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. 651*ff*).

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. 76*ff*) 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/ulonline.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_konkurencnost/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/svlsrp.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. 653*ff*). 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.

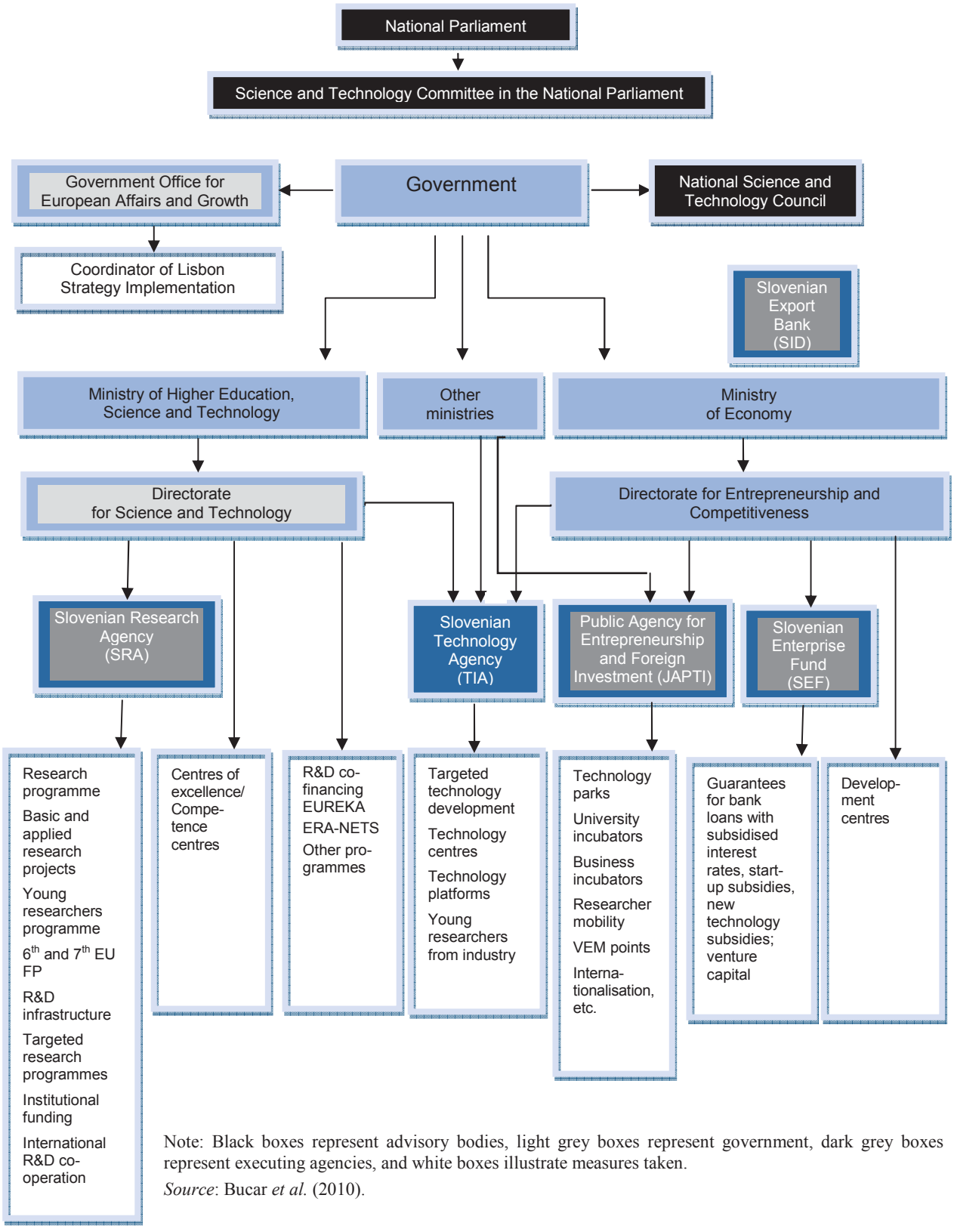
4.2. Governance and the policy mix

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



Note: Black boxes represent advisory bodies, light grey boxes represent government, dark grey boxes represent executing agencies, and white boxes illustrate measures taken.

Source: Bucar *et al.* (2010).

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 million[2] 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. 7*ff*). 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. 11*ff*). 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 93*ff*). 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), inter-disciplinary 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 (w*ww.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. 14*ff*). 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 JAPTI 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 counterproductive[4] 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, polices 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.

… /…

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. 83*ff.*).

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. 15*ff.*). 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. 113*ff.*). 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. 346*ff.*). 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. 115*ff)* 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

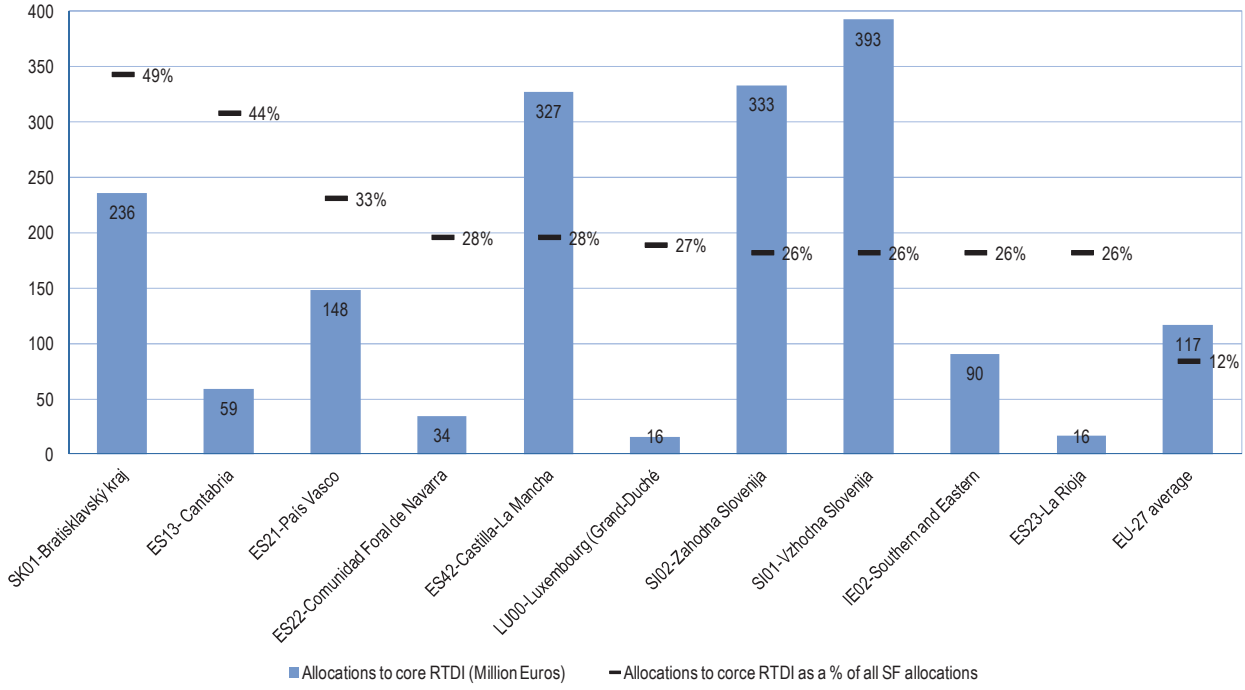
While the FPs mainly attempt to increase research collaboration within Europe, the structural funds (SF) basically try to help less favoured regions catch up. They are the main policy instrument for redistributive cohesion policy and cover a broad range of topics and goals, from social policy to basic 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 innovation[9] (Rivera León *et al.*, 2011, p. 28*ff.*; 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

EUR million (estimated)



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. 74*ff.*). 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 stablility-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. 31*ff*). 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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