created from 1945 when Slovenia was part of Yugoslavia and the six republics/federal states had "rights and obligations to draw up their own constitutions and organize political, economic and cultural life as they saw fit" (Meske, 2004a, p. 32). The science and technology systems in the various republics were similar in structure but were organised separately, with their own planning and budgeting cycles. It can be said that a Slovenian innovation system had existed already before Slovenia became an independent state.

Slovenian governmental structures therefore already played a role in creating, maintaining and funding research organisations before 1992, allowing a specific "innovation system" to evolve. Strong industrial structures and a network of research organisations provided for comparatively well-developed stocks of research and development (R&D) and human capital. Comparable assets existed in other central and eastern European countries and within Yugoslavia. Compared to the other Yugoslav republics, Slovenia had a somewhat stronger university base in the technical sciences, equally strong public research organisations (PROs) and a higher share of researchers (Meske, 2004a, p. 33), plus strong cores of industrial R&D.

Properties of this innovation system made possible a comparatively smooth transition to the post-Socialist era when compared to some other new EU members. These include decentralised research organisations, the lack of a strong National Academy of Sciences, the absence of rigid branch research institutes, strong in-house industrial R&D with links to the science sector, and a comparatively high degree of openness towards western Europe (Stanovnik, 2004, p. 337). These properties set Slovenia apart from countries such as the Czech Republic, Hungary, Poland or the Slovak Republic. Moreover, compared to other former Yugoslav republics, Slovenia emerged relatively unharmed from the conflicts of the early 1990s. All these properties contributed to a relatively smooth transition to a market economy and allowed Slovenia to become an independent state.

Slovenia succeeded in preserving a relative high level of R&D expenditure during the 1990s (1.5% to 1.8% of gross domestic product – GDP), while the Czech Republic, Hungary, Poland or the Baltic States had significant cuts (Meske, 2004b). It maintained its public research structures and intensified public spending when spending in the private (*i.e.* semi-public, then privatised) sector dropped sharply. A main reason for the temporary decline in business enterprise expenditure on R&D (BERD) was the sell-off or disintegration of a number of larger vertically integrated firms – "oversized, under-utilised and technologically unspecialised manufacturing enterprises" (Stanovnik, 2004, p. 340) – and the closure or downscaling of their in-house R&D laboratories. This led to a first shift in the orientation of PROs and universities towards more scientific research (European Commission, 2010, p. 2; see also Bucar and Stanovnik, 1999). A further shift in this direction occurred later owing to strong reliance on bibliometric criteria for most kinds of public research funding (see Section 4.2).

During the 1990s, other central and eastern European countries saw their innovation systems collapsing, their “industrial champions” being either sold off or closed down, PROs downsized, many top researchers leaving the country or their profession, and most of the established links between the formerly centrally planned economies disappearing. Throughout the decade, research and innovation policy played only a minor role in the transition countries. Appropriate research and innovation structures and policies became an issue only in the early 2000s, often in conjunction with the process of EU accession and *acquis communautaire* negotiations, eligibility for structural funds, and organisational change towards agencification (see Suurna and Kattel, 2010, pp. 651ff).

The Slovenian innovation system did not undergo fundamental reforms during the first years of the transition. The main efforts went towards opening up and stabilising the system, given the reductions in private-sector R&D and an outflow of around 3 000 qualified R&D personnel from industry, many of whom moved to PROs. However, by the end of the 1990s industry had bounced back: in 1993 the shares of government and industry in gross domestic expenditure on R&D (GERD) were respectively 48.3% and 38%; in 1999 they had reversed to 36.8% and 56.9% respectively (Stanovnik, 2004, p. 342). This considerable achievement indicated Slovenia’s successful integration of large parts of the economy into European supply chains. After 2000, Slovenia gradually developed instruments and programmes to fund individuals, firms, research groups, transfer organisations and networks. It placed special emphasis on quality-based funding of scientific research and technology transfer.

The 2000s saw a constant rise in the number and importance of intermediate organisations (Suurna and Kattel, 2010, pp. 660f; Breitfuss and Stanovnik, 2007; Bucar and Stare, 2006; Bucar, 2008 and 2009) and a large number of planning documents. A first wave resulted in a stronger agencification process, with the formation of the Slovenian Technology Agency (TIA), the Slovenian Research Agency (SRA) and the Public Agency for Entrepreneurship and Foreign Investments (JAPTI) (see also Section 4.2). A second wave consisted of strategies to remodel and modernise the Slovenian innovation system and better integrate Slovenia into Europe, including the translation of EU competitiveness and cohesion policies into national action plans. According to Bucar *et al.* (2010, pp. 76ff) the most important policy documents are:

- The Law on Research and Development (2002), which states the fundamental organisational and institutional rules (http://zakonodaja.gov.si/rpsi/r07/predpis_ZAKO3387.html). It gave rise to TIA and SRA and the Research Council.
- The Supportive Environment for Entrepreneurship Act (2007), which covers the business, innovative and financial environment for supporting enterprises and entrepreneurship (http://zakonodaja.gov.si/rpsi/r03/predpis_ZAKO5073.html).
- The Slovenian Development Strategy (SDS) 2006-13 contains innovation-driven economic policies (www.gov.si/umar/aprojekt/asrs/ssd.php).
- The Resolution on the National Research and Development Programme (NRDP) 2006-10 (www.uradni-list.si/1/ulononline.jsp?urlid=20063&dhid=80293).
- The National Reform Programme (NRP) for Achieving the Lisbon Strategy Goals 2005-10, revised 2008 (www.svr.gov.si/fileadmin/srs.gov.si/pageuploads/Dokumenti/SI-NRP2008-en.pdf).

- The Programme of Measures for Entrepreneurship and Competitiveness 2007-13 (www.mg.gov.si/fileadmin/mg.gov.si/pageuploads/DPK/Program_ukrepov_angl_071009.pdf).
- The Programme of Financial Engineering Instruments for SMEs (PIFI) 2009-13 implemented within the holding fund managed by the Slovene Enterprise Fund (http://www.mgrt.gov.si/si/zakonodaja_in_dokumenti/podjetnistvo_in_konkurencn_ost/drugi_pomembni_dokumenti/).
- The National Development Programme (NDP, 2007–13) and the National Strategic Reference Framework (NSRF) with three operational programmes (OPs). This key document includes the structurally important competitiveness and research excellence programmes overwhelmingly funded by EU structural funds: “The support goes to joint research and development projects as well as to the investment in modernisation, construction and equipment of intermediary organisations and other institutions in R&D and business support environment as well in business enterprises” (Bucar *et al.*, 2010, p. 78) (www.svlr.gov.si/fileadmin/svlr.gov.si/pageuploads/KOHEZIJA/Programski_dokumenti/NSRO_Slovenija_POTRJENO.pdf).

Critics deplore the quick succession of strategy plans, with new administrations tending to ignore what their predecessors have done (Suurna and Kattel, 2010, pp. 653ff). This seems to have led to a certain amount of overlap, as emphasis on technology transfer, business innovation support and entrepreneurship has increased during the 2000s. The obvious oversupply of measures and organisations could also stem from the successive formulation of strategies (discussed below).

The National Research and Development Programme 2006–10 has played a crucial role in the last years. Its most important objectives included (see also Bucar *et al.*, 2010, pp. 77 ff; European Commission, 2010, p. 6):

- Public R&D investment equal to 1% of GDP by 2010.
- A shift in the balance of public research funds from basic non-targeted research towards targeted (and applied) research.
- Introduction of support measures to stimulate growth of BERD to help achieve a target of 2% of GDP.
- An increase in the number of researchers with PhDs in the business sector.
- Higher rate of establishment of new high-technology firms, including promotion of spin-offs from universities.
- Continuous participation in international research, especially in the European Research Area (ERA).
- Rise in patents, as an indicator of business relevance of research.
- Growth of high-technology exports and of value added in the Slovenian economy.

These valid and middle-of-the-road objectives have not all been achieved.¹ They represent mainstream thinking in Slovenia (and in many other countries). However, the two main concerns of Slovenian policy makers, of this review and of other analyses were addressed in the NRDP. They are the reform of the universities and PROs and the development of measures to help Slovenian firms grow and raise their productivity

significantly. The two recent “Audacious Slovenia” documents, the Research and Innovation Strategy of Slovenia 2011-20 (RISS) and the National Plan for Higher Education 2011-20 (NPHE), are more ambitious as regards the time horizon (to 2020) and the readiness to address structural reform instead of only increasing inputs, outputs and the expanding the number of interventions / programmes.

Compared to the other central and eastern European countries, Slovenia seems to have fared better in some respects in the last 20 years. While most of these countries recorded much lower GERD and a massive reduction in both industrial and public R&D actors, Slovenia was better able to maintain its industrial and public research capacities. However it shared with the overall region a general neglect of innovation policy in the 1990s and bias towards a high-technology and academic technology transfer (Suurna and Kattel, 2010, with a number of further sources; Radosevic, 2002), along with agency-ministry arrangements characterised by difficult principal-agent relations, understaffing and a certain degree of duplication.

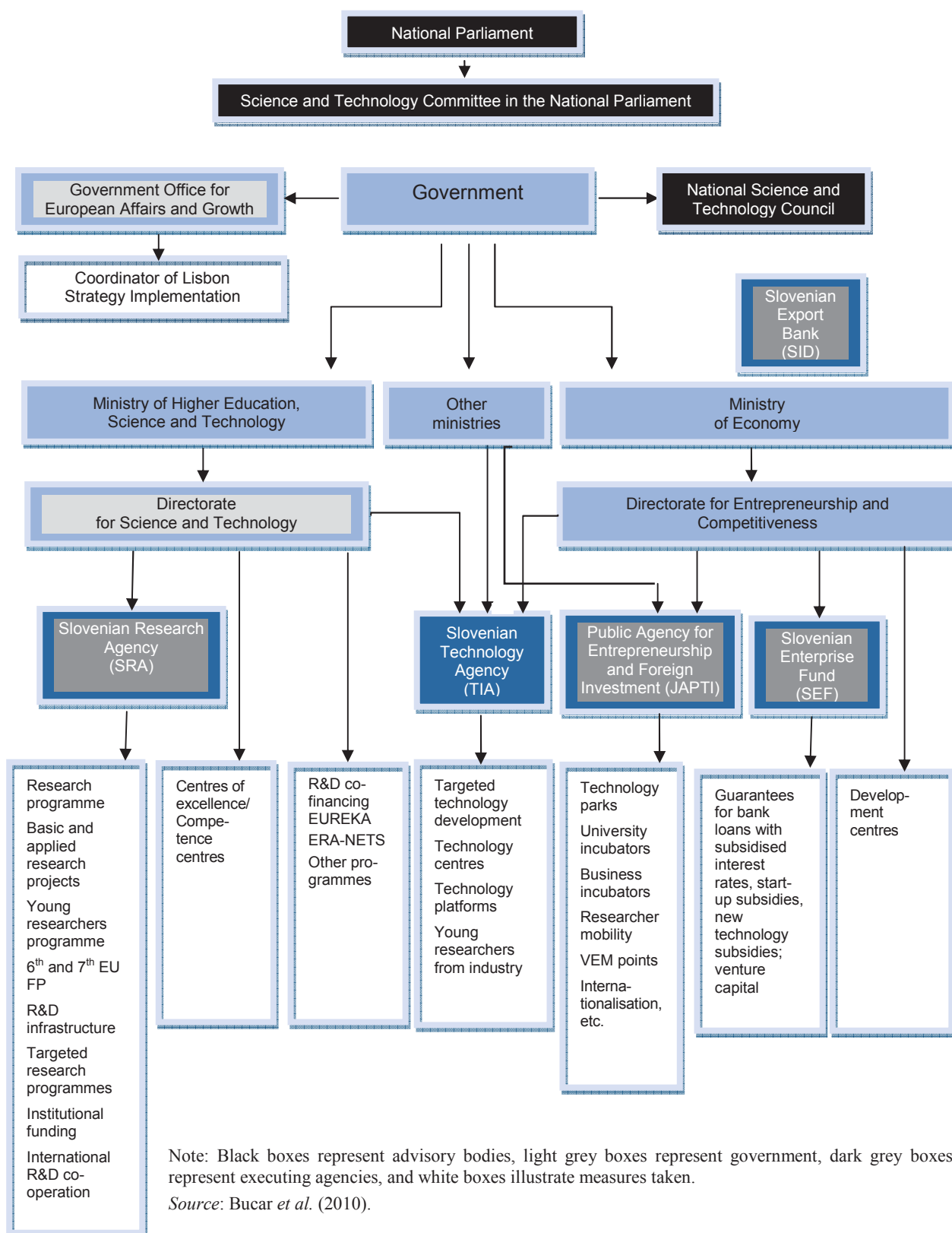
4.2. Governance and the policy mix

Institutional setting: ministries, agencies, councils and cross-cutting structures

Like many OECD countries, Slovenia has a three-tier governance structure for research and innovation policy (Figure 4.1). At the level of overall government policy and budgeting, the Ministry of Finance and government offices headed by cabinet ministers determine the importance and allocation of funds. In addition, a high-level council gives advice on science, technology and innovation matters. At the next level, the Ministry for Higher Education, Science and Technology (MHEST) and the Ministry of Economy (ME) are charged with policy formulation, strategy and policy execution. The third level consists of specialised agencies that fulfil operational tasks and develop and perform specific sub-strategies. The overall arrangement is not an unusual one, and the principal-agent relations (Braun, 2008; Braun and Guston, 2003) are in the mainstream of European structures for the governance of national science, innovation, and higher education policies. However, each level has a number of specific characteristics.

The Ministry for Higher Education, Science and Technology has two main directorates, one for higher education and one for science and technology (S&T), complemented by two directorates, on investment and on the information society. Both have responsibilities for planning, budgeting, execution and European and international issues. The S&T directorate is the result of a recent merger of two former units for science and for technology. MHEST has by far the largest share of public expenditures for R&D. Out of its approximately EUR 600 million annual overall budget for all activities, including non-research items such as tertiary education, around EUR 180 million (2010) to EUR 200 million (2009) (MHEST, 2010a) are spent on financing science schemes and programmes, and another EUR 55 million (2009) to EUR 60 million (2010) on innovation programmes. This represents most of Slovenia’s public R&D funds. Annual variations in expenditures are due to policy shifts but also to important allocations of EU structural funds. These are earmarked for specific programmes such as the competence centres (CCs) and the centres of excellence (CoEs) and thus constitute a major part of current and future financial allocation. Their share of spending in the overall ministry budgets is scheduled to rise from 7% in 2009 to nearly 20% in 2012 and to decline in subsequent years. The actual impact is expected to be high as most of the EU funds are used for specific strategic programmes. The main agencies affiliated with MHEST are the Slovenian Research Agency and the Slovenian Technology Agency which act on behalf of MHEST and the Ministry of Economy.

Figure 4.1. Slovenian STI governance



The second important ministerial actor is the Ministry of Economy. It has a broad range of responsibilities for competitiveness, competition, tourism and energy. In the context of research and innovation policy, its Entrepreneurship and Competitiveness Directorate seeks “to create the conditions for developing a new concept of quality economic growth, based on ideas, knowledge, information and new technologies” with its policy oriented towards “strengthening key factors for success for companies” (www.mg.gov.si/en/). The annual budget allocation was around EUR 100 million² in 2009 and 2010. There are several agencies and other intermediaries within ME, with apparently overlapping responsibilities, including with MHEST activities. The work of TIA, for example, is complemented by the Agency for Entrepreneurship and Foreign Investments (JAPTI), the Slovene Enterprise Fund (SEF) and the Slovene Export Bank (SID). On the government level, line ministries such as the Ministry of Defence also have a stake in research and innovation policy making.

Above the ministries, the National Parliament decides on the legal and budgetary framework. A dedicated committee deals with science and technology. The Ministry of Finance (MF) is a central actor in a complex planning and budgeting structure and exerts considerable influence on the governance structure. It has recently introduced performance-based budgeting strongly oriented towards goals and priorities. From the mid-2000s Slovenia experimented with this kind of budgeting, drawing on external advice from organisations such as the OECD and the International Monetary Fund (IMF) and on the examples of countries such as the United States and New Zealand. In addition to the Ministry of Finance and GODEA (Government Office for Development and European Affairs, see below), the national Court of Auditors has a strong role. Implementation of the new budgeting approach still requires refinement (OECD, 2011a, pp. 34 and 54; Republic of Slovenia, MF and GODEA, 2010) and much remains to be done (for details and recommendations, see Aristovnik and Seljak, 2009, pp. 7ff). It will be necessary to close the gap between strategic goals and limited public finances and to align expenditures with priorities. Priority setting and the effectiveness and efficiency of public spending need be improved as well as coherence between policy areas. Government activities comprise developmental policies and programmes with specific goals and targets for each of them. A multilateral negotiation process shall reconcile budget frameworks, strategy documents for sector policies and individual programme needs (Republic of Slovenia, 2010). For example, Higher Education, R&D and Information Society is one of 16 developmental policies, with MHEST largely in charge and other ministries more or less strongly involved (for an exemplary operative technology policy sub-programme with quantitative targets see Aristovnik and Seljak, 2009, pp. 11ff). Note that the budgeting principles seem to have fed into the drafting of the RISS and the NHEP with their individual goals and quantitative targets.

In OECD countries research and innovation policies are typically drafted, negotiated and adapted in a broader arena composed of government and other actors. In Slovenia, MHEST and ME deal not only with MF but also with government agencies endowed with cross-cutting responsibilities for growth or budgeting. One of these agencies deals with local self-governance and regional development and co-ordinates the implementation of the operational programmes that provide EU structural funds (Bucar *et al.*, 2010, p. 71). GODEA (formerly, Government Office for Growth), a government agency at ministerial level, provides indicators and monitoring systems, in addition to co-ordinating and monitoring the implementation of Slovenia’s development strategy, fighting the effects of the financial crisis and dealing with European affairs. The overall policy planning process is still at an early stage and past structural and policy changes make it impossible to

identify clear-cut trajectories. However this planning and budgeting process provides two main messages for research and innovation policy:

- Research and innovation are clear planning and budgeting priorities in Slovenia.
- The process could offer an appropriate and supportive framework for difficult mid-term changes in the reorganisation of university and PRO governance. If applied appropriately, performance-based budgeting could contribute strongly to what is commonly called evidence-based policy making.

Support for evidence-based policy making can also be expected from high-level advisory bodies and councils. The National Science and Technology Council (MHEST and ME, 2010, p. 5; see also Bucar *et al.*, 2010, p. 72), which was inactive for quite a period of time, has recently been reorganised, but has yet to define its role within the governance structure. It could facilitate the two main changes ahead: *i*) organisational reform of the universities and the PRO sector; and *ii*) a public policy focus on raising productivity throughout the Slovenian economy. A second council at ministerial level, the Competitiveness Council, was also created to define priorities in technology fields in order to streamline government investment. A merger of these two advisory bodies into a new Council for Research and Innovation has been considered. The RISS has been adopted by the Slovenian National Assembly, and the merger of the two councils is one of the measures foreseen for 2012 (*Official Gazette of the Republic of Slovenia*, 2011, p. 6).

The agencies translate government strategies into operative programmes. Some, such as SRA and TIA, are still rather young and in their present form, dating back only to the early and mid-2000s. The Slovenian institutions tend to be “fully autonomous” agencies (Suurna and Kattel, 2010).

The biggest is the Slovenian Research Agency, which funds science and relies strongly on a combination of mostly international peer review and indicator-based *ex ante* assessment. Its budget amounts to about EUR 180 million for 2010 and has grown constantly over the last years. More than half of the budget is used for typical research funding council (RFC) activities: individual projects, grants for young researchers and international activities. Nearly half of the budget is allocated to tasks many other OECD countries include in their general university funds (GUF), such as research infrastructure financing and multiannual funding for research groups (also called research programmes). In contrast to project-based applications, “research group” funding totalling around EUR 60 million a year provides more than 300 groups at Slovenian universities and PROs with core funds for performing research. A formalised application process and a review system including quantitative, mainly bibliometric indicators of past scientific performance suggests the presence of a competitive element in this funding and puts Slovenia among the European countries with the highest share of competitive funding in university and PROs. However, about 90% of applications are accepted for funding, which suggests rather that it may be *de facto* basic funding (CREST, 2010, pp. 17f). The research groups will be mentioned several times in this review, as this instrument appears to have considerable side effects (for SRA see also Bucar *et al.*, 2010, pp. 54f and 93ff). Note that the Slovenian Science Foundation (SSF) is a much smaller science funding agency. It is a non-profit organisation, “involved with the promotion of science and in providing scholarships for young researchers but not in direct research funding” (European Commission, 2010, p. 16). No other noteworthy charitable foundations seem to be in operation.

The Slovenian Technology Agency (TIA) is the main agency for the support of applied and co-operative research, mainly in the enterprise sector. TIA has been operative now for some years as a joint agency of MHEST and ME (plus the Ministry of Defence), with MHEST apparently occupying the lead role. TIA has a number of applied research and innovation funding programmes, including support for technology platforms, strategic R&D projects in the business sector, support for the entry of young academics into the enterprise sector as researchers, plus a number of apparently less focused programmes of national and international scope (see Section 4.4). With a rather small in-house expert base, TIA has had to cope with rapid growth, in part owing to the administrative tasks associated with EU structural funds and their conversion into programmes and projects. Its budget has fluctuated; after starting at around EUR 30 million a few years ago, it reached a peak in 2009 with the allocation of EUR 160 million of mostly EU structural funds money in 2009. In 2010 TIA reimbursed around EUR 80 million but has only EUR 20 million for new allocations. Long delays in processing the grants are reported and there are continuing operational challenges.

The Public Agency for Entrepreneurship and Foreign Investment (JAPTI) operates under the auspices of ME and employs a wide range of financial and soft/consulting support schemes that are directed either to firms or to intermediaries such as technology parks or platforms. It has one branch for innovation promotion and another for foreign direct investment (FDI). JAPTI supports entrepreneurship development at all levels and works to foster innovative business environments. It organises Slovenian innovation forums and runs a number of funding programmes for the transfer of human resources (HR), interdisciplinary development groups in firms, and R&D projects within enterprises. Overall, JAPTI can deploy around EUR 30 million to EUR 40 million (including the structural funds money) annually. The agency has also a strong consulting arm for Slovenian firms and supports intermediaries with similar activities. Consulting and promotion are the main tools also for JAPTI's second task, the international search for firms as potential foreign direct investors. JAPTI is interesting because of the two layers in the system with the same goals (see Section 4.3 on governance relations in the field of business promotion).

The Maribor-based Slovene Enterprise Fund (SEF) is also under ME and deals with support for business R&D and innovation. It specialises – again partly with European money – in financing for small and medium-sized enterprises (SMEs), with grants for start-ups, guarantee credit lines for different growth stages and equity finance in the form of mezzanine and venture capital. In budget terms, the nature of the main instruments does not allow for a simple comparison with TIA and JAPTI. However, SEF reported earmarked capital at the end of 2009 of EUR 53 million and 700 projects with EUR 120 million of approved financial support in 2009, ten times more than some years ago (www.podjetniskisklad.si/). Besides guarantees and equity, SEF has also operated a grant scheme for the purchase of new technological equipment. From 2003 to 2009 nearly EUR 150 million were allocated in all, with a “crisis” peak in 2008 (SEF, 2010, pp. 14ff). Though it initially operated on a smaller scale, SEF already has a track record of 15 years.

The Slovene Export Bank (SID) mainly acts as a public export and development bank. The main instruments include export insurance, refinancing bank credits, co-financing transactions, and, increasingly, direct financing of projects, generally acting through commercial banks. Recently, some direct financial instruments to support SME R&D and innovation investments have been added. Around its insurance and finance business the bank has also built up a consulting arm and sees itself as a one-stop shop supporting enterprise growth. SID's role in the Slovenian economy became more important during the financial and economic crisis of 2008 and 2009, when it ensured the financial liquidity of

many private actors, backed by a guarantee of the Republic of Slovenia. One example was the extensive financial help given to the car component industry. The volume of the bank's financing activities grew by more than threefold from 2007 to 2010 to more than EUR 3 billion (SID, 2010). A strong future role is envisaged for the bank.³ It has a critical role in restructuring the Slovenian economy towards more innovation, a role that has recently been strengthened with EUR 100 million in long-term loans from the European Investment Bank (EIB) to co-finance R&D and innovation-related investments in SMEs.

In addition to these agencies, there are many other intermediary agents. Technology parks, technology centres, technology platforms, remnants of the terminated cluster initiative, university incubators, business incubators, technology transfer offices, regional development agencies and others have been created. Some of these organisations thrive while others seem barely to survive. Many are supported by programmes of the above-mentioned agencies. For example, TIA and JAPTI provide funding for intermediaries that partly offer the same services as the agencies themselves. These numerous instances of a strong Slovenian emphasis on technology transfer mechanisms, broadly understood, are mentioned precisely because their portfolio of services tends to overlap somewhat not only with each other but also with the services and consulting activities of some of the funding agencies.

Planning documents

There is a tradition of policy planning in Slovenia, including for R&D. The 2002 Law on Research and Development provides the framework of these planning documents. In the 2000s, the key documents were five-year plans, in particular the National Research and Development Plan 2006-10. It was prepared by the ministry responsible for research, now MHEST, and the top policy advisory body, now the National Science and Technology Council. NRDP was a legally binding document adopted by the National Assembly. The plan, described above, contains research priorities, funding mechanisms, roles of performing organisations and rules for evaluation and therefore had a certain guiding function for the policy-making process. However in retrospect the plan was not well implemented: “A consequence of the fragmented system of governance of research and innovation is a ... poor implementation of the adopted strategic documents, notably the existing National Research and Development Program (NRDP)” (*Official Gazette of the Republic of Slovenia*, 2011, p. 3).

Today, Slovenia has more ambitious and long-term policy planning processes for research and innovation and for higher education. Slovenian policy makers saw the need to increase the speed, size and scope of reforms and now rely upon two ten-year strategies, RISS and NHEP (see Box 4.1), recently adopted by Parliament (MHEST, 2011b). Together they offer an analytically and empirically well-grounded diagnosis of Slovenia's current economic and social situation, the economy's overdependence on low or medium-low technology industries and traditional services, and the shortcomings and gaps in its higher education system. The plans also identify structural weaknesses that threaten the “relatively good” quality of life currently enjoyed by the nation's citizens. Yet, it can be argued that even if these plans are fully implemented – which cannot be guaranteed – additional measures will be needed. To respond fully to the challenges for addressing simultaneously short-term productivity improvements, firm modernisation, technology transfer gaps, and human resource needs, Slovenia requires a broader perspective on the elements of a national innovation system and more far-reaching actions than those contained in the two plans.

The drafts of the RISS and the NHEP were already written when this review began. The final version of the RISS adopted by the Government and the National Assembly in 2011 took into account a number of recommendations made in the first draft of the Overall Assessment and Recommendations (OAR) of this review delivered to the Slovenian authorities in December 2010 (MHEST, 2011a, 2011b).

Box 4.1. Audacious Slovenia: The RISS and the higher education strategy proposals

In the past, Slovenia has had mid-term strategies in the area of R&D and innovation policy. They typically involved a five-year period and ambitious goals and programmes. However, changes in government sometimes meant changes in strategies. There is still a current but not entirely valid plan, the NRDP (for its goals see Bucar *et al.*, 2010, pp. 77-78).

Now – in the view of challenges ahead – two long-term and to some degree interconnected strategies have been prepared, one for research and innovation and the other for the higher education sector. They both adopt a ten-year perspective. They link objectives to measures, to deadlines and to indicators. Both address major change agendas in areas in which structural weaknesses have been identified in the Slovenian innovation system. Both are generally in line with the observations and recommendations of this report. The adoption of both documents by the Government and the National Assembly can be described as audacious steps indeed (see also Republic of Slovenia, 2011).

The RISS proposal and changes during the RISS adoption process

The Research and Innovation Strategy of Slovenia 2011-20 (RISS) was jointly drafted by MHEST and ME (MHEST, 2010b) and has following overall goals: To achieve social objectives such as improved living standards and quality of life by the establishment of a modern research and innovation system, which will contribute to increased knowledge, address societal challenges, raise value added per employee and provide quality jobs and living environment. In terms of governance, the reorganisation of advisory councils and funding agencies and the implementation of monitoring and evaluations are foreseen. For PROs, reform should include closer links to universities, higher mobility, strengthening of autonomy and leadership, and promotion of co-operation with industry. As regards scientific excellence the quality of applications and research is to be raised. Future policy is to allow for larger research infrastructures and more stable arrangements and better business infrastructures, mainly in the “e”-realm. Knowledge transfer strategies include technology transfer offices (TTOs) and spin-offs and increased mobility of young researchers. International co-operation is to be strengthened, with Slovenian actors participating in ambitious transnational programmes. International inward and outward mobility of people is to be supported. The volume and direction of public funding is to focus more on co-operation and applied research. The foreseen “60% for projects in co-operation with [the] economy” rule and better tax incentives should help to accelerate private R&D investments. A comprehensive support package for start-ups and an array of measures to help innovative companies grow faster complete the RISS strategy.

In Spring 2011 RISS was adopted by the Slovenian government and subsequently by the National Assembly (*Official Gazette of the Republic of Slovenia*, 2011; MHEST, 2011b). While the main elements have remained the same, a number of points have changed or been formulated more precisely. External assessments of the Slovenian innovation system, notably the CREST report (CREST, 2010) and the draft Overall Assessment and Recommendations of this review are reflected to some extent in the formulation of the RISS. The strategy was also subjected to a broader stakeholder process, with consultations and written comments. Changes between the draft and final version include: a more prominent pledge to spend more public money on R&D (1% of GDP by 2012 and 1.2% by 2020); the reinforcement of competent staff to administer policies; a more focused policy on and for PROs; dedicated policies for stronger use of structural funds for research and innovation from 2014 to 2020); the restructuring of JAPT and TIA and a stronger emphasis on business models and productivity in the firm sector. The changes are described in the *Official Gazette of the Republic of Slovenia*, 2011, *passim*.

In summary, RISS provides a solid basis for realising a long-term agenda for reform. While the 2010 proposal did not reach far enough in all respects, the final version can contribute to the restructuring the Slovenian innovation system. At the same time the comprehensive nature and long-term view of this strategy carry some risk, given the changes and adaptations associated with changes in government.

... / ...

Box 4.1. Audacious Slovenia: The RISS and the higher education strategy proposals (*cont'd*)**The NHEP strategy and changes during the adoption process**

The National Higher Education Master Plan 2011-20 (NPHE), a MHEST document, addresses a number of issues related to tertiary education reform. It states the need for a higher share of the population in tertiary education and an increase in inflows from abroad and “brain gain”. It calls for higher expenditures for tertiary education and for new requirements for establishing and operating different types of higher education institutions (HEIs). The two new baseline “connecting grounds” are the reform of the study system and a new form of financial allocation. The system is envisaged to be more strictly separated into university education and professional education, and includes the uptake of a binary system comprising universities and technical colleges/polytechnics. The funding system is to introduce more block grants for universities plus a new developmental part of funding, *i.e.* a kind of incentive-based extra block funding element. The developmental part is linked to four supporting pillars: diversification of organisational types and study programmes, internationalisation, quality assurance, and a social dimension. Universities are to have a higher degree of autonomy. HEIs shall “independently manage their tangible assets, autonomously prepare study programmes, set academic standards, select staff and students and form their own organisation, management and financial decision-making ... (and) have more influence on the selection of students, particularly for the second and third study cycle” (p. 9). The new organisational freedom allows for better co-operation across disciplines and faculties and with the outer world, whether PROs or industry. Furthermore the plan calls for de-linking academic qualifications such as the “habilitation” from job posts, thus allowing universities greater freedom for career development.

In the adoption process a number of recommendations were added, including bolder steps towards internationalisation and academic recruitment. An increase in public funding for tertiary education to 2% is to be reached in 2020, bolstered by a number of shorter-term announcements on staff and infrastructure investments.

In May 2011 the National Assembly adopted a resolution on the NHEP, following a stakeholder process similar to that of RISS (MHEST, 2011a). Both documents have recently been adopted by the National Assembly.

Evaluation, foresight, priorities and policy intelligence

Building a policy evaluation system is an important task. While *ex ante* evaluation is in place for scientific projects and seems to ensure good technological projects, programme and institutional evaluations are still underdeveloped. This is an issue of considerable concern: As a consequence, the system lacks important information and feedback loops. A large number of distinct funding programmes also need a clear evaluation structure and an underlying culture; this takes some time to develop. Following the example of other small countries, Slovenia should develop evaluation standards, engage in community building and invite foreign experts to participate in well-prepared tenders (Zinöcker *et al.*, 2007). The formal requirements for the administration of structural funds and the need to assess the impacts of national programmes will lead to a more structured approach to evaluation. It is true that the structural funds present a risk of high administrative burden, too many rigid indicators and an overemphasis on detailed *ex post* control. In contrast to some national funding initiatives, the CC and CoE programmes have formal programme evaluation cycles. Evaluations of research performers such as universities and PROs could be developed along with the necessary organisational reform and contribute considerably to this goal. In general, at the level of national programmes and organisations, a much more structured and rigorous approach to evaluation is needed. The official RISS strategy therefore includes various proposals for better evaluation instruments and a corresponding evaluation culture (*Official Gazette of the Republic of Slovenia*, 2011).

For priority setting and foresight, only an evolutionary approach will do. Priority setting is a complex process and there are many pitfalls. In many countries nearly everyone is in principle in favour of a few clear priorities, but in practice everybody is afraid of too few. This tension seems to be stronger in very small countries. That said, some priority setting has to take place. Small countries' limited capacity to support a broad research agenda influences the governance of publicly supported R&D. The capital intensity of many contemporary fields of science and technological research, the need for differentiated sets of skills, and the long gestation periods of scientific discovery and the subsequent application of findings to societal objectives, compounded by multiple challenges in appropriating the economic and societal benefits that flow from new knowledge leaves little choice but to direct publicly funded research to clearly defined national priorities. The priorities need to be based on national economic, environmental and societal objectives. Setting these priorities is the basis for subsequent decisions on funding allocations by fields of science, mission objectives, funding mechanisms and choice of performers. A considerable portion of these funds should be reserved for open-ended, bottom-up, investigator-driven research and for fields that can make merit-based claims for their intrinsic value. This is no contradiction as in most countries top-down and bottom-up approaches exist side by side, and priorities in many countries are simply a reflection of existing strengths and past and current successes, defined by the respective communities through their work and its results.

Slovenia has experimented with different foresight processes (Stanovnik and Bavec, 2008) and has implemented the CC and CoE programmes as comparatively large-scale instruments with bottom-up prioritisation. This is valuable insofar as it ensures that existing strengths are the basis of the priorities that are set. However, the topics covered by the exercises and programmes mentioned include a very high percentage of the entire Slovenian research portfolio (outside the humanities and social sciences) and are therefore to a certain extent non-discriminatory.

Portfolio of instruments

The main organisations are described above, and programme details are provided below. The following is a brief description of the relevant instruments:

- The science funding instruments largely follow the European mainstream. The new centres of excellence provide an opportunity to create critical mass and to invest in physical infrastructure. The overall portfolio is clearly arranged, with good funding conditions and endowments. The SRA research group programme and the organisational set-up of universities and PROs seem, however, to have unintended negative side effects.
- Science-industry co-operation appears to be well covered by the new CC, CoE and development centre programmes financed by structural funds. These programmes complement smaller pre-existing national and other structural fund interventions to foster co-operation. It can be argued that other activities should not be started until these three programmes have taken root and the organisational reform of universities and PROs shows real progress. In other words, the earmarking of 60% of funding for projects including at least one industry partner (*Official Gazette of the Republic of Slovenia*, 2011, p. 18) could be counterproductive⁴ and should definitely not lead to a huge wave of new co-operation programmes. It appears preferable to strengthen incentives for universities and PROs to co-operate with industry, e.g. through career models and PRO reform.

- For technology funding, a multitude of programmes address a large number of critical issues concerning the innovation system, including intra-firm innovation, co-operation between actors, and human resources. However, the relevant agencies and programmes show some degree of overlap and tend to cluster in certain areas of funding and other support measures. Moreover, simple low-key instruments to encourage innovation in small firms and to raise productivity should be considered as labour productivity is still comparatively low in Slovenian enterprises.
- The overall mix of grants and other instruments such as loans, guarantees, mezzanine capital and equity appears appropriate. The creation of instruments by SEF and SID to finance firms and their investments seems to complement the system of industry funding/financing: Firms have needs beyond grants for individual projects and these instruments could help foster productivity in the business sector.
- Slovenia has a complex system of instruments in the innovation value chain: technology parks and centres (1994), clusters (2001), incubators (2003), technology networks (2003), technology platforms (2004), centres of excellence (2005), and various business information units such as the Small Business Development Centre, numerous innovation relay centres, Euro-Info-Centres, regional development agencies, etc. These were created in subsequent waves, and the weaker and older ones sometimes seem neglected. For example, the entrepreneurship, start-up and early growth segment is covered by a number of organisations with differing records and by a number of agencies that fund intermediaries and/or young firms. Clarification and co-ordination of the organisations in this chain is a necessity.
- Allowing for some experimentation, there are currently few demand-side measures to stimulate innovation. Slovenia is not alone as regards the low level of demand-side instruments, as many OECD countries are struggling to successfully employ this kind of innovative instruments (Box 4.2; OECD, 2010). While there is no single definition of demand-side innovation policy, it is often understood as a set of 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 diffusion (Edler, 2007; OECD, 2011b; see also Box 4.2). It often aims at addressing barriers that affect market introduction and diffusion of innovations. Demand-side innovation policies take a variety of forms. Innovation-oriented public procurement and innovation-related regulations and standards are considered key instruments (Table 4.1 sets out their main features). However, policies that affect demand for innovation, such as consumer policies or tax policies, are also important, *e.g.* in the context of green innovation. For innovation-related public procurement, a few niches could be chosen, either in socially important fields such as sustainability or when a nascent innovative Slovenian industry needs first key customers. In terms of standards and regulations Slovenia as a small country fares best when following the (often legally mandatory) European mainstream and embracing the Common Market.

In general, while instruments and intermediaries are widely available, they are not well co-ordinated and show significant overlaps. Instruments aimed at improving the productivity and innovative performance of SMEs could be strengthened. The allocation of funds among instruments and intermediaries lacks a clear strategic vision and rationale and the means of ensuring accountability and performance could be more effective. In addition, funding for core activities has been insufficient and irregular at times, without the long-term sustainability necessary for results to be achieved and measured effectively.

Table 4.1. Key features of demand-side policy instruments

Demand-side policy	Procurement	Regulation	Standards
Objective	New product or service	Market uptake, increased competition, social goals	Market uptake, interoperability, transparency
Input	Money, performance requirements, skills	Legal process, need to co-ordinate	Standards agencies, need to co-ordinate
Participatory incentive	Sales, preferential treatment (e.g. SMEs)	Mandatory	Voluntary
Main player	Government	Government	Industry
Effects on success	Improved public services and stimulation of innovation	Reducing market risk	Reduce market risk
Possible risks	Insufficient skills in the public sector, idiosyncratic demand	Conflicting goals, lengths of the process	Technology lock-in

Source: OECD (2011b), based on Aschhoff and Sofka, 2008.

Box 4.2. Examples of demand-side innovation policies

Australia: The Australian Climate Ready programme provides SMEs with support to undertake R&D, proof of concept and early-stage commercialisation activities to develop innovative clean, green products, processes and services and thereby address the effects of climate change. Part of the Climate Ready policy intent is to raise awareness of the impact of climate change and to increase demand for innovative solutions. At the strategic policy level the programme stimulates a market for technological and other innovative solutions to the challenge of climate change.

Flanders: The Flemish government approved in July 2008 an Action Plan on Procurement of Innovation (PoI). Under this plan the government focuses on procurement of innovations requiring pre-commercial R&D. This new scheme aims at horizontal integration in the innovation policy mix. The government buys innovations of companies and knowledge institutes in various policy domains. The target groups for the innovative procurement instrument are 13 policy domains in Flanders. Each policy domain has been allocated EUR 1 million to set up a pilot.

Denmark: The Danish programme for user-driven innovation aims to strengthen the development of products, services, concepts and processes in companies as well as public institutions through increased focus on innovation from the perspective of the user. The programme funds projects that develop and test methods of user-driven innovation. It focuses on areas in which Denmark has strong business specialisation, areas in which innovative solutions are needed to solve societal issues, or areas in which public welfare is involved.

Finland: Demand and user-driven innovation policy is one of four key areas in Finland's broad-based Innovation Strategy, adopted in 2008. Under the national innovation funding agency, Tekes, public procurement units and public utilities (at central and local level) can apply for funding for public procurement of innovations. Tekes funds can be used both for the planning and R&D stages. External advisors can be called upon in the planning stage (legal, commercial and technological as well as user experience issues) in order to support the procurement process.

Korea: The New Technology Purchasing Assurance scheme requires public agencies to give preference to the procurement of goods and services from SMEs, which also receive a new technology guarantee from the government. Under this programme, the Korean Small and Medium Business Administration finances the technological development of SMEs, and public institutions purchase the products for a certain period.

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Box 4.2. Examples of demand-side innovation policies (cont'd)

Netherlands: The Launching Customer Scheme is an awareness and information scheme on the use of public procurement by government procurers and suppliers. The Dutch Innovation Agency, NL Agency, complements this scheme by advising municipalities and other agencies on how to promote innovation through tendering.

United Kingdom: The UK government decided to support standardisation in the area of biometrics and technical standards supporting interchangeability and interoperability. The objective was for standards to reduce the risk for the procurer, system integrator and the end user, because they simplify integration and enable vendor substitution, technology enhancement and development.

Spain: The Spanish State Innovation Strategy is developing measures for an innovation policy based on specific markets: health and welfare, green economy, e-government, science, defence, tourism and information and communication technology (ICT). For these markets, public procurement policies encourage innovation through public-sector demand, under the legal framework recently endorsed by the new laws on public contracts and the project on sustainable economy.

United States: US procurement policy stimulates green innovation in two ways. Under the general procurement framework purchasing energy-efficient products has indirect demand-pull impacts. Procurement that can foster innovation in green technologies more directly concerns several US procurement programmes with the intention to procure green innovative goods and services. These include the Federal Procurement Challenge (FPC) programme for acquisition of advanced energy-efficient, renewable and water-conserving products.

Source: OECD (2011b).

4.3. Governance structures in supporting public research and business sector innovation

Overall, innovation policy governance structures in Slovenia are broadly in line with established international practices and patterns in many OECD countries: Policy making is linked to budgeting at the highest government level. Mid-term, even long-term strategy documents form the basis of policy execution, and two ministries, MHEST and ME, are mainly in charge of policy formulation and overall execution, one for higher education and science, the other for industry. A high-level advisory council was established but replaced before it found a clear role to play. A number of agencies deal with the design and execution of funding programmes and other initiatives at the operative level. The portfolio of support measures covers the most important topics with appropriate measures, ranging from science funding to incentives for entrepreneurship. Linkages to other policy fields exist in various forms, yet at a low level. These good practices, however, are embedded in a rather complex overall set-up with some duplications and a fair degree of fragmentation. The RISS strategy foresees some remedies, while this review focuses on a small number of specific issues, both for science funding and for technology policy measures.

Relations between levels and impact on performers: support for public research

Across Europe, different models are used for authority relations, steering and (inner) organisational structures between the policy level and public research performers (Whitley, 2010; Benninghoff and Braun, 2010; Christensen and Laegreid, 2006). Some of the main properties of the Slovenian system are described in the sections on the university and PROs in Chapter 3. A first set of observations relates to the intensity of interactions between the policy-making and the performing levels. In this respect, the links between MHEST and universities and PROs are rather weak and could be strengthened:

- On the personnel level, MHEST has a small staff and the performing organisations lack strong director / rector / president positions. This can create difficulties and gaps on both sides. Mutual trust in everybody knowing each other – often to be found in small countries – should not lead to an under-valuation of the negotiation table.
- Regarding formal / legal relations there seems to be a prevalent mix of both strong and weak authority relations between the State and the universities, and also the PRO sector. Greater freedom for the latter in terms of recruiting and careers would be beneficial, as more open, autonomous and internationally compatible frameworks are needed. However, stronger regulations or legal/organisational incentives are needed, *e.g.* as regards revenue from collaboration between industry and public sector research bodies. In such cases additional funding programmes cannot always replace proper organisational solutions. Often they aim at symptoms or form welcome bypasses.
- As regards advisory bodies, the National Science and Technology Council (or its successor) could link the government to the research-performing level. Given its history, it is unclear whether it can fulfil such a task. However, its envisaged replacement may provide a new opportunity.
- Agencies are a natural link between the ministry and the research-performing levels. However for science funding, Slovenia has chosen a very particular path.

The “governance chain” formed by MHEST, SRA and the public research sector appears to have strikingly idiosyncratic properties. In most EU and OECD countries relations between the science funding agency or research funding council and the responsible ministry mainly take one of two forms: *i)* the RFC operates as an agent of the ministry to transfer government policies to the public research sector for implementation; or *ii)* the scientific community is entrusted with organising science funding in an autonomous RFC or has “captured” an agency over time and has made it a more autonomous organisation. In the latter case the scientific community shapes science funding, while in the former there is a greater chance that a considerable part of government policy is finally materialised in public research. There is no “optimal” model, and a mixed structure often exists. Both have strong points and weak points and, as always, the national context and history matter strongly.

With the current MHEST and SRA set-up Slovenia seem to have developed a third pattern. While MHEST draws up the main strategies, SRA appears to be truly autonomous, deploying policy quite independently from academic *and* ministry governance,⁵ while the academics operate in a highly decentralised manner. SRA’s autonomy manifests itself in the way it steers and funds scientific research projects or groups based on quantitative, bibliometric indicators and peer review (SRA, 2010; Juznic *et al.*, 2010). This is an interesting approach and has certainly helped to raise the output and impact of scientific publications. Rigour and quantitative measures can indeed contribute to boosting quality in small countries’ science systems where nepotism, a narrow focus and inbreeding are a danger and often a bitter reality.

This special pattern is noted by Slovenian observers as well: “Due to various personnel problems and organisational difficulties, R&D policy has not been receiving sufficient attention from the MHEST in recent years and has been left largely in the hands of the Slovenian Research Agency” (European Commission, 2010, p. 5). As a result, the weak principal–agent links between MHEST and SRA have a number of downsides:

- The emphasis on bibliometric indicators tends to reward actors who have regularly done good academic research before and without interruption. It creates disincentives to other kinds of scientific activities, such as applied or contract research, venturing into new fields, or planning ambitious interdisciplinary activities. As the track record counts strongly not only in project appraisals but also in the basic GUF-type funding, researchers and fields with long, “impeccable” track records seem to have the best chances of funding.⁶
- This mode of policy delivery – combined with the compartmentalisation and lack of strategic levels at universities and PROs – can lead to lock-in. The main point here is that SRA funding practices could collide with plans to empower research organisations, both PROs and universities. If the main research budget lines of these organisations follow certain external indicators (SRA bibliometrics) and address only sub-levels (individual research groups), strong leadership is not likely to develop in these organisations.
- Finally, such an approach has to be co-ordinated with efforts to focus on specific national research strengths. Different approaches are possible, as evidenced by international examples, but it must aim to avoid contradictory signals and incentives. A two-tier structure seems most appropriate. Targeted top-down funding or investment needs a strong bottom-up element to ensure a basis and sufficient quality.

The main problem certainly lies with the organisational structure of the universities and PROs and not with SRA, but the current SRA instruments cannot act as drivers of organisational change. In particular, the research groups programme can, over time, isolate the individual units; they become overly independent micro-actors and an obstacle to efforts of Slovenian universities and PROs to develop institutional strategies. While up to now, SRA has had many beneficial impacts on the quality of the system, the necessary university reform will require funding instruments with more dynamic elements. The priority is to reform HEIs and PROs so that they are empowered and autonomous, and SRA mechanisms and instruments should be adapted to the goal of furthering this reform.

Relations between levels and between agents and impact on performers: Support for the business sector

A large number of agencies and programmes deal with business-related research and innovation. Belief in the effectiveness of supply-side measures for fostering innovation could be one reason for this situation, along with a tendency of successive administrations to create their own agencies, programmes and “linking” initiatives. Other reasons may include the desire by prolific and perhaps competing agencies to create more programmes, the pressure on public research performers to set up transfer and entrepreneurship activities, the financial needs of intermediaries, and finally international influences. The last is often exercised through European funding, notably the structural funds, but also sometimes by a misplaced emphasis on fashionable European or other international “best practices”. Benchmarking activities, open co-ordination, EU projects with agencies and intermediaries as recipients of EU Framework Programme funding, etc., have induced a tendency to introduce in each EU country all of the funding and support instruments that seem to have been successful in other countries. Slovenian policy makers and strategists appear to have succumbed too readily to this fashion. Some restraint should be used so as not to adopt too many good ideas.

The principal–agent relations in public support for business differ from those in science funding. TIA has less autonomy. It is endowed with programmes through ministry contracts and therefore appears less independent than SRA. Problems arise owing to the sheer number of activities, and it would be worth examining whether some of the agencies and intermediaries tend to flock to the most attractive and visible activities. There is a multitude of programmes and initiatives to: *i)* fund co-operative projects and platforms of all kinds, sizes and durations; *ii)* supply consultancy services and advice; and *iii)* support entrepreneurship, start-ups and early growth. The number of proclaimed one-stop shops in the Slovenian innovation system suggests that some streamlining could be beneficial.

In this context it has been proposed to merge TIA and JAPTI into one agency. This is an interesting development. Yet this cannot substitute for the more arduous fine tuning, co-ordination and in some cases decommissioning of individual programmes, nor for including all technology intermediation activities in this screening process. It is puzzling to hear so many voices bemoaning the discontinuation of the cluster programme given the newer initiatives with similar instruments and target groups. The issue of layers upon layers of actions and policy instruments becomes more pressing with the arrival of the big programmes financed by EU structural funds.

4.4. National sources for funding innovation

Slovenia has a number of programmes to fund research and innovation. Some follow the international mainstream, while others reflect specific national characteristics. This section first provides some general observations and highlights pertinent properties of the funding portfolio. It then describes major programmes and is closely based the background report by Bucar *et al.* (2010, pp. 83ff.).

Noteworthy properties of the funding portfolios include:

- The programmes emphasise funding generic and structural elements of the innovation system: persons, groups, networks, linkages. Although Slovenia engages in some prioritisation and foresight processes, thematic programmes are negligible. This seems to be – quite rationally – linked to the small size of the country and the correspondingly small number of research actors per field. However, ongoing European discussions of “Grand Challenges” are provoking policy responses in most EU countries, with programmes addressing issues such as climate change, sustainability or ageing.
- As mentioned elsewhere in the report, a large part of the funding for scientific research is in the form of multiannual grants for research groups at universities and PROs. These groups apply for funding directly at the responsible agency and when successful dispose of the funds. These funds constitute the bulk of the money available for research. They effectively bypass the management of universities and PROs.
- In recent years, funding of scientific/public research had a higher priority than funding of applied/industrial research. The latter is now higher on the agenda and has been promised 60% of all funding in the RISS strategy.

- Larger-scale public-private collaborative research activities did not develop in the past owing to the lack of appropriate funding instruments. This gap has been closed in the last years with the help of European structural funds (see Section 4.5).
- Obtaining funding for infrastructures is difficult everywhere. With the structural funds and a dedicated SRA funding line Slovenia has at least two possibilities.

The funding system is well endowed with both programmes and funds. Competitive elements are strong, and the number of programmes seems to be quite high for a country of the size of Slovenia.

Table 4.2. List of national funding measures

	Title of the measure
SI 24	Technology equipment subsidies for SMEs
SI 19	Guarantees for subsidised bank credit to SMEs
SI 57	Development of centres of excellence
SI 56	Promotion of R&D projects in SMEs
SI 55	Strategic R&D projects in enterprises
SI 10	Voucher system for consultancy and training services
SI 54	Innovation voucher
SI 51	Support to one-stop shop (VEM) services
SI 35	Research Group Programme Financing Scheme
SI 40	Young Researchers' Programme
SI 29	Technologies for Security and Peace 2006-12
SI 41	Targeted research programmes
SI 52	Co-financing of start-up of innovative companies
SI 23	Co-financing of employment of researchers in enterprises
SI 22	Financial assistance to institutions
SI 50	Direct subsidies for joint development investment
SI 53	Incentives to interdisciplinary teams for technology
SI 36	Applied projects
SI 13	Development of business incubators at universities
SI 1	Young researchers from business sector
SI 3	Co-financing of the activities of technology parks, business incubators and university incubators
SI 18	Development of innovation infrastructure

Source: Trendchart/ERAWATCH database, Bucar *et al.* (2010, p. 85).

The promotion of business R&D and technological innovation includes a number of programmes offering direct subsidies mainly under the auspices of MHEST and ME, with agencies such as TIA or JAPTI handling the programmes. In addition, tax incentives for R&D were introduced in 2006 and increased to the current level in 2010: Investment in R&D is deductible in the amount of 20%. Income subject to corporate income tax can be reduced up to 40% of the investment in R&D. The eligible cost base includes costs for personnel, hardware and the purchase of licences. As direct support, the Slovenian government offers firms: *i)* direct investment grants for start-ups, guarantees for loans in the context of technology investments and equity finance for SMEs through SEF; *ii)* subsidies for strategic R&D research projects in enterprises along certain of the government's priority lines, provided by TIA with structural funds as co-financing; *iii)* joint development-investment projects, again provided by TIA, for collaborative inter-firm product or service development, with structural funds involvement; and *iv)* innovation and training vouchers for SMEs as part of JAPTI's portfolio, allowing smaller enterprises to acquire know-how, *e.g.* in the handling of intellectual property.

In addition a number of funding activities promote (public-private) partnerships for innovation and entrepreneurship, such as VEM points (one-stop shops), advisory networks, support to technology parks, incubators and other innovation support infrastructures. As these initiatives have distinct goals and show some problematic overlaps, they are discussed separately in Section 4.3.

Funding of human resources mainly covers promising young researchers in the science system and the business sector. The Slovenian Young Researcher Programme is typical of measures to promote young scientists. Such instruments exist in most OECD countries and can be found in the portfolio of many research councils. Many young researchers around the PhD phase are selected by their institutions and financed by an important SRA programme. Another programme supports the employment of young postgraduates in industry, with a dual mentorship (an academic and an industry-based researcher). The principle is “technology transfer via human resources” and is a basis for future collaborations. TIA acts as funding agency, complemented by structural funds. A similar transfer programme for researchers to industry is provided by JAPTI.

Research funding in HEI and PROs is regularly provided through SRA programmes. As already mentioned, its remit is extraordinarily broad and includes the core research financing of universities and PROs. The main instrument covers the research groups (or research programmes) and funds individual groups for a period of three to six years. The programme covers basic research in all disciplines; Bucar *et al.* (2010, p. 94) call it “‘responsive mode’ funding” as funding is provided directly to research teams to carry out specific projects of their own choice. The proposals undergo a review and in principle the programme is competitive; however a very high share of proposals is accepted. For the repercussions on university and PRO governance see the preceding section. Besides the research groups, SRA offers different kinds of project funding for scientific research, with external peer review and stronger competition. One extra feature is the so-called targeted research programmes, apparently a hybrid between grants and commissioned research: other ministries define topics of interest within the priorities of the Slovenian Development Strategy and SRA manages the calls. This programme is a source of income particularly for the social sciences (European Commission, 2010, pp. 15ff.). SRA also provides important infrastructure funding to universities and PROs.

4.5. European funding and internationalisation

Maximising benefits from internationalisation

Internationalisation has a variety of dimensions, including cross-border flows of investment and mobility of personnel, language and entitlements; it is shaped among other things by the self-perception of a nation and the attractiveness of a country in the eyes of international actors. In this regard the new EU member states of central and eastern Europe have chosen different approaches to internationalisation. While all had to restructure the economy in the face of the collapse of previous patterns of international linkages, some enthusiastically embraced internationalisation, while others took a more cautious or gradual approach. EU accession engendered “mainstreaming” through the adoption of EU law and the Internal Market, with the four freedoms of movement of goods, capital, services and people.

As shown before when discussing openness to international trade and foreign direct investment, Slovenia’s internationalisation is in some ways uneven and patchy, with some success stories:

- Some basic and straightforward goals have been achieved. Slovenian firms have linked up with western European production chains as suppliers, and Slovenian innovation actors of all kinds have won numerous EU grants under the European Framework Programmes. Achieving these goals created some challenges, but no systemic changes were/are needed.
- A more recent success story is potentially related to longer-term and larger-scale innovation instruments and Structural Funds interventions, which result in a higher planning capacity, continuity and larger scale than what is offered by some national programmes.
- Slovenia’s record is weak with respect to outward FDI and shows a relative lack of dynamism as regards inward investment compared to countries such as Estonia, Hungary or the Slovak Republic. Slovenian firms tend to rely on internal solutions and are reported neither to invest significantly in R&D facilities abroad nor to commission R&D or innovation activities from research facilities in other countries on a larger scale. R&D is one of the less internationalised business functions and Slovenia does not strongly rely on international, *e.g.* intra-firm, technology transfer mechanisms (Bucar *et al.*, 2010, p. 113ff.). The choice to integrate the international economy primarily through international trade, to perform and collaborate on R&D largely at a national level, combined with comparatively low FDI could be termed an example of “internationalisation à la carte”.
- Successful internationalisation in science, technology and innovation requires the alleviation or removal of barriers to allow highly qualified people to enter the Slovenian labour market. While some Slovenian high-technology companies boast a truly international workforce, the opportunities for foreigners to work at universities and PROs seem very limited. Teaching in Slovenian is a stringent requirement for an academic teaching appointment, and limits access to European and other international scholars. At a Slovenian university the “habilitation”⁷ is reportedly required to become a full professor. This is another example of uneven internationalisation (or “internationalisation à la carte”), with potentially harmful implications for long-term performance. In this respect, Slovenia closely resembles most central and eastern European countries with academic job markets effectively closed or unattractive to researchers from abroad.

There is no “optimal” recipe for dealing with internationalisation and globalisation. However, if Slovenia wants to become more visible and attractive at the international level and fully benefit from global trends, an “internationalisation à la carte” approach is likely not to be sufficient. Other small countries provide interesting examples of how to deal with this issue. Close to home, Europe provides very instructive examples: Austria, the Benelux countries, central and eastern European and Nordic countries, Ireland and Switzerland, to name a few. Some have chosen explicit internationalisation strategies in order to become international players in the production and distribution of goods, services and knowledge and to link up to other hubs and nodes of the world.

The European Union has strongly influenced central and eastern European countries over the last 15 to 20 years and continues to do so. Suurna and Kattel (2010, p. 657) identify three main factors, ranging from a much more active state role in structural and innovation policies, the increasing fragmentation of the policy arena, and a growing mismatch between the R&D system, high-technology biased innovation policy and actual industry needs. As described, Slovenia has taken a somewhat distinctive path.

Active participation in international funding programmes is important and useful for a small country in different ways. Like other EU member states Slovenia benefits from these advantages:

- First, linking into international communities in collaborative activities helps to open up the national innovation system. The smaller the home base, the more important the embedding in a wider system. In this way, Slovenian researchers, groups and organisations can gain higher visibility, sharpen their profiles thematically and their management and adopt new developments and directions.
- Second, competition transcends the small home base and competition among all researchers in a given field across Europe should have a beneficial influence on quality.
- Third, European funding has a number of specific properties and requirements, such as programme orientation or the need to set up consortia. These can help to mobilise efforts to reform rather rigid national systems.
- Fourth, being both eligible for substantial structural funds allocations *and* successful opens a significant additional funding stream and should increase the overall budgets available for research activities. This can be especially important when international funds allow for additional types of activities or investments.
- Finally a ladder of competences (and learning opportunities) structure international and European programmes and initiatives, which leads from participation in smaller consortia to actively management of large multi-actor networks.

The following sections discuss the two main funding lines in more detail. One is support for mainly collaborative transnational research and innovation activities under the European Framework Programmes (FPs); the other concerns funding mainly for the building of competitive infrastructures in less favoured European regions with structural funds.

EU Framework Programmes

Slovenia actively approached international, in particular European, funding programmes well before EU accession in 2005. In the 1990s it participated in many programmes aimed at the transformation of central and eastern European countries such as TEMPUS, PHARE, PECO or INCO-COPERNICUS, and prepared Slovenian research and innovation actors for the EU Framework Programmes and the Competitiveness and Innovation Framework Programme (CIP), with emphasis on eco-innovation. Moreover, Slovenia successfully entered other European multilateral initiatives for scientific and technological co-operation such as COST or EUREKA.

Slovenia's record in the FPs is noteworthy. These multiannual programmes – FP7 is currently in operation – call mainly for multi-partner, multinational applied research projects. In FP4 more than 100 Slovenian organisations participated. Numbers rose strongly in FP5 with positive results as regards international networking and mobility, quality of research or international exchange (Stanovnik, 2004, pp. 346ff.). In FP6 nearly 4 000 applications from all kinds of organisations led to more than 600 participations in around 500 projects, with a cumulative “value” of EUR 76.4 million. This was twice Slovenia's imputed contribution. Given Slovenia's strengths, 20% of successful participations were in ICT programmes, followed by 12% in sustainable development and about 10% in nanotechnology/materials (Bucar *et al.*, 2010, pp. 114ff; for nanotechnology see also Rivera León *et al.*, 2011, p. 61). This positive trend has continued in FP7. As a result, Slovenia boasts the highest number of participations in EU programmes per 1 000 researchers (MHEST, 2010a, based on European Commission data), followed by Greece and Estonia, and continues to reap an impressively high financial return.

This success, however, comes with four caveats:

- First the success rate of Slovenian applicants and the number of project co-ordinators are among the lowest in the EU27 (MHEST and ME, 2010, p. 13).
- Second, Slovenian researchers tend to be content with specific targeted research projects (STREPs) (see Bucar *et al.*, 2010, pp. 115ff) and other simpler EU projects. This suggests that there may be a relation between institutional weakness in the university and PRO sectors and a lack of ambition or ability to participate in more sophisticated international technology collaborations. Some agency managers even seem to have a preference for the FP5 project set-up (terminated in 2002) still and would like to see Europe return to these smaller collaborative projects.
- Third, active participation in Framework Programme projects tends to have negligible influence on the strategic agenda of most research performers in Slovenia as elsewhere in Europe. In the public sector, EU Framework Programme money is mostly seen as a welcome alternative source of funding with no strategic impact. Individual research groups apply and use the funds the way they use national funds (apart from the international consortium effect). Framework Programme funds generally change neither the direction nor the structure of research, as a recent study on Swedish universities has shown (Arnold *et al.*, 2008).
- Finally Slovenia has the highest relative share of “applied research” in contrast to basic research or experimental development. In the current context this can be taken as a sign of a potentially harmful catch-all strategy, with no clear path towards excellence or market innovation. The mainstream funding opportunities of the EU FP programmes can sometimes be cosy opportunities to do more of the same middle-of-the-road research, with no or weak strategic orientation.

A logical next step for Slovenian research organisations might be to move up the competence ladder by entering more ambitious programmes such as Joint Programming Initiatives (JPIs) or the knowledge and innovation communities (KICs) of the European Institute of Technology (EIT), by taking on the role of co-ordinator more often and by embracing top-quality funding initiatives such as the FP7 European Research Council (ERC) with its large-scale frontier research grants for top individual researchers.⁸ This is demanding, but seems to be the logical complement to the national goals of an “Audacious Slovenia” strategy. It can only be achieved if individual organisations, universities as well as PROs, adopt a more strategic agenda and if the government supports agenda building with adequate organisational reforms.

The second European funding programme seems not only to actively support strategy building, it appears to be the basis of the measures employed in Slovenia: the research and innovation-related programmes that draw on structural funds.

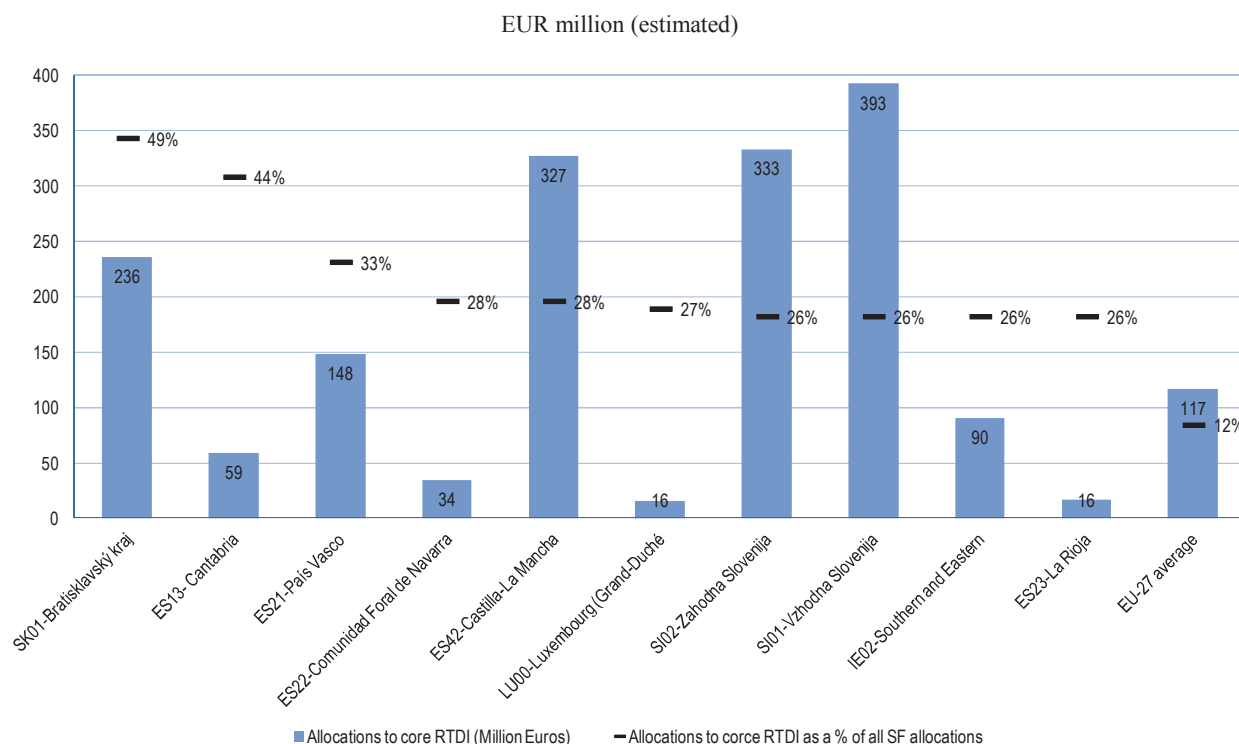
Research and innovation and the structural funds

While the FPs mainly attempt to increase research collaboration within Europe, the structural funds (SF) basically try to help less favoured regions catch up. They are the main policy instrument for redistributive cohesion policy and cover a broad range of topics and goals, from social policy to basic infrastructures such as roads and ports. Research and innovation have become more and more important elements of the SF, reflecting both the importance of research and innovation for growth and the insight that less favoured regions need strong research cores to counter brain drain or to give these regions a fair chance in competitive programmes. Overall, Slovenia is among the largest net recipients per capita of structural funds among the ten new EU members. The country as a whole is eligible under the convergence objective. The financial allocations available have increased substantially: in 2004-06 EUR 334.5 million were available for regional policy funding, but EUR 4.1 billion can be spent during 2007-13 in a number of policy fields. In terms of Structural Funds allocation, Slovenia receives approximately twice as much as it contributes to the EU general budget. (OECD, 2011c, p. 90).

Slovenia entered the EU at the moment when these cohesion instruments evolved from providing funding of basic physical infrastructure into a potentially powerful instrument for renewing the knowledge infrastructure. There has been a considerable shift towards spending for research and innovation from the programme period 2000-06 to 2007-13, with core research and innovation activities nearly tripling their share in the SF budgets from 8% to 22% (see Rivera León *et al.*, 2011, p. 12). This trend will continue during 2014-20.

Slovenia has seized the opportunity and designed programmes with SF financing, notably the centres of excellence and competence centres. Other new EU member states such as the Czech Republic, Estonia, Poland or the Slovak Republic also use this instrument heavily to renew their structures and adopt new organisational and managerial features in their public research system. Slovenia already used SF money for research and innovation in the planning period 2000-06; in the current period the two Slovenian regions are among the top regions for SF allocations to core research and innovation⁹ (Rivera León *et al.*, 2011, p. 28ff.; Figure 4.2). Taken together, Slovenia has the highest average annual per capita expenditure on core research and innovation activities of all new EU member states in the 2007-13 period, with a steep increase from 2000-06 (Rivera León *et al.*, 2011, pp. 31 and 38). However as Slovenian GERD is relatively high, the relative share of SF research and innovation funds in the overall GERD is much lower than in other old or new EU convergence countries.

Figure 4.2. Top 10 regions in terms of the highest intensity of core research and innovation allocation in total SF allocations, 2007-13



Source: Rivera León *et al.* (2011).

Slovenian SF spending goes to numerous activities ranging from innovation-led business support to the build-up of research centres and physical infrastructures. A National Strategic Reference Framework (NSRF) has been issued as a central planning document. R&D and innovation, including human resources, are listed as high priorities, and have been translated into operational programmes (OPs) (Bucar *et al.*, 2010, pp. 74ff.). Funding ratios are high, with up to 85% from European sources. Like other countries Slovenia uses the SF in part to change the structure and rationale of existing funding regimes. Larger-scale, collaborative infrastructures and research centres are being funded to counterbalance small-scale grants, small groups and local entrenchments. For this reason, three major programmes could trigger structural changes in the Slovenian R&D landscape (information provided by MHEST, 2010c):

- *Centres of excellence (CoE)*. The CoE programme aims at strengthening academic excellence and co-operation by building critical mass and by linking up to top centres abroad. It funds high-quality multidisciplinary groups of researchers. Currently there are eight CoEs, in which 70 industrial partners participate. The CoEs undertake fundamental research, but in addition to scientific publications they should also give rise to patents, innovations and spin-offs. The first ten CoEs were formed on a relatively small scale during the SF period 2004-08. EUR 15 million was allocated over three years. In the current OP period eight centres (Table 4.3) were selected for funding from 2009 to 2013, with nearly EUR 80 million allocated on the basis of a selection process that drew upon the expertise and recommendations of foreign peers. The centres, each of which has a budget of around EUR 10 million, represent strongholds of Slovenian science and their

formation is thus the result of a *de facto* bottom-up process. Each CoE is required to form a distinct legal entity. A mid-term evaluation is planned for 2011 to see whether and how to deal with these centres in the longer run. MHEST is in charge of this programme as SRA cannot act as an agent and TIA was reportedly too occupied with other programmes.

- *Competence centres (CCs)*. This science-industry linkage programme is also administered by MHEST. CCs are similar to CoEs but with a much stronger role for industrial partners, applied research and industry networks. The programme is aimed at strengthening the capability to develop and use new technologies to create new products, processes and services in important technology areas. They are meant to build critical mass. In contrast to CoEs but like development centres the CCs have a co-financing structure that includes public funds as state aid. The programme has a number of thematic priorities and a call for proposals was issued in mid-2010. The programme has an overall budget of EUR 45 million. Seven CCs in which 46 companies and 16 research organisations are participating have been awarded EUR 6.4 million each on the basis of an *ex ante* evaluation including foreign peers. The mid-term evaluation is planned for 2012.

Table 4.3. Slovenia's centres of excellence and competence centres

	Budget (EUR millions)
Centres of excellence (8)	
CoE in Nanosciences and Nanotechnology (CE NS and NT)	9.8
CoE for Biosensors, Instrumentation and Process Control (CEBIC)	10
CoE for Integrated Approaches in Chemistry and Biology of Proteins (CIPKeBIP)	8.4
CoE for Low-Carbon Technologies (CoE LCT)	10
CoE Advanced Non-Metal Materials with Technologies of the Future (CE NAMASTE)	9.4
CoE for Polymer Materials and Technologies (CE PoliMaT)	10
CoE Space: Science and Technology (CE Space.si)	10
NMR CoE for Studies in Biotechnology, Pharmacy and Physics of Matter (CE EN-FIST)	10
Competence centres (7)	
CC for Advanced Control Technologies (CC ACT)	6.4
CC for Advanced Systems for Efficient Use of Electrical Energy (CC SURE)	6.4
CC Biomedical Engineering (CC BME)	6.4
CC for Sustainable and Innovative Construction (CC SIC)	6.4
CC for Biotechnological Development and Innovation (CC BDI)	6.4
CC for Cloud-Assisted Services (CC CLASS)	6.4
CC Open Communications Platform for Integrated Services (CC OPCOMM)	6.4

Source: www.mvzt.gov.si/en/areas_of_work/science_and_technology/centres_of_excellence_and_competence_centres/, accessed 26 July 2011; MHEST (2011c).

- *Development centres.* ME initiated this programme in 2010. The objective is to support projects that include R&D and investment in related infrastructure to promote technological development with an overall budget of more than EUR 185 million. Applications will be received from consortia with at least two companies; these can also include research organisations, municipalities and foreign companies. The selected centres will receive a maximum of EUR 20 million per project. About half of overall project costs can come from structural funds. In early 2011, 17 centres were to be accepted. Situated in different regions of Slovenia they concern wood processing, new materials, ICT, car industry, pharmacy and biotechnology, electric engineering, electronics industry and energy (Republic of Slovenia, 2011, p. 22).

These new programmes can boost infrastructure renewal, research performance and prioritisation and can also contribute to the upcoming organisational reform of HEIs and PROs. They introduce clear evaluation cycles and encourage Slovenian research to collaborate and to compete with strong centres abroad. As they constitute comparatively large interventions for Slovenia, a number of procedural (and substantive) issues should be kept in mind:

- Documentation and policy learning, as these interventions can and should lead to new forms of research management and collaboration patterns and the formation of real strongholds.
- Duration, as these programmes and centres should not share the fate of earlier innovation policy initiatives but should remain in place for a sufficiently long period of time.
- Organisational change in the Slovenian public research system. Management practices and organisational structures should be developed in parallel and in close relation to university and PRO reform. For purposes of comparison and learning, countries such as the Czech Republic have similar structural fund OPs, and a number of OECD countries have similar CC programmes which also aim to generate “behavioural additionality” in the business and public research sectors (OECD, 2006).
- Internationalisation, as CCs, CoEs and development centres can help to overcome national limitations of various kinds. Later, separate programmes can be integrated. Note also the subsequent integration of different programmes in some countries: Austria for example has merged two competence centre programmes into the large COMET Competence Centre initiative, but also operates the SFB (“*Spezialforschungsbereiche*” – special research areas) programme, which is a distinct CoE-style science funding scheme.
- Focus or variety, as the need for distinct competence centres and development centres is not completely clear to external observers. They seem to have similar goals and similar instruments although academic involvement seems smaller in the development centres. Together the two programmes have created 24 centres, a large number for the size of the country, all with medium-sized budgets, compared to activities in the Czech Republic, for example (see Box 4.3).

Box 4.3. Structural funds for upgrading the research landscape of the Czech Republic

Like Slovenia, the Czech Republic can make use of structural funds for research and innovation activities. The Czech government decided to focus on innovation and established a special operational programme for research and development and innovation (OP R&DI) for 2007-13. The programme is based on a SWOT (strengths, weaknesses, opportunities and threats) analysis of the Czech innovation system and is embedded in a number of relevant planning documents, including the National Development Plan 07-13, the National Strategic Reference Framework and various innovation policy frameworks. OP R&DI runs from 2007 to 2013, with operational spending until 2015. The overall budget is nearly EUR 2.44 billion, 85% of which from the structural funds. Execution of the OP R&DI suffered delays, but in 2009-11 an impressive evaluation and selection process took place. Upgrading of the Czech research landscape mainly comes through the priority axes I and II and covers the whole country except the capital Prague, which is too rich to be an eligible region:

Priority axis I, with more than EUR 800 million, supports the creation of a few large CoEs. It aims at funding a small number of internationally competitive centres to put Czech science more firmly on the international map but also to strengthen ties to local and international users of their research. In one competitive call in 2010, 8 proposals out of 15 were selected and are being implemented. Some CoEs are very large such as the Brno-based CEITEC in life sciences and material sciences or the European Research Infrastructure Project ELI (Extreme Light Infrastructure).

Priority axis II, also with more than EUR 800 million, funds comparatively smaller regional R&D centres, with a mainly sector-specific, application-oriented and demand-driven mission. These centres help local firms to innovate strategically and other users to perform their mission better. In successive rounds in 2009 and 2010, 33 initiatives were selected from 96 proposals. The centres are now starting their operational activities.

Both kinds of centres are being established in existing universities and PROs, sometimes in the form of co-operation between organisations. They are not distinct legal entities but have strong management, rules and procedures. The use of structural funds is therefore expected to lead to physical and organisational restructuring of the Czech university and public research landscape. While most of the money is used for new buildings and scientific equipment, a considerable share goes to new research staff, graduate schools and mechanisms to strengthen governance and research management.

A few research locations profit strongly from this renewal process. Brno, the second largest city in the Czech Republic (a little larger than Ljubljana), now hosts 15 centres with an overall investment of roughly EUR 600 million. Among the chosen projects, a few such as CEITEC at the Central European Institute of Technology, with EUR 200 million in funding, have the potential to become major European players. The International Clinical Research Centre at St. Anne's Hospital (ICRC-FNUSA), a collaboration with the Mayo Clinic in Rochester, Minnesota, receives funding of about EUR 100 million. Brno has traditionally had a large number of strong universities and PROs. It now has the chance to become a first-rate European R&D location.

The selection process was highly structured, with numerous SF indicators broken down into a few core operational indicators. The process included a number of steps to evaluate technical feasibility, regional impact and property development. An international peer review and panel process then examined the scientific quality, governance and international potential of the projects. Only 43 out of 111 proposals were accepted, an acceptance rate of 39%. This selection process was followed by intense indicator-driven contract negotiations.

The Czech Republic has five times more inhabitants than Slovenia and an aggregate R&D intensity of around 1.5%. The overall OP RD+I is comparable with its Slovenian counterpart. Slovenia has the highest per capita average annual expenditure on core RTDI with structural funds in 2007-2013 (EUR 51 per inhabitant, followed by the Czech Republic with EUR 40). They are followed by Estonia (EUR 38) and the Slovak Republic (EUR 32, with the highest sub-regional concentration among central and eastern European countries in Bratislava).

.../...

Box 4.3 Structural funds for upgrading the research landscape of the Czech Republic (*cont'd*)

Two major differences relate to the Czech ambition to form a few really large centres of excellence with funding up to EUR 200 million for five years for the largest of them, and to concentrate OP funds on research infrastructures and centres of competence. (In comparison, Slovenia has an extremely high share of technology transfer and SME assistance activities in the structural funds portfolio.) If a long-term perspective beyond 2013 / 2015 can be upheld, this OP R&DI process has the potential to change the face of academic and applied public research in the Czech Republic, inserting new quality and management impulses plus renewing the infrastructure.

Sources: Arnold *et al.* (2011), pp. 97-103; Rivera Leon *et al.* (2011), pp. 29-34; Ohler *et al.* (2011).

In addition to the three instruments presented above there are also Research and Investment Projects (RIP). Their aim is to support joint development projects that bring together different enterprises for the creation of new and improved products, thus enabling competitiveness on EU and other foreign markets. Two calls were issued in 2008 and 2009, funding 60 projects involving 164 enterprises with support worth EUR 135 million until the end of 2011, and a further EUR 6 million foreseen in 2012 and 2013. There were no additional calls foreseen in the EU programming period 2007-13.

In summary, these various centres and programmes have the potential to build critical mass. This is important, given the traditional small-scale interventions and the reluctance to undertake structural change in the public research sector. The centres have some characteristics that can facilitate change: *i*) a strong bottom-up element in thematic prioritisation; *ii*) funds for physical investment; and *iii*) the introduction of a qualitatively and quantitatively new form of science-industry co-operation. They can therefore help to change attitudes and practices in universities and PROs. This will nevertheless be a long-term process and will require a significant rise in funding in the next funding period.

4.6. Strategic tasks of innovation policy – a functional assessment

Over the last 20 years, Slovenia's research and innovation policies have evolved in a specific and overall successful form. By choosing an incremental path Slovenia retained most of its existing institutions and organisations and gradually added new instruments and achieved a gradual improvement across a wide range of indicators. It prevented "systemic shocks" resulting in a collapse or serious contraction of key organisations of the innovation system. It tried hard to prevent a mass exodus of talent from the knowledge-producing sector and to minimise brain drain. A strong sense of community and culture and the desire to protect the young nation resulted in a somewhat cautious approach to internationalisation, liberalisation and the rebuilding of institutions. Compared to other central and eastern European countries and new EU member states, Slovenia followed a much more stable path as regards R&D funding, human resources or organisational mode, even though some relatively large industrial conglomerates disintegrated in the years after 1991.

This stability-oriented and to some extent inward-oriented approach came at a cost, however. First, it proved difficult to abandon or decommission obsolete policies, programmes and intermediaries and led to layers of similar activities and a degree of over-complexity. Second, the main producers of knowledge were not sufficiently challenged: universities and PROs are still characterised by weak leadership, excessive devolution of power and partly unclear missions. Third, Slovenian innovation actors did not have incentives to undertake active and strategic internationalisation, especially to

attract investment and human resources and to build internationally attractive providers of higher education and research. Few resident scientists and students are not Slovenian, few universities and PROs work for foreign firms, and few Slovenian innovation projects have access to international sources of finance.

There are structural and institutional limits to Slovenia's current ability to generate the level of innovative output necessary to move into the innovation vanguard. For example, a recent Slovenian Technology Forecasting Exercise (Stanovnik and Bavec, 2008), while identifying promising areas for future economic growth – such as sustainable chemistry, biotechnology, and information and communication technologies (ICTs) – concluded that “as a small economy with accordingly small R&D potential we cannot develop technologies that require high R&D or industrial potential”. This makes developing and improving an efficient innovation system that can generate critical mass and raising the capability to absorb knowledge from external sources very important.

While “high-end” scientific research and internationally competitive innovation projects cannot easily be expanded further owing to the limitations of a small home base (and a selectively international mindset), the “lower end” has not received enough attention. Most of the energy of Slovenian innovation policy seems to have gone into measures to promote R&D and co-operation in firms that already innovate. Despite impressive pockets of technology-intensive, export-oriented firms and industries, productivity in most sectors is significantly below EU and OECD averages and many firms remain on the lower rungs of the innovation ladder. This is a warning sign in terms of Slovenian firms' ability to compete. The future competitiveness of the Slovenian economy depends significantly on increased technological and non-technological innovation in both processes and products that generate significant reductions in costs for existing production and the development of new high value-added products.

The global financial crisis of 2008 and its aftermaths has hit the Slovenian economy particularly hard and exposed latent weaknesses. Fortunately, the government has maintained its research and innovation spending priorities in times of tighter public budgets and the National Assembly has recently adopted the Slovenian Research and Innovation Strategy (RISS) with a ten-year horizon and an ambitious reform agenda. However there are limitations on the overall scope of government action. An expansion of public R&D funds will prove difficult and “near term public finance challenges are high” (see OECD, 2011a, pp. 31ff). There are thus some serious questions about the country's future competitiveness. The following concluding remarks focus on these issues.

Improving framework conditions for innovation

OECD experience shows that the quality of framework conditions for innovative behaviour is essential for a country's overall innovation performance. These framework conditions include macroeconomic stability, many aspects of the regulatory regime and the tax system, the intellectual property rights regime, competition frameworks that influence the vigour of competition and can induce economic actors to “innovate their way out”, and openness to international trade and foreign direct investment (FDI). For this reason, framework conditions that can be expected to have an impact on innovation should be continuously screened and adjusted if they hold back innovation efforts. They should be shaped so as to be supportive to private and complementary public investment in innovation. For Slovenia as for other countries maintaining macroeconomic stability and sound economic performance is essential. Innovation can play an important role in

this effort as it helps improve productivity and maintain firms' competitiveness. Sufficiently vigorous competition, openness to international trade and foreign direct investment are important for innovation performance and should be closely monitored. While the FDI framework has improved over time, it still needs to be screened for features that hold back innovation. The administrative burden for existing and start-up firms also requires continuing attention, including aspects of the financial system that might constrain innovative business projects.

Maximising benefits from the internationalisation of R&D

Integration in international research and high absorptive capacities are critical for successful innovation in a small country. Slovenia's level of development, geographical location, European integration and other factors provide a sound basis for its internationalisation.

Slovenia should consider taking a bolder approach to academic openness. It currently has a small number of students from abroad and of foreign researchers in universities and PROs. Its stock of talent relies on 2 million inhabitants plus a few returning expatriates. Given this small base the results of Slovenian R&D have been remarkably good but a quite radical opening of academic labour markets and a stronger international profile as an attractive place for higher education are options to consider. In this respect, different world regions choose different paths. While central and eastern Europe seems to have difficulty overhauling and internationalising their university and PRO systems, the Gulf states and Asian countries such as Singapore offer the necessary framework conditions and infrastructure and invite top researchers and students from all over the world.

Slovenia's lack of attractiveness as an international research location has less to do with size or tradition than with a number of impediments. These range from Slovenian as teaching language to somewhat opaque selection procedures, from unattractive career models and salary regulations to the question of student fees. The main issue indeed seems to be a cultural one: Do the relevant communities recruit largely at home or do they embrace two-way internationalisation? Singapore has shown that small countries can quickly enter the scientific top league. This is not the same as linking academic communities in EU-funded projects and thereby claiming success in internationalisation.

Internationalisation of R&D and innovation is also increasingly important in the business enterprise sector but the drivers of internationalisation differ from those operating in public research institutions as competitive pressures in an open market environment play an important role. Given Slovenia's economic integration in European production chains, further progress can be made through improving productivity and identifying and nurturing promising market niches. Other small countries such as Austria have successfully employed this approach and achieved high levels of productivity in the export-oriented sector, innovation-based competitiveness and a number of – often hidden and less well-known – niche champions.

Strengthening the human resource base for science and innovation

The human resource base can quite easily be strengthened through active internationalisation, as described above. A focus on lifelong education can help to nurture local talent and bold and explicit skills policies allied with active labour market policies can form one pillar of a future approach to improving productivity and competitiveness in

the less innovative parts of the Slovenian economy. The Slovenian education system already has a strong vocational focus (OECD, 2011a, p. 60).

In the university sector the share of tertiary graduates is growing but fails to keep up with the OECD average. By removing obstacles and correcting for distorted incentives, graduation rates could be considerably increased and the time students spend to complete studies reduced. Action should be taken to raise the effectiveness of the higher education sector. Further, the current numbers of science and engineering students and graduates should not lead to complacency as demography and study preferences may be regarded with some concern. In addition, most industrial researchers seem to hold only a BA degree but higher levels will be needed as technological sophistication of Slovenian firms increases. The National Higher Education Plan and the RISS document describe a number of reforms that are strongly endorsed by this report but these should not be considered the end point of higher education reform in Slovenia.

Third, the permeability between industry and public research should be enhanced and mixed careers made possible. Career models in universities and PROs should be adapted to allow for including people with an industry record in their ranks. The programmes to fund the transfer of young researchers to firms seem generally to work well and should be continued.

A fourth avenue is the introduction of universities of applied sciences or polytechnics in Slovenia. Evidence for Slovenia is scarce but Switzerland, Germany and Austria have significantly enhanced their higher education sector by building up a polytechnics sector. In those countries, local industry plays a considerable role in the development of specific curricula and in the assessment of future demand for graduates.

Improving the governance of the innovation system

The governance of the Slovenian innovation system has been strongly shaped by its gradual, step-wise evolution. As in many countries, a preoccupation with “favourite problems” of the time, particular types of trajectories and the adoption of good practices from abroad seems to have dominated this process. The result can be described as a good, middle-of-the-road governance structure with performance-based budgeting processes, long-term planning, an advisory council, two main ministries, a number of agencies with differing degrees of independence, a funding system with more than 20 individual programmes and with a variety of feedback and communication loops. Again, as in many countries, none of the elements of the system seems free of problems. Performance-based budgeting needs fine tuning and long-term planning should eventually lead to continuity in action. The council needs to improve its record, and the understaffed ministries face problems for policy execution. The “business models” of the main funding agencies need a close review as do the authority relations between some agencies and “their” ministries. Funding programmes partly show overlapping portfolios and seem to duplicate efforts of other intermediaries funded by the same agencies. Finally a more mature evaluation culture could contribute to better feedback and communication loops.

While these points have been discussed in detail in preceding chapters, three main issues are highlighted here.

The need and possible avenues for university and PRO reform are discussed extensively in this review. Both public research sectors seem to have been largely spared the changes of the last two decades. As a consequence, Slovenia enters increasingly vigorous international competition for talent and scientific and innovation-related results

with an outdated (and therefore costly) public research system. This review points out the need for urgent and comprehensive reform. Fortunately, the two “Audacious Slovenia” strategies, RISS and NPHE, foresee the adoption of a number of overdue measures. This review suggests that reform should aim at greater international competitiveness, improved leadership and clearer roles and organisational safeguards to complement the commendable goal of greater autonomy. International competitiveness translates into more attractive positions, international recruitment and the creation of critical mass. Stronger leadership means empowering rectors, directors, dedicated committees and leaders at all levels as regards organisational and budgetary matters, while increasing accountability. Clearer roles and organisational safeguards help make autonomy work; autonomy requires a strong and clear governance model at MHEST and its active support of the process of change. For PROs this means a thorough revision of current “catch-all” approaches to scientific research, user needs and (lack of) critical mass. If a fair process does not result in a main strategic objective another solution will be needed, such as potential merger into a university.

The Slovenian policy mix and specific policy instruments show signs of overcrowding and in a few cases send conflicting signals. While instruments such as equity-related measures, loans or tax credits have clear-cut features, there are duplications in applied funding programmes for technology transfer, entrepreneurship, science-industry co-operation or R&D funding, with some smaller structural fund programmes entering an already full arena. Moreover some programmes and agencies seem to provide funds directly and indirectly at the same time by subsidising both end users and intermediary technology transfer or entrepreneurship organisations (which provide similar support) at the same time. Further, conflicting signals appear when RISS and NPHE aim at increasing university and PRO autonomy while SRA provides research group core funding directly to individual investigators. It should be possible to find remedies and merger discussions involving applied funding agencies are an encouraging sign.

Finally, evaluation – notably programme and institutional evaluation – needs to receive much more attention. The evaluation of (larger) programmes, initiatives and organisations should be made mandatory soon. For a small country it is indispensable to draw on international know-how and to include evaluators from abroad. Provisions should be made for documentation and monitoring of programmes and organisations to be available in at least one widely accessible language.

Fostering innovation in the business sector

Until 2008, the business sector recorded steady growth, with many firms specialising as suppliers in international industrial value chains. However, only some Slovenian firms succeeded in becoming truly innovative and raising productivity to levels comparable to those of western European countries. The economy proved vulnerable during the crisis, owing to relatively high wages and low average productivity, relatively strong dependence on single large corporate customers abroad, a weak financial sector and a housing bubble. The government introduced a number of anti-crisis policies to rescue troubled sectors with special emphasis on the car component industry. These packages included public guarantees and loans to ease the credit shortage or measures to subsidise private expenditures for research and innovation.

Slovenia needs to put strong emphasis on measures to raise overall industrial competitiveness, including by strengthening entrepreneurial and innovative capacity. This has a near-term and a long-term component. Near-term improvements include innovation based on existing technologies of both domestic and foreign origin. Productivity improvement can be achieved by applying existing knowledge and practices, moving sequentially from marginally profitable to industry average practice and to world best practice. Improvements of this type generally require managerial awareness and commitment to improved performance, recruitment, training and retraining of a technically skilled labour force, and access to trusted sources of technical and managerial knowledge. Even more important is the introduction of long-term improvements in the capability of Slovenia's innovation system to generate and apply new knowledge. For both short-term and long-term approaches, international examples of successful smaller countries should be studied and adapted. Initiatives may include manufacturing extension programmes, the broad insertion of quality policies, lifelong learning policies and a stronger focus on non-technological improvements to foster productivity growth.

This review argues for upgrading firms and sectors with lagging productivity levels through hands-on, pragmatic programmes. This does not mean abandoning other sectors and better performers. Both young and established firms should remain in the policy focus, with the portfolio selectively enriched by demand-side instruments such as innovation-driven procurement.

Fostering critical mass, excellence and relevance of public research

Universities and PROs are characterised by an abundance of small groups and a multitude of fields. High and growing research productivity, supported by quality-inspired funding instruments, goes hand in hand with rather mediocre international impact. This is another argument for timely reform of public research, including a strengthening of organisations and a review of incentives through organisational set-ups and funding instruments.

Slovenia should aim at achieving critical mass in at least a few fields. This does not necessarily require top-down priority setting, though foresight procedures should continue. For creating critical mass, the larger Slovenian research and innovation programmes drawing on EU structural funds can be seen as a major step forward, by moving away from small programmes and projects and by linking infrastructure investment more tightly to projects and programmes. Competence centres, centres of excellence and development centres should become a priority for 2014-20, building on current experience. The centres of excellence in particular should have considerably more funding in the next period (perhaps at the expense of smaller programmes that tend to duplicate national funding). Through their programmes, management, industry involvement and critical mass, these centres can contribute to the excellence and industrial and societal relevance of Slovenian research.

Strengthening the links in the innovation system

Strengthening system linkages is a critical element of innovation policy. In the last 15 years Slovenia has implemented a large number of policy initiatives to align different actors. It has accumulated various schemes for science-industry collaboration, technology transfer and activities related to entrepreneurship and inter-firm co-operation. On top of the existing multitude of public interventions a new wave of programmes is being added,

financed partly from national budgets, partly from structural funds. While all these activities are worthwhile in principle, Slovenia should pay attention 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 large a set of small-scale interventions, Slovenia should take care to handle the overall funding portfolio pragmatically: the RISS proposal to use 60% of all public funds for activities with industry involvement or direct industry orientation is a valid one in principle. However, it might lead to more programmes and activities with diminishing marginal returns and undermine the funding needs of the public research sector.

Finally, Slovenian policy makers should be a little less concerned about the immediate usefulness of the results of public research and put more emphasis on structural issues in the public research sector. How can the best people be hired, wherever they come from? How can the best students be attracted and nurtured? How can research groups, fields of excellence and new topics evolve dynamically? What kinds of resources and infrastructures are required for first-class research? How can strategic partnerships with key users be built up? What kind of institutional incentives for co-operation and transfer policies can be introduced in the management and financing of knowledge producers? This kind of approach would be better suited to build strong research cores and to act strategically, whereas another co-operative funding programme would only add to already problem-laden and overly decentralised (small-scale) research structures.

Notes

1. A number of goals were restated or altered in the Research and Innovation Strategy of Slovenia 2011-20.
2. The combined MHEST and ME research budget was EUR 350 million in both 2009 and 2010, considerably above 2008 when governmental funding amounted to EUR 193 million (Bucar *et al.*, 2010, pp. 33ff). The difference can be explained by rising budgets, inclusion of structural funds in the MHEST sources and differences in representing funding streams (as funding allocations or actual payments). It is however largely due to higher public budgets (including structural funds). There was also a remarkable jump between 2008 and 2009 (OECD, 2011b, p. 82).
3. Figures for both SEF and SID cannot be directly compared to the budgets of the other agencies owing to the differences in the instruments involved. The “net funding worth”, *i.e.* what remains as a subsidy in the balance sheets of the supported enterprises, of most SID and SEF instruments is considerably lower than the amounts listed above. It is also difficult to get figures for “net funding worth”.
4. The plethora of science-industry co-operation programmes and industrial research promotion initiatives in Austria is sometimes seen to be at the expense of adequate science funding of a clear programme portfolio.
5. The viewpoint here is functional and not formal. Formally SRA is a largely independent agency that executes government policies.
6. Of course, other funding agencies or RFCs across Europe also rightfully value past records when reviewing project proposals.
7. “Habilitation” is a continental European academic qualification which is to a certain degree comparable to the position of tenured professor in terms of results but not of process.
8. One Slovenian researcher is said to have won in 2011 the nation’s first ERC grant, a starting grant. Compare this record to the striking ERC success stories of small countries such as Israel or Switzerland.
9. A few years ago all of Slovenia still counted as one NUTS 2 region according to the European statistical classification. Now Zahodna Slovenija (western Slovenia, including the capital Ljubljana) and Vzhodna Slovenija (eastern Slovenia) form two distinct NUTS 2 regions.

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Annex A

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