Chapter 4

The role of government

The first section outlines the evolution of Croatia's post-independence innovation policy, from the transition period, the period of building infrastructure and initial transfer of approaches and solutions from more advanced countries, the 2000s up to the crisis which saw a move towards an articulated innovation policy and attempts to strategic planning, and the following phase lasting up to the present which was strongly shaped by preparations for EU accession. The second section describes the overall configuration and main actors of the STI governance system – primarily ministries, councils and agencies –with their respective roles. The next section discusses the innovation policy mix currently in place in Croatia, dealing with resource transfers in the form of direct public support and tax incentives for R&D and innovation, and the transfer of authority and institutional reconfigurations associated with an ongoing process of delegation of tasks and competences. The potential role of regulation and public procurement is also discussed. The fourth section focuses on international sources of funding for innovation which has played an important role in the past decade and is set to increase further in the wake of Croatia's recent accession to the EU, with full access to Structural Funds in addition to the already established full participation in the Framework Programmes. The final section summarises some major results of the review by discussing strategic tasks of Croatia's innovation policy from a functional assessment perspective.

4.1. The evolution of Croatia's science, technology and innovation policy[1]

The first phase (1991-93): economic downturn, transition to a market economy, privatisation, survival of a traditional science system

Immediately after independence, economic recovery, institution building and transition to a market-based economy, including privatisation and restructuring, were the major economic challenges. Particular problems arose from the combined effect of the economic downturn, the discontinuation of supplier-customer and innovation linkages, and a troublesome privatisation process, with severe consequences for the manufacturing industry (which had been a pillar of the Croatian economy) in terms of decline of incentives and capabilities for innovation. Public investment was mainly directed toward physical, and in particular road, infrastructure (Aralica and Redžepagić, 2012).

Science, technology and innovation (STI) policy was mainly understood as science policy: state-organised and state-budget-supported science aimed at extending the frontiers of knowledge. The scientific community, dominated by established interests, adopted an "ivory tower" approach in its relations with society; this had both positive and negative effects on the evolution of the system (Švarc, 2006, p. 152). The positive effect, and an important achievement, was the preservation of the academic community and related institutions, competences, equipment and skills. However, this approach had serious drawbacks, as it hampered recognising innovation and technological change as the driving force of economic growth, the roles of applied science and technology and of the interaction of science and industry (Švarc, 2006).

The second phase (1994-2000): building the infrastructure, transfer of ad hoc solutions from advanced innovation systems

The beginning of the second phase was marked by the first attempts to transfer methods and know-how from advanced innovation systems to Croatia, as the idea of a more comprehensive and systematic handling of STI matters gained ground. In 1994, the first steps were taken by transferring "best practices" from abroad, in particular from Germany and Italy, with a focus on science-industry co-operation and financial support for technology-based small and medium-sized enterprises (SMEs). Special attention was paid to knowledge and technology transfer from higher education institutions (HEIs) and public research institutes (PRIs) through the establishment of incubators, support of new technology-based firms, contract research, and the establishment of research labs. An agency was also established to implement functions formerly carried out by the ministry.

These actions led two years later to the National Scientific and Research Programme 1996–1998. Although the programme's name made no reference to "technology" or "innovation", it was used by the Ministry of Science and Technology (MoST) to implement two framework programmes that shaped the future of the innovation system (Švarc, 2006, p. 153). The first dealt with the establishment of a national network of institutions for the development, transfer, implementation and financing of new technologies. The second stressed the importance of government support measures for innovation and technology-based business. They were the source of several follow-up programmes and initiatives, such as the establishment of business innovation and technology centres, viewed as "interface institutions" between universities/public research and industry, with supporting institutions to assist companies through their start-up and expansion phases. In terms of building innovation *policy*, the centres were

expected to become reference points for future international and regional programmes (e.g. PHARE, INTERREG). However, while they were seriously considered at the time, the centres never materialised.

Between 1996 and 1998, three technology centres based in major cities and university centres were established and supported: the Centre of Technology Transfer, CTT, in Zagreb; the Technology Centre Split, TCS; and the Technology-Innovation Centre of Rijeka, TIC. All aimed to establish links between public-sector research and the private sector and to "develop innovation, know-how, technology, prototypes and to market preliminary products in as short a time span as possible" (ZSI, 2011).

In 1999, collaboration and transfer of know-how from Italy resulted in the establishment of Business Innovation Centre of Croatia (BICRO), with programming and implementation functions. It was the first operationally independent agency of its kind. BICRO's mission was to devise and implement financial models and instruments to support innovative or research-based entrepreneurship. At the same time, and much more important for the evolution of Croatia's innovation policy and innovation system, this was an opportunity to collect valuable practical experience and to learn about and assimilate new ideas about innovation management and policy delivery. It helped to build up and secure the human capital and networks formed by a core group of technology centre managers and relevant civil service officials. The decision to focus on technology transfer, interfaces, technology-based firms and start-ups was largely determined by a contemporary international drive to transfer best practices without much concern about their suitability to national settings (Tödtling and Trippl, 2005) and had a formative influence on the future policy trajectory.

The third phase (2001-08): towards an articulated innovation policy – HITRA, STP and attempts at strategic planning

The third phase in the development of innovation policy played a critical role in the evolution and shaping of the Croatian innovation system. In 2001, MoST established the Ministry of Crafts and Small and Medium Sized Enterprises (MOMSP) and HITRA, the Croatian Programme for Innovative Technological Development. These initiatives reflected a political intention to launch innovation and entrepreneurship.

The establishment of MOMSP signalled recognition of the need for an innovation policy in addition to science and research policy. HITRA was the first public policy programme to treat the national innovation system as a complex dynamic structure. Its main task was ambitiously defined: to restructure the wider R&D sector to meet the requirements of the knowledge economy. An increase in business R&D activities was perceived as a vital aspect of structural adaptation, and three activities were identified as core parts of HITRA: i) revitalisation of industrial R&D; ii) fostering science–industry co-operation; and iii) commercialisation of research results (Švarc, 2006).

As HITRA's aim was system-wide, it implicitly called for a change in the policy system, with co-operation across departmental boundaries and the alignment of departments' actions, not least through changes in legal and financial arrangements. To deal with potential frictions, an Inter-ministerial Control Group was established in 2001 to supervise HITRA's financial operations but also to be a "forum" for reaching consensus on conflicting policy issues. However, the Control Group never became fully operational. In the end, HITRA was forced to respect ministry borders and confined its policy measures and programmes to projects and companies that engaged in co-operation with the public R&D sector. It therefore became a programme targeting the clientele of

MoST: universities and PRIs, and its scope narrowed to the commercialisation of research results and stimulation of co-operation between companies and the public research sector (Švarc, 2006).

On this basis, HITRA established *de facto* a dominant policy design in the Croatian innovation policy community, and performed quite well within this narrow conceptual and institutional framework. However, this left vital areas of the innovation system unaddressed: the accumulation of R&D and innovation capacities in industry and related policies, such as intellectual property rights (IPRs), specialised financial instruments, science–industry researcher mobility, and the availability of qualified human resources.

Following HITRA's decline from a comprehensive to a rather narrowly defined programme, the World Bank's Science and Technology Project (2005-11) (STP) provided much needed funding and critical policy design support. STP was associated with more sophisticated support and with a push towards further delegation to operationally independent implementation agencies. As reported by the World Bank (2012), the project enabled R&D institutions to commercialise their research outputs and increased the ability of enterprises to develop, use and adapt technology by correcting the weaknesses of programmes to finance business R&D. Its main beneficiaries were the Ministry of Science, Education and Sports (MSES), two PRIs – Brodarski Institute Ltd and Ruđer Bošković Institute (RBI) – and the universities of Zagreb and Rijeka. The emergence of BICRO, founded some years earlier, as a central policy implementation agency was an important development during this period. MSES benefited from BICRO's development and implementation of innovation programmes and the implementation of the Unity through Knowledge Fund (UKF) in 2006. In terms of policy focus and the overall policy mix, the STP re-emphasised and amplified the existing focus on academia-industry interactions and the transfer of science from the public research sector to the economy.

A second stage in the evolution of the Croatian research and innovation system was the adoption in May 2006 of the Science and Technology Policy 2006-10 as Croatia's main strategic policy document. It aimed to stimulate scientific excellence and enable the transfer of knowledge and research results to the private sector in order to increase competitiveness and generate sustainable growth and productivity. Although it formally expired in 2010, no new major policy document has been adopted. A national innovation strategy is under preparation.

This phase created the foundation for further strengthening the overall STI policy infrastructure and for fostering science-industry co-operation. The Science-Technology Park in Rijeka and TERA in Osijek were established in 2007, followed by technology transfer offices at the universities and attempts to create spinoffs from PRIs (Ruđer Innovations at RBI). Greater attention was given to co-operation by the MSES and the former Ministry of Economy, Labour and Entrepreneurship (MELE). Because MELE recognised the importance of innovation for the economy, it started programmes to support investment in R&D and to develop science and business infrastructure and entrepreneurial education. These activities were included in the Programme for Supporting Small and Medium-Sized Entrepreneurship 2008-12.

While this phase commenced with the intention to move towards a comprehensive approach to research and innovation policy, this goal was not attained. Nevertheless, it had several notable achievements in terms of inter-ministerial co-ordination (MSES and MELE), delegation (BICRO and other executive agencies), and improvements in policy design and delivery. Co-operation between MSES and MELE constituted a significant step forward, at least in principle, because of its potential to address the co-ordination

failures that prevented more comprehensive treatment of innovation, especially the provision of meaningful support to the business sector. However, policy continued to focus on the public research sector, particularly its periphery.

The fourth phase (2008-present): institutional actions and plans, drawbacks and new opportunities

The current phase started in the second half of 2008 with preparations for EU accession and associated policies and plans. It has been affected by the global economic crisis and institutional funding problems. A total of more than 30 strategies and plans have been or are being developed. Most are under the responsibility of the Ministry of Economy and the Ministry of Entrepreneurship and Crafts. The efforts of these two ministries, the inclusion of a sectoral focus (e.g. energy, tourism) and the adoption of the cluster concept have the potential to lead to a more comprehensive approach to innovation. In the same period BICRO joined Enterprise Europe Network (EEN) and took a role of main partner for technology transfer and innovation, providing SMEs with educational events and tools on managing innovation, protecting Intellectual property and business models to enter new markets.

On the downside, the flurry of activity associated with the launch of the World Bank's STP and the Science and Technology Policy strategic document (Republic of Croatia, 2006) eventually slowed, and economic and political uncertainty led to the suspension of numerous measures and the winding down of public R&D budgets. In order to intensify inter-governmental co-operation for planning and monitoring science and innovation policy, the Strategic Council for Science and Technology (SVEZNATE) and the National Innovation System Council of MSES (VNIS) were established in 2008, the former presided by the prime minister. However, they did not become operational.

A major initiative of the previous government was the reform of the science and higher education system, with the Law on Science, the Law on Universities and the Law on Higher Education. The main intention of the proposed laws was to strengthen the functional and financial integration of universities (which are fragmented into faculties with a high degree of local autonomy) by changing the current models of financing, election of staff and the granting of licences. They also aimed to merge Croatia's two national councils (for science and for higher education) into a single body nominated by the government rather than parliament. The new laws would have increased institutions' autonomy but also their accountability. The scientific community strongly opposed the proposed laws and the delegation of power from the state to the institutions and they were withdrawn when the new government took office.

In July 2012 the amended Law on the Croatian Science Foundation (CSF) was adopted. It transfers funding of scientific research from MSES to CSF. This will have a positive impact on the quality of scientific research in the long term, provided practices such as the evaluation of proposals by peers from abroad are implemented. In parallel to the institutional empowerment of CSF, the Croatian Institute of Technology (HIT) merged with BICRO, in an attempt to strengthen coordination at the level of implementation. Moreover, BICRO is set to merge with HAMAG-INVEST, a business funding agency, as of 2014[2].

EU membership opens many opportunities to Croatia. Eligibility for the Structural Funds (SF) and greater participation in the next Framework Programme (FP), Horizon 2020, can help to transform the research and innovation system through unprecedented amounts of funds and opportunities for world-class collaboration. The planning and implementation challenges to be addressed are of a similar magnitude: past experience from the FP suggests that Croatia can expect one call for proposals a week. An important planning challenge is to develop a smart specialisation strategy as a precondition for the use of SF. An even greater challenge is the efficient and timely absorption of SF. To help Croatia meet this challenge, the World Bank recently launched STP II, with funding of USD 20 million, to support Croatia in applying for and implementing EU-funded projects.

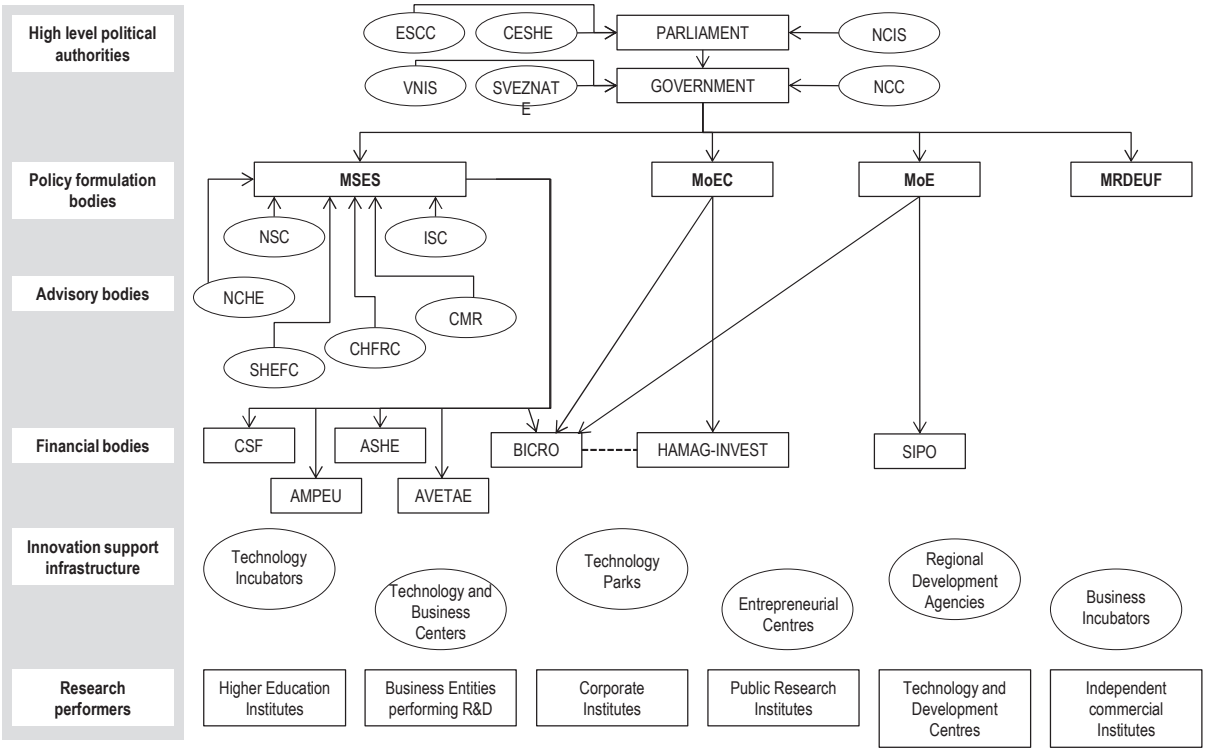
Over the long term the principal challenge will be to govern and manage the overall portfolio of EU instruments and develop and maintain a well-balanced national policy. It will be important to resist the temptation to use EU instruments and headline initiatives as substitutes for well-informed and well-articulated national planning that goes beyond the reach of these instruments.

4.2. The governance system: The main actors and their roles

Overview of the institutional configuration

The configuration of Croatian institutions in charge of governing STI shares many features with many other countries. As in many EU and OECD countries, higher levels of governance are in charge of orienting and programming policy. They include the parliament (in particular, the Parliamentary Committee for Education, Science and Culture in addition to the general body's say on changes in legislation) and four central government ministries: MSES, the Ministry of Economy (MoE), the Ministry of Entrepreneurship and Crafts (MoEC) (MoE and MoEC are the successors of MELE) and the Ministry of Regional Development and EU Funds (MRDEUF). This last ministry was established in anticipation of EU membership and motivated by an awareness of the opportunities and challenges arising from the implementation of Structural Funds across a wide array of ministries, agencies and beneficiaries. In addition, each ministry has a fairly distinct set of stakeholders. Lower-level implementation, monitoring and funding involve various intermediaries in the form of councils, committees and funding agencies, although some funding functions remain in the ministries (Figure 4.1). In common with comparable countries that have recently joined the EU, much of the institutional infrastructure for STI policy is relatively new – just over a decade old for most intermediaries – and in a state of flux.

Figure 4.1. The structure of the Croatian research and innovation system



Policy formulation bodies:
Ministry of Economy (MoE) Ministry of Science, Education and Sports (MSES) Ministry of Entrepreneurship and Crafts (MoEC) Ministry of Regional Development and EU Funds (MRDEUF)

High level political authorities:
Education, Science and Culture Committee (ESCC)
Committee for Ethics in Science and Higher Education(CESHE)
National Innovation System Council of MSES (VNIS)
Strategic Council for Science and Technology (SVEZNATE)
National Council for the Information Society (NCIS)
National Competitiveness Council (NCC)

Advisory bodies:
National Scientific Council (NSC)
International Scientific Council (ISC)
National Council for Higher Education (NCHE)
Science and Higher Education Funding Council (SHEFC)
Committee for the Hosting Foreign Researchers (CHFRC)
Committee for the Mobility of Researchers (CMR)

Financial bodies:
Croatian Science Foundation (CSF)
Agency for Science and HE (ASHE)
Business Innovation Centre of Croatia (BICRO)
Croatian Agency for Mobility and EU Programmes (AMPEU)
Agency Vocational Education and Training and Adult Education (AVETAE)
State Intellectual Property Office (SIPO)

Source: OECD based on ERAWATCH (2010a), "ERAWATCH Country Reports 2010: Croatia", European Commission, JRC-IPTS, erawatch.jrc.ec.europa.eu/erawatch/opencms/information/reports/country_rep/, p. 12, accessed June 2013.

The following section examines the characteristics, key activities and roles of the central government governance actors (MSES, MoE, MoEC, MRDEUF), the consultative and supervisory actors (councils), and the executive agencies (BICRO, CSF, the Agency for Science and Higher Education [ASHE], HAMAG-INVEST, the State Intellectual Property Organisation [SIPO]) with special reference to the extent and potential for interactions among them.

The central government

The Ministry of Science, Education and Sport

MSES is the government body most prominent in STI matters and is primarily responsible for programming, co-ordinating and monitoring science and education policies, in addition to its important role (although it shares some of the policy remit with the Ministry of Economy, see below) in shaping innovation policies. The part of its mission statement that relates to STI suggests that MSES exercises a high degree of control over the higher education and the public research sector. At the same time,

although MSES is the key orientation and programming ministry, as demonstrated by its role in drafting the 2006-10 policy agenda document (Republic of Croatia, 2006) and its role in the recent innovation strategy process, its mission does not explicitly include long-term planning or agenda setting. Moreover, some functions that appear to be an integral part of its mission have been delegated to agencies such as BICRO and CSF, but its mission does not specify any supervisory role. An indication of MSES' priorities is the absence of any explicit mention of support of innovation in the business sector, even though BICRO, the business innovation agency, fell under its exclusive remit until recently.

MSES' current situation is the result of its history and the challenges it has faced. Its scope for policy action has changed considerably over time and is partly reflected in its name. It began as the Ministry of Science, Technology and Informatics (1990-92) and evolved into the Ministry of Science and Technology (1992-2002) before obtaining its current title (in 2003). From 1990 to 2002, its focus was science and technology (and informatics for the first two years). From 2003 its mandate expanded to include education and sport; this coincided with a shift in rhetoric from technology to innovation. From 2006, the (former) Ministry of Economy, Labour and Entrepreneurship entered the field of innovation policy, its portfolio represented by the Ministry of Entrepreneurship and Crafts and the Ministry of Economy from 2011. In 2011, the Ministry of Regional Development and EU Funds also became active in the areas of skills and innovation. These changes took place against a background of rapid political change; MSES and its predecessors have had 13 ministers in 23 years. Such change is generally incompatible with planning, launching and implementing significant changes and creating sustainable impacts on the wider research system, especially if it is symptomatic of a weak political mandate and a lack of sufficient resources. It is therefore not surprising that planning has consisted mostly of incremental additions to the system and has stopped short of fundamental reform.

In parallel, MSES has seen increased institutional complexity, both internally and in the system of its stakeholders, some of which – notably BICRO (World Bank, 2012) and ASHE – have achieved more effective policy delivery. However, increases in complexity have also fostered inefficiencies and left room for functional consolidation and specialisation.

MSES is the leading funder of research in the public sector and covers the entire portfolio of science, education and sports. According to its Financial Department, its total budget in 2010 was EUR 1 571.6 million, or 9.8% (10.1% in 2009) of the state budget and 3.5% of GDP. The budget for R&D amounted to EUR 163.4 million in 2010 (1.02% of the state budget, 0.95% in 2009) (Švarc and Račić, 2012). Just under a third of MSES funding (according to Švarc and Račić, 2013) consists of institutional funding for public research-performing organisations (such as PRIs and HEIs), and about the same share is devoted to the rejuvenation and expansion of the research community through the Junior Researchers Programme. Most institutional funding goes towards the salaries of researchers. About a sixth of the total is spent on support programmes (including those administered by BICRO), co-financing of international projects, and research support overheads, such as assistance for publishing, conferences and association membership. Another sixth goes to support institutes of national interest. Only about 10% is used for competitive R&D project funding via the Z-Projects initiative.

The establishment of agencies has resulted in the delegation of an increasing number of MSES's responsibilities to an intermediary level between government and researchers. Among the most important of these agencies are: BICRO, which caters to support for business sector innovation; CSF, which caters to science, principally through the allocation of competitive funding; and ASHE, which caters to quality assurance in research and education, with a mandate to accredit universities and PRIs. Some of MSES's orientation and advisory functions for STI policy making have also been delegated to expert councils and committees.

MSES concluded its latest programming cycle in 2010 (Republic of Croatia, 2006); the drafting of a new planning document was delayed by the onset of the economic crisis and the uncertainty created by the changes of government in 2008, 2009 and 2011 and the protracted EU accession process. Important support measures for the purchase of research equipment and for the commercialisation of research, such as the Science and Innovation Investment Fund (SIIF) and the Unity through Knowledge Fund, were discontinued or interrupted. A new World Bank loan granted in May 2013 for STP II is now helping re-introduce some of these schemes. Following evaluation, about 10% of publicly funded projects were terminated and funding was reduced for over half of all projects. Budget reductions also threatened the training of young researchers, as scholarships were temporarily abolished and opportunities for their career progression reduced (Švarc and Račić, 2013). A major concern of MSES in recent years has been the process of reform in the public research system in general and HEIs in particular. An important part of this process stalled when the proposed Law on Science, Law on Universities and Law on Higher Education were withdrawn. A new effort is under way, but has backtracked from the original ambition to consolidate management in the four old universities (see section 3.2.5 in Chapter 3).

The Ministry of Economy

While MSES has been the principal actor for research and innovation policy, both in its own right and through ASHE, CSF and BICRO, other ministries have also become important stakeholders in research and innovation policy. Overall, their entry has completed the policy portfolio, mainly by expanding the remit of innovation policy (which had been closely linked to public research) and by catering to a wider range of target groups, notably the business sector.

The MoE's policy scope covers economic development, competitiveness, industrial policy, energy policy, public procurement, the implementation of directives, standards and regulations for the EU internal market, and intellectual and industrial property rights (MoE, 2013). Innovation is also an explicit part of its mandate, both as a current policy concern and as a potential dimension of many of its other activities: For instance, the creative use of public procurement (see section 4.3.3), coupled with the mobilisation of international resources in the field of energy, present useful opportunities for stimulating innovation. The use of standards and regulation (see section 4.3.2 and Table 4.10) as a vehicle for innovation is another promising area for innovation policy development (EC, 2012a; Stewart, 2010; Blind, 2012).

The MoE (and its predecessor, MELE) have been quite active in developing and launching strategies and plans. Since 2010, they have (co-)launched at least 20 strategies, programmes and plans (Table 4.1). The innovation strategy and the cluster programmes are co-owned with other ministries, in particular MoEC and MSES.

Table 4.1. Policies, strategies, programmes, and actions plans launched by the Ministry of Economy or its predecessors since 2010

	Field of strategy or action plan	Collaborating ministry	Year of launch
1.	Women entrepreneurship development strategy in the Republic of Croatia 2010-13		2010
2.	Action plan for the implementation of the strategy female entrepreneurship 2010-13		2010
3.	Entrepreneurial learning strategy 2010-14		2010
4.	Operational plan, encouraging SME for 2011		2011
5.	Cluster development strategy in the Republic of Croatia 2011-20		2011
6.	Innovation strategy	MSES, MoEC	(in preparation)
7.	Economic development strategy		2012
8.	Energy development strategy		2012
9.	Investment promotion strategy		2012
10.	Industrial development strategy		(in preparation)
11.	Development strategy for food processing industry	MoEC	2012
12.	Development strategy for wood processing industry	MoEC	2012
13.	Development strategy for metal processing and production industry	MoEC	2012
14.	Development strategy for creative industry	MoEC	2012
15.	Development strategy for ICT industry	MoEC	2012
16.	Development strategy for defence industry	MoEC	2012
17.	Development strategy for textile industry	MoEC	2012
18.	Development strategy for building and construction industry	MoEC	2012
19.	Development strategy for pharmaceutical industry	MoEC	2012
20.	Smart specialisation strategy		2013

Source: Ministry of Economy.

The large number of strategies and plans led by MoE is indicative of a broad agenda serving a wide range of stakeholders. MoE is particularly active in developing sectoral policies and criteria for cluster formation in collaboration with MoEC.[3] Alignment with policies that are popular among EU members appears to be well advanced both in terms of themes (smart specialisation, clusters, entrepreneurship) and policy approaches and instruments (industrial policy, competitiveness, operational plans). The extent of inter-ministerial collaboration appears mostly confined to MoEC (MoE and MoEC were formerly parts of MELE). More extensive coordination would be in keeping with MoE's central place in economic policy.

The Ministry of Entrepreneurship and Crafts

MoEC's stakeholders are similar to those of MoE, focusing on SMEs and the drafting of concrete support measures. MoEC is in charge of a wide range of issues ranging from entrepreneurship, trade and foreign direct investment (FDI), to competitiveness, balanced regional development and innovation (MoEC, 2013).

Institutions such as regional development agencies and business centres initiated by local governments and MELE are now under MoEC. It was estimated that Croatia has 27 regional development agencies, 44 entrepreneurial centres, 23 business incubators (most

attached to regional development agencies) and 8 technology parks, including those of the Technology Infrastructure Programme (TEHCRO) (WBC-INCO.NET, 2011).

The Ministry of Regional Development and EU Funds

MRDEUF was founded to meet the challenges of effective and efficient absorption of the Structural Funds. In addition to its responsibility for EU funds, it is in charge of regional development and sustainable development of the Adriatic Sea islands and coastal areas. In this dual role MRDEUF has the opportunity to act as a showcase for aligning policies and related programmes and actions. MRDEUF's portfolio includes the full range of programming, funding and implementation functions relating to EU funds (Table 4.2).

Table 4.2. Portfolio of the Ministry of Regional Development and EU funds

	Planning	Implementation	Coordination	Policy intelligence
1. Planning and implementing of regional development policy and establishment of an integrated system for planning, programming, management and financing of regional development	x	x		x
2. Co-ordination of participants and of planning, programming, implementation, monitoring and evaluation of the annual and perennial regional development programmes and projects			x	x
3. Preparation of priorities and annual and perennial strategic and operational documents for the use of EU funds and other international sources of funding for regional development initiatives	x			
4. Co-ordination and management of interdepartmental working groups concerning the regional development and co-ordination of all activities for harmonisation with EU in the field of regional policy and structural instruments management			x	
5. Co-ordination of activities to ensure effective co-ordination with the units of local/regional self-government and with other stakeholders in drafting, organisation and implementation of regional development programmes and projects			x	
6. Sustainable development of the Adriatic Sea, islands and coastal areas; development of policy proposals and establishment of an integral system of planning, programming, management and financing the development of islands and coastal areas; planning, drafting and implementation of strategic documents and projects for the development of transport, utility and social infrastructure on the islands and in the coastal areas; commencement, co-ordination and supervision of activities pursuant to legislation that regulates the development of islands and coastal areas	x	x	x	x

Source: Adapted from www.mrrfeu.hr/default.aspx?id=866.

Croatia has become eligible for the full range of Structural Funds upon EU membership in 2013 and has already benefited from the Instrument for Pre-accession Assistance (IPA). The European Funds managed by MRDEUF cover a wide range (MRDEUF, 2013): institution building, transport, environmental protection, regional competitiveness, agriculture and rural development, and cross-border co-operation. Examples of MRDEUF's contributions include the preparation of a project pipeline and setting up the inter-ministerial thematic working groups to decide on priorities for the SF.

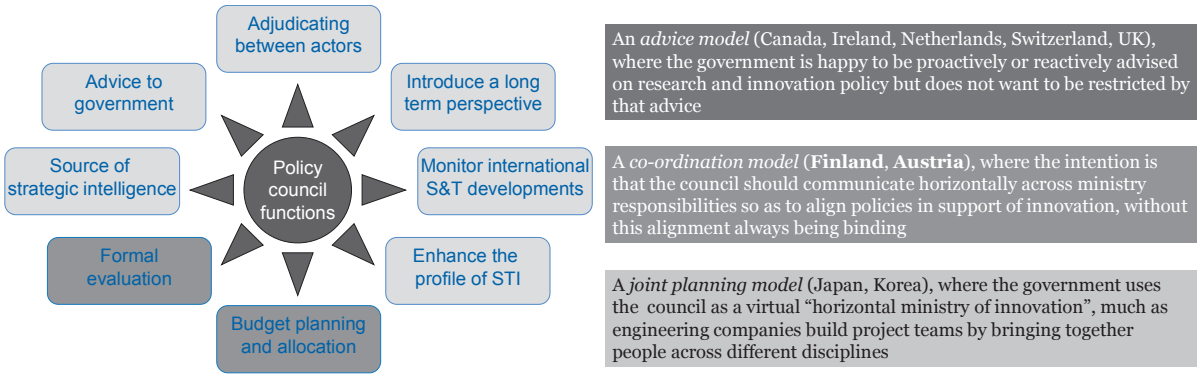
MRDEUF already has experience in planning, co-ordination and application of policy intelligence. While this experience and these capacities can be redeployed for the SF, staffing needs for implementation - including the required coordination with other ministries - will be at least an order of magnitude greater and will pose real challenges for

effective absorption. It is therefore critical to address this issue in time, both within MRDEUF and in the regions and to explore scope for collaboration with implementation agencies in the research and innovation policy area (BICRO, CSF, HAMAG-INVEST).

The councils

The last decade has seen a delegation of policy functions to operationally independent units. While ministries have maintained control over programming decisions, there has been a drive to delegate a considerable share of implementation to agencies and to give councils and committees an increasing say in orientation, long-term planning, co-ordination and monitoring. Such delegation is common in other countries and is motivated in part by the need to professionalise the delivery of these functions and foster learning. In the case of the councils, further reasons include the need to foster inter-ministerial co-ordination, to take a long-term outlook and strategic approach, and to strengthen high-level monitoring of and commitment to research and innovation. Councils can also serve as aggregators of the viewpoints and interests of various stakeholders and can play a crucial role in mediating between principals (society, represented by the government in its various forms) and agents (scientists and other knowledge workers). This can lead to a better-accepted form of governance than command-and-control steering (Rip and van der Meulen, 1996). The functions and types of councils vary among countries in response to national conditions (Figure 4.2).

Figure 4.2. Functions and types of high-level STI policy councils



Source:OECD (2012c), *OECD Science, Technology and Industry Outlook 2012*, OECD Publishing, doi: 10.1787/sti_outlook-2012-en.

The *National Council for Science (NCS)* is a strategic advisory body established in 1994 to develop and maintain overall scientific quality in Croatia. It has a wide range of functions (Table 4.3).

Table 4.3. The tasks of the National Council for Science

Task	Advice	Operation	Decision making
Discusses issues important for improving scientific activity in Croatia	x		
Monitors and evaluates the quality of scientific organisations		x	
Proposes budgets for scientific activities	x		
Organises the evaluation of scientific projects and programmes		x	
Submits annual budget proposals for science and higher education to the government	x		
Determines scientific fields, areas and discipline, as well as interdisciplinary fields of science and arts			x
Determines detailed requirements for appointment to science ranks			x
Determines detailed requirements for attaining authority to conduct a procedure for appointment to science ranks			x
Appoints the members of its own scientific field councils, art councils and peer review groups for scientific evaluation projects			x
Proposes the proclamation of the scientific centres of excellence and monitors their quality	x	x	
Provides its opinion on establishing technology and science parks.	x		

Source: www.nvz.hr/index.php?option=com_content&view=article&id=114&Itemid=27.

The tasks of the NCS are a mixture of standard research council tasks (classification of scientific fields, requirements for appointment to science ranks), advisory tasks (on budgets or on investments such as science parks) and more operative tasks (monitoring and evaluating scientific organisations, evaluation of scientific projects and programmes). Some of its tasks throw light on some perceived problems in the wider innovation system. For example it provides its opinion on establishing technology and science parks. The NCS does not have own operative capacity. Instead, it relies on the expertise of the six scientific and arts councils (natural science, technical, biomedical, bio-technical, social sciences, humanities) and the 22 scientific field committees. ASHE serves as a base for its operations.

The *National Council for Higher Education (NCHE)* is an expert advisory body established in 2004 and is responsible for the development and quality of higher education. It examines the evaluations of HEIs and their study programmes and provides a platform for networking the public HEIs. Its operations are carried out in co-operation with ASHE. NCHE submits, in co-ordination with the NCS, annual proposals on the allocation of budget resources for science and higher education to the Croatian government. To help in this task, the *Science and Higher Education Funding Council (SHEFC)* was established in 2005 to provide the councils with expertise and professional assistance. Its task is to develop the criteria for public funding for higher education and research which still poses important challenges.

The *Committee for Ethics in Science and Higher Education (CESHE)* was included in the Law on Scientific Activity and Higher Education 2003. Its nine members are proposed by the NCS and the NCHE. Its objective is to promote ethical principles and values in science and higher education, in relation with social stakeholders, as regards the application of technologies and the protection of the environment.

The *Strategic Council for Science and Technology (SVEZNATE)*, founded in 2008, is a high-level government body, responsible for co-ordinating and harmonising the government's efforts on science and technology development and is presided by the

prime minister. While SVEZNATE has been established, it is not operational. This is particularly unfortunate, because high level councils, chaired by the head of government, have been instrumental in raising the profile of innovation policy in other countries, and raising the profile of innovation policy within government is a key obstacle to the development of the Croatian innovation system.

The *National Innovation System Council (VNIS)* was founded in 2008 and is a high-level government body responsible for the development of the Croatian innovation system. Like the SVEZNATE, it has been established but is not operational.

The *Education, Science and Culture Committee (ESCC)* is appointed by parliament. It monitors the implementation of policies that are under the authority of MSES: pre-school education; primary, secondary and higher education; science culture and technical culture; international scientific and technical and technological co-operation; protection and use of cultural resources, historical materials and heritage; archives and archival materials, and the commemoration of historical events and persons; co-operation with religious communities; information technology; and other matters of education, science and culture.

After the parliamentary election in December 2011, the new minister of science, education and sports named the *International Scientific Council (ISC)* in January 2012. It consists of three prominent scientists from abroad whose main task is to provide advice and technical assistance to improve the efficiency of the science and higher education system.

The *Committee for the Hosting of Foreign Researchers in Croatia (CHFRC)* was established in 2009. Its purpose is to facilitate the hosting of foreign researchers participating in research projects in Croatia. The Code of Procedures for the Approval of Temporary Stay permits foreign researchers to work in private and public research and education institutions without a work permit. Moreover, to strengthen co-operation of Croatian researchers with their international peers, the *Committee for the Mobility of Researchers (CMR)* was also established in 2009 and prepared the action plan for researcher mobility (Švarc and Račić, 2012).

The *National Competitiveness Council (NCC)* was established in 2002 to improve Croatia's competitiveness and prepare its entry into the EU. It is an independent advisory body with 26 members and includes representatives of the government, business and academic sectors, and trade unions. Its recommendations have covered a wide array of policy issues, including education, market regulation, cost competitiveness, innovation, development of SMEs and regional development.

The *National Council for the Information Society (NCIS)* provides advice on proposed strategic and policy documents, laws and projects relating to the information society and also initiates and co-ordinates the activities of various stakeholders. The council has 14 members, with representatives from government, civil society, academia and the business sector.

Other policy advice mechanisms include the hiring of national and international experts either directly or by setting up *ad hoc* advisory groups or task forces of experts and scientists to assist in the drafting of policy documents; the expert advice provided through EU- and World Bank-funded projects; and the participation of middle-management policy makers in international policy discussion forums (e.g. EU, OECD, UNESCO-based working groups) (Švarc and Račić, 2012).

The agencies

The most significant expression of the central government's broader process of delegation of policy functions is the delegation of part of programming and especially implementation to specialised agencies. This process of "agencification", inspired by the "new public management" model, has been carried out in many OECD countries over the past three decades. Overall, despite some downsides, the ensuing reorganisation has had a positive impact on performance (OECD, 2010, Chapter 4). Operationally independent implementation agencies improve policy effectiveness by employing professionals who combine experience in specific funding and other financing instruments (including co-funding and the leveraging of complex financial instruments) with an understanding of the needs of target groups. By virtue of their independence, they can be shielded from occasional political interference in operational decisions and may be better able to maintain the long-term outlook. Independent agencies can also help overcome problems arising from ministerial compartmentalisation and seek synergies across issues that span portfolio boundaries.

The Business Innovation Centre of Croatia

BICRO was established by the Croatian government in 1998 as a public limited liability company to support innovation in the business sector. It is the most visible outcome of Croatia's first comprehensive research and innovation policy programme, the National Scientific and Research Programme 1996-98 and it was the first operationally independent agency to be entrusted with the implementation of research and innovation policy. At its inception its mission and approach to the support of industry were influenced by collaboration with the Business Innovation Centre Friuli-Venezia Giulia in Italy. BICRO developed the current range of its activities thanks to funding from the World Bank STP (2005-11). In addition to its operational independence in terms of implementation, BICRO has considerable discretion for parts of programming, specifically the design of instruments. Over time it has experimented with and accumulated significant experience with various support instruments (Table 4.4).

BICRO places strong emphasis on the commercialisation of science and the support of technology-based start-ups. As a result, its efforts have focused on the interface of public research and the business sector with a view to greater collaboration between these sectors and the commercialisation of public research. This focus is evident in the overall balance between types of instruments employed and their relative funding shares, i.e. the dominance of incubators and technology transfer, mainly from public research and higher education to the private sector, with a focus on promising technological areas such as the life sciences, nanotechnology and information and communication technology (ICT).

Table 4.4. BICRO programmes

Programme	Description	Status
Development of knowledge-based firms, academic spin-offs (RAZUM)	RAZUM aims at the development of new technology-based firms and academic entrepreneurship. It provides support for the commercialisation of products and services whose market value is primarily based on the results of R&D. It provides funding to start-ups or established SMEs that undertake applied research leading to new or improved products or services. Subsidies are only available for projects at the pre-commercial stage. Projects that already include investment in manufacturing or service facilities are evaluated by RAZUM, but can only be financed by the Croatian Bank for Reconstruction and Development. Over 2007-10, 31 projects were approved and 22 were contracted, and six commercial projects were directed to the Croatian Bank for Reconstruction and Development.	Started in 2007
Technology infrastructure programme (TEHCRO)	TEHCRO provides financial support to establish organisations that provide facilities, advisory services, and overall support to technology transfer and commercialisation of research results. It provides support to establish technology transfer centres, business incubators and R&D centres. This includes: setting up specialised technology incubators for life sciences, including nanotechnology and information and communications technology (ICT); setting up technology transfer centres; providing equipment for the aquaculture R&D centre founded by the University of Dubrovnik and co-financed by the International Bank for Reconstruction and Development. Applicants to TEHCRO are consortia that must include a public body (e.g. a regional development agency) and an R&D partner (public or private). Other private partners may also be included. Subsidies provided through TEHCRO may last up to five years. The company is then expected to become self-sufficient. The projects are: • Technology Park Varaždin Ltd. • Science and Technology Park of the University of Rijeka Ltd. (STeP Ri) • Technology and Business Innovation Centre for mariculture MARIBIC d.o.o. in Dubrovnik • Industrial Park Nova Gradiška Ltd. • Regional Development Agency Međimurje REDEA Ltd. • TERA Tehnopolis Ltd. in Osijek	Started in 2007
Venture capital industry (VENCRO)	This programme is not fully operational owing to a lack of financial resources and interest from potential private partners.	Started in 2008
R&D services for companies (IRCRO)	It aims at encouraging SMEs to establish R&D activities. It intends in particular to encourage and stimulate demand for the services of HEI/PRIs. Projects under IRCRO involve co-operation between industrial firms and HEI/PRIs and are jointly funded by IRCRO and the company using a 50/50 matching grant scheme.	Started in 2007
Business competitiveness upgrading programme (KONCRO)	Provides support to high-technology SMEs that want to hire consultants in order to acquire technology and management competences, develop new products and processes, enhance productivity and quality or invest in environmental protection. Applicants are obliged to hire consultants that have been pre-approved by BICRO.	Closed in 2010
Proof of Concept programme (PoC)	Aims to ensure pre-commercial capital for technical and commercial testing of innovation concepts. The activities eligible for funding (max. EUR 47 000) include: protection of intellectual property, demonstration of feasibility, development of prototype. Funds can also be used for market analysis, business planning, concept/strategy development. PoC was introduced in 2010 and is implemented with the help of first 11 and later 17 recognised centres that provide support for the preparation of project applications. A total of four calls have been launched so far, with the number of applications growing each time. In 2010, a total of 284 pre-applications and 159 full applications were received, of which a total of 46 were approved and funded. In 2011, 33 projects were approved. During the fourth call (published in 2012), a total of 241 project applications were received, for almost EUR 8 million, with private-sector participation of an additional EUR 4 million. Overall, the requested amount was around 12 times higher than the total programme budget.	Started in 2007
EUREKA	EUREKA is a European network that supports businesses performing close-to-market R&D projects. Croatia has been involved in EUREKA as a full member as of 23 June 2000. In February 2009 MSES transferred operative implementation of EUREKA programme to BICRO. Since then BICRO became the National EUREKA Office for Croatia, responsible body for the whole implementation including financial management and contracting.	Started in 2010

.../...,

Table 4.4. BICRO programmes *(continued)*

Programme	Description	Status
Eurostars	Eurostars Programme is a European Joint Programme dedicated to the R&D performing SMEs, and co-funded by the European Union and 33 EUREKA member countries. Eurostars aims to stimulate these SMEs to lead international collaborative research and innovation projects by easing access to support and funding. It is fine-tuned to focus on the needs of SMEs, and specifically targets the development of new products, processes and services and the access to transnational and international markets.	Started in 2011
Enterprise Europe Network (EEN)	BICRO is one of seven Croatian members of EEN. BICRO is the co-ordinator of technology transfer, innovation and joint research activities.	Started in 2009
Technology projects programme (TEST)	TEST, operated by the former *Croatian Institute of Technology* provides funding for pre-commercial research to develop new technologies (products/ processes/ services) through the development of original solutions (prototypes/pilots), as well as research linking basic science and its technological application to the development of industry sectors. During 2001-09 EUR 6.3 million was spent for the TEST programme.	2007-2012
National technology foresight platform and business intelligence system	HIT was also in charge of developing the national technology foresight platform and business intelligence system, and was supposed to take over the consolidation of the administrative structure of the national focal points of the EU Framework Research and Technology Development Programmes from MSES.	

Source: BICRO (2009, 2010, 2011), Annual Reports, www.bicro.hr/en/; Švarc and Račić (2012), "ERAWATCH Country Report 2011: Croatia", European Commission, Brussels.

BICRO manages half a dozen programmes which have been introduced during the last five years (Table 4.5). Over this period it has evaluated 455 pre-applications and 219 applications and funds 160 projects (89 if Proof of Concept is not included). Some programmes are oversubscribed, particularly Proof of Concept (332%), RAZUM (345%) and EUREKA (375%), mainly owing to limited resources for funding. Given the scale of resources and the number of projects involved, BICRO has so far nurtured a small sector, essentially hedging its bets on a few contenders, each of which has an uncertain probability of successful employment creation and long-term sustainability. This approach can be useful for capturing serendipitous and radical ideas and has a non-negligible probability of a reasonably strong economic impact if pursued vigorously over a sufficiently long period. However it cannot be the main basis of support for business-sector innovation as a whole. Addressing a much larger part of the business sector would inevitably involve nurturing the accumulation of a wide range of in-house innovation capabilities in firms, including in R&D, but also in engineering, design, IT and marketing (Bell, 2009), which would require a much wider range of policy instruments and a different approach and mindset. The BIOCentre project (funded under the Regional Competitiveness Operational Programme 2007-2011) is somewhat of an exception within BICRO's portfolio, in terms of the wide range of services offered, though the focus on the research-intensive end of the spectrum of possible innovation modes is evident there too.

Nevertheless, within the rather narrow focus of its past activities, BICRO has already achieved some notable results in terms of new products and processes, IPR generation[4] and support of knowledge-intensive employment (BICRO, 2011). Moreover, BICRO appears well respected, especially by the business sector.

Table 4.5. BICRO programmes and total funding

	Number of pre-applications	Number of applications	Number of projects	Over-subscription	Contracted funds EUR
PoC	364	236	71	332%	1 638 587
RAZUM	154	76	22	345%	13 977 380
IRCRO		61	22	277%	2 020 127
EUREKA		30	8	375%	1 075 253
TEHCRO		19	14	136%	9 333 580
KONCRO		32	22	145%	155 539
BIOCENTRE (IPA IIIc)		1	1		16 376 410
Total		455	160		44 421 337
Total national					28 044 927

Source: BICRO (2009, 2010, 2011), Annual Reports, www.bicro.hr/en/.

BICRO's mandate and operational scope expanded in 2012 when it absorbed the former Croatian Institute of Technology. HIT had been established primarily to create the pre-conditions for accelerated application of new knowledge and technologies by providing services, expertise and project funding. The merger of HIT with BICRO was motivated by concerns over the efficient absorption of EU funds and possible overlap of responsibilities for innovation and policy measures.

BICRO – just as the general innovation policy debate in Croatia – considered the binding constraint on the development of the innovation system to be the weak interface between science and industry. The contrast between perceptions of a strong science base and the evident absence of strong economic impact may have contributed to the emergence of this view. As indicated in Chapter 2, however, Croatia's performance in science actually trails that of comparable countries. Crucially, as shown in Chapter 3, various dimensions of business-sector innovation activity and capacities are also weak. Therefore, the balance of available evidence – the quantity and quality of scientific output, the lack of requisite skills in the business sector and the weak commitment of businesses to R&D and other knowledge-intensive activities –supports the view that the binding constraint is not at the interface but at the core of public-sector and, especially, business-sector innovation capacities.

In any case, international experience (see section 3.1, especially discussion around Table 3.9 and references therein) demonstrates that among the possible types of economically useful innovation, the science-driven variety has been dominant in only a few places and only some of the time. Even in advanced innovation systems, companies that innovate tend to do so on their own. When they collaborate they tend to do so primarily with other companies rather than HEIs or PRIs, and when they collaborate with HEIs or PRIs they tend to do so on their own initiative.[5] Therefore, even under optimal conditions, overemphasis on a "science-push" model, while potentially useful for a small part of the business sector, would not reach the majority of firms.

BICRO's current portfolio caters to new-to-the-world innovators. It offers little that is likely to encourage non-innovators and new-to-the-firm or new-to-the-country innovators to upgrade capacities, develop activities and change innovation behaviour. From an international perspective, BICRO's relatively meagre resources are striking given the task it performs. BICRO's annual statements emphasise the design of instruments tailored to condition incentives and leverage additional funding and focuses on a few issues identified as priorities. This seems a sensible response.

Despite its focus on the interface with science rather than the core of business innovation capacities, its pronounced resource constraints and their temporary deterioration, and the well-documented inflexibilities of HEIs and PRIs, BICRO's performance is positive and is a credit to the competence and dedication of its staff. In moving BICRO's agenda closer to that of a fully-fledged innovation agency, it would be useful to consider ways to cater to the needs of the majority of Croatian firms, including large ones, by rebalancing its objectives and delivery instruments (see section 4.3.1, especially the parts 'Direct and fiscal support for business-sector innovation' and 'Funding skill development'). Recent developments, including the merger with HAMAG-INVEST and the joint supervision of the enlarged BICRO by MSES, MoE and MoEC seem compatible with the direction proposed.

Croatian Agency for SMEs and investment (HAMAG-INVEST)

HAMAG-INVEST draws on a network of certified consultants to provide support to SMEs through financial incentives and business advisory services. Originally, HAMAG-INVEST was the agency for credit guarantee schemes, while MELE implemented non-financial measures directly. In 2007, HAMAG-INVEST began to take over some MELE programmes that dealt with the improvement of business support infrastructure, such as business centres, regional development agencies, entrepreneurship of target groups (youth, start-ups, disabled persons), and support for student co-operatives and student enterprises.

HAMAG-INVEST is in charge of public guarantee funds and grants guarantees for loans by commercial banks and other creditors that focus on financing fixed assets and working capital. Its grant capital is EUR 65 million. It encourages small business creation, growth and investments, provides loans, issues guarantees for small business loans, and provides financial support to reduce the cost of loans. It also supports high-growth, export-oriented businesses ("gazelles"), subsidises participation in international fairs and exhibitions, marketing, certification, introduction of new technologies and protection of intellectual property, and develops women and youth entrepreneurship. Finally, it has developed an accreditation system for trainers and has started a project for the Accreditation of Business Consultants, based upon regular participation by Croatian consultants in tailored training programmes for business service providers.

HAMAG-INVEST and BICRO both address SMEs, but do not appear to have co-ordinated their activities in the past and seem to have rather different cultures. However, there are a number of possible synergies, including the design of financial instruments tailored to the needs of innovating companies and the exchange of experience about their common target groups. For example, they might set up a one-stop clearinghouse for clients and possibly a learning platform. The creation of clusters, and even more, the planning of operational programmes for the EU Structural Funds would be an ideal point of departure. HAMAG-INVEST's experience in leveraging complex financial instruments may help address certain aspects of BICRO's underfunding. The merger of BICRO and HAMAG-INVEST in 2014 will be an important step in the direction of supporting the accumulation of innovation capacities in a greater number and variety of firms as well as supporting a greater variety of modes and types of innovation.

The Croatian Science Foundation

The CSF was established in 2001 and currently has 11 staff. Its mission is "to promote science, higher education and technological development in Croatia in order to ensure the development of [the] economy and to support employment" (CSF, undated).

There is no doubt that science should remain relevant to social and economic concerns. However, the emphasis on economic impact in the mission of the main science policy implementation agency seems too strong, especially in a short to medium-term context. In OECD countries, especially those with strong innovation systems, such organisations[6] typically aim, above all, to foster scientific rigour and a culture of constructive scepticism. This is generally achieved by encouraging within-country competition and international collaboration, dimensions apparently lacking so far in the Croatian innovation system. Of course, this should not stop CSF from seriously considering ways to strengthen the economic and social relevance of the high-quality research it funds.

As Table 4.6 indicates, CSF has launched almost two dozen programmes since its inception, only a few of which are still active. The suspended or terminated programmes and funding schemes generally ran for only a few years. Among those suspended in 2010 and 2011, lack of funds appears to be a more common cause of suspension than a change in priorities or their perceived (lack of) success.

Table 4.6. Programmes of the Croatian Science Foundation

Programme	Description	Status
PROGRAMMES		
Research Projects	The basic aim is to create new or enhance existing knowledge. The main support instrument for international co-operation but also for developing and promoting Croatia's strategic priorities. Support for research groups working on internationally competitive issues, whose leaders have been recognised for their scientific achievements. The ultimate goal is to create a critical mass of research groups, competitive on the international level. Criteria: Proposal must fit the priorities of CSF. Internationally competitive issues. Coherence of project proposals with the strategy of the applicant institution. Project leader must be an active researcher with internationally recognised achievements, employed at the institution at which the project is to be carried out, permanently or during the project period.	On-going
Collaborative Research Programmes	Carried out by universities, faculties or public institutes and involving a number of content-related research projects – minimum of three groups of which at least two from different legal entities. The programme has to be approved by the Senate or Academic Council of the scientific institutions and comply with the priorities of the home institution. Project leader has to be an internationally recognised, qualified and productive researcher. The ultimate goal is to encourage the development and strengthen co-operation by research groups to create internationally competitive programmes and provide conditions for centres of excellence. Criteria: Proposal must fit one of the themes of the call and the strategy of the institutions. Programme leader and research group leaders must hold a doctoral degree, be active researchers employed at the Croatian research institution that submits or carries out the programme. Institution must provide support (adequate space, infrastructure, equipment).	On-going
HIGHER EDUCATION REFORM		
Learning Outcomes-Based Higher Education	To encourage Croatian educational institutions to develop institutional strategies for the introduction of learning outcomes; adjust regulation and development of institutional guidelines for the definition of learning outcomes; train teachers and academic staff, reform programmes of study and disseminate experiences and good practices.	Closed in 2008
Integrated University And Integrated Tertiary Education System	To study organisational and legal models of integration of universities and tertiary education as a model for the effective use of human resources, jobs, promotion and realisation of labour rights.	Closed in 2006

…/…

Table 4.6. Programmes of the Croatian Science Foundation *(continued)*

Programme	Description	Status
Development of Institutional Quality Assurance Units	To support the establishment of quality assurance units, the spreading of the culture of quality in the academic and non-academic society and collaboration between the institutions	Closed in 2007
Development of Joint Studies	To support the development of joint studies and joint degrees and co-operation among universities, particularly with universities in the European Union, to develop programmes of study, research and development of human resources.	Closed in 2005
Development of PhD Programmes	To support the development of doctoral studies in the tertiary cycle of higher education, and to encourage co-operation between universities, to co-operate with the public and private sectors to build doctoral programmes.	Closed in 2004
BRAIN GAIN		
Homing Programme	To enable research activities in Croatia for researchers who have built an independent research career abroad.	Closed in 2008
Postdoc	To improve the professional competencies of young researchers holding a PhD and to support their early scientific independence.	Closed in 2011
Visitor	To enable researchers from abroad to carry out research projects in Croatia.	Closed in 2009
Senior	To provide employment for researchers from abroad, enable them to carry out research projects and train young researchers at Croatian universities and institutes.	Closed in 2009
HRZZ Installation Grant	To help scientists with two to five years of postdoctoral experience to set up their research in Croatia and rapidly establish a reputation in the European scientific community.	Closed in 2011
TRAINING OF DOCTORAL STUDENTS		
National Training Courses and Summer Schools for Doctoral Students	To improve the quality of doctoral studies via training courses and summer schools.	Closed in 2010
Fellowships for Doctoral Students	To improve the research standards and quality of doctoral studies and to promote international mobility of young researchers during their doctoral studies.	Closed in 2011
Partnership in Research	To improve co-operation between research institutions, industry and entrepreneurship and increase budgetary investments in research.	Closed in 2010
INTERNATIONAL PROGRAMMES		
Support for Joining European Science Foundation programmes	To integrate Croatian scientists into the European Research Area via scientific and EUROCORES programmes of the European Science Foundation (ESF).	
EMBO Installation Grant	To help leading life scientists to set up labs in Croatia and rapidly establish a reputation in the European scientific community.	Closed in 2010
European Social Survey	Facilitate the involvement of Croatian scientists in European social research in order to gain better insight into social change in Croatia and facilitate comparison with other European countries.	Closed in 2010
International Collaborative Workshops	To foster and strengthen co-operation between Croatian and foreign research groups in preparation for joint projects and research co-operation.	Closed in 2009
AWARDS		
Science Award	To recognise, reward and promote scientific research in undergraduate and graduate courses. Tender is invited in September each year.	On-going
Science Award Sculpture Solutions	Awarding sculpture solutions to students and alumni from the Academy of Arts of the University of Osijek, the Academy of Applied Arts in Rijeka, the Art Academy in Split and the Academy of Fine Arts, University of Zagreb.	Closed in 2009
SOCIOCULTURAL TRANSITION FROM INDUSTRIAL INTO THE KNOWLEDGE BASED SOCIETY		
Development of Croatian Professional Terminology	To foster the development, systematisation and unification of Croatian professional terminology, to organise terminology workshops and educate experts to take care of Croatian terminology.	Closed in 2011

Source: www.hrzz.hr/index.php?option=com_content&view=article&id=3&Itemid=7&lang=en.

Many of the terminated programmes were devoted to specific higher education issues such as implementation of quality assurance systems, development of joint studies or of PhD programmes and training of doctoral students, mobility schemes (with a focus on "brain gain"), summer schools, scientific workshops, links to international programmes such as the European Science Foundation (ESF) and EMBO, and participation in the European Social Survey.

Given the status of the Croatian innovation system, much of CSF's effort so far has had to deal with "system failures" as regards systematic internal quality assurance, training of young researchers, and use of international programmes and research infrastructures. At the same time, owing to the number and diversity of these failures and its limited budget, CSF's responses have been less than comprehensive. It has supported participation in EMBO and ESS but not other supra-national research infrastructures. Likewise, it has supported ESF and EUROCORES but not participation in the FP. The suspension of initiatives for young researchers contrasts with the practice of the increasing number of European countries that are putting doctoral schools in place and attempting to expand their capacity (European University Association, 2005).

A cursory overview of the funding allocated to the programmes over their duration highlights the small numbers of projects and volumes of funding, less than EUR 10 million over a period of about a decade (Table 4.7). In recent times, CSF has undergone a streamlining of its portfolio of activities and has only a small number of funding schemes.

Table 4.7. Total funding provided by the Croatian Science Foundation

Programme	No. of projects	Allocated funds EUR
Research Projects	9	1 089 117
Collaborative Research Programmes	4	744 598
Learning Outcomes-Based Higher Education	6	156 963
Integrated University and Integrated Tertiary Education System	1	39 521
Development of Institutional Quality Assurance Units	8	188 320
Development of Joint Studies	4	107 358
Development of PhD Programmes	9	183 476
Homing Programme	6	547 453
Postdoc	76	785 336
Visitor	11	370 769
Senior	3	224 250
HRZZ Installation Grant	12	1 434 943
National Training Courses and Summer Schools for Doctoral Students	11	135 958
Fellowships for Doctoral Students	129	732 178
Partnership in research	19	1 771 090
Support for Joining European Science Foundation Programmes	1	435 490
EMBO Installation Grant	2	300 000
European Social Survey	1	38 994
International Collaborative Workshops	16	176 500
Science Award	15	27 665
Science Award Sculpture Solutions	4	2 635
Development of Croatian Professional Terminology	1+27	26 347+217 485
Total		9 736 446

Source: www.hrzz.hr/index.php?option=com_content&view=article&id=3&Itemid=7&lang=en.

In 2012, the MSES shifted its Z-Projects funding scheme to the CSF following the Law amending the Law on National Science. This is an important step towards integration of science programming and implementation in a single specialised organisation. However, even the Z-Projects scheme is too small to rebalance overall public research in the direction of competitive funding. Resource constraints therefore appear to be the main binding constraint for realising the potential of CSF.

More broadly, the Croatian science system needs to move beyond ASHE's "bare minimum" criteria for accreditation and other *ex post* quality assurance processes towards the proactive pursuit of excellence. CSF will be crucial for bringing about a major shift in the balance of HEI/PRI funding towards competitive funding and for supporting a concerted, system-wide drive to internationalise. The success of this wider process will also depend on factors beyond CSF's mandate, notably a meaningful reform of HEIs and PRIs and reliance on performance-based principles in the allocation of funding, the proper functioning of the advisory councils, and full exploitation of the opportunities presented by EU membership, especially with respect to the FP and the European Research Council (ERC).

The Agency for Science and Higher Education

The beginnings of quality assurance in science and higher education in Croatia date back to 1993 when the NCS and NCHE were established. ASHE, founded in 2005, now has the external quality assurance competences of the two national councils and is in charge of initial accreditation/reaccreditation, thematic evaluation and audit, and recognition of foreign educational qualifications. ASHE has grown rapidly and employs a total of 64 people (ERAWATCH, 2010b).

ASHE is in charge of setting up a national network for quality assurance in higher education and providing professional assistance to the NSC, NCHE, SHEFC and CESHE. Within ASHE, the National ENIC/NARIC (European Network of Information Centres-National Academic Recognition Information Centres) office operates as a reporting centre for academic mobility and the recognition of higher education qualifications. ASHE's willingness and ability to respect its mandate was demonstrated in 2008 when, following the evaluation of a number of PRIs, it recommended the removal from the Registry of Scientific Institutions of more than ten of these organisations (ENQA, 2011). Since 2009, ASHE is also responsible for collecting information on Croatian higher education and research developments, for providing support for the implementation of the state *matura* (a secondary-level graduation examination linked to access to university) and for administering the centralised applications and admissions to higher education.

ASHE acts as a link to the international and European higher education policy and regulatory community. It is a member of relevant international associations, such as the International Network for Quality Assurance Agencies in Higher Education and the Network of Central and Eastern European Quality Assurance Agencies in Higher Education; it is an associate of the European Association for Quality Assurance in Higher Education (ENQA) (ERAWATCH, 2010). Membership in such bodies serves to transfer international standards, both to ASHE and to the Croatian higher education system. On its own initiative, ASHE has been evaluated for its compliance with the European Standards and Guidelines (ESG) for external quality assurance agencies and thus with the membership criteria of ENQA. An external peer review, conducted in 2011, rated ASHE's overall performance very highly against ESG standards and found that ASHE is well managed at both executive and board levels (ENQA, 2011).

ASHE works to foster quality at the level of organisations, and the accreditation and evaluation process acts as a powerful instrument in this regard. However, raising the quality of scientific research in Croatia will require additional effort, with more proactive approaches and instruments at CSF and reform of HEIs and PRIs coupled with systematic monitoring and evaluation of policy support measures.

Agency for Vocational Education and Training and Adult Education

Vocational education is the responsibility of the Agency for Vocational Education and Training and Adult Education. AVETAE's activities are defined by the Vocational Education and Training Act. One of its primary tasks is to develop a modern vocational education and training (VET) system, as outlined in the Vocational Education and Training System Development Strategy of the Republic of Croatia 2008-2013. Another of the Agency's tasks is the development of adult learning to facilitate labour market inclusiveness. Its actions are mostly funded by IPA Component IV: Human Resources Development and were previously funded by the CARDS (Community Assistance for Reconstruction, Development and Stabilisation) programme. To reform education by taking into account aspects such as creativity, critical thinking or teamwork, the Croatian National Educational Standard was created and has been implemented since 2005 in elementary schools. Entrepreneurship training is still not widely included in curricula. At the level of university education, initial steps have been taken through the TEMPUS project FoSEntHE, which focuses on development of teaching programmes for enterprises and entrepreneurship.

Agency for Mobility and EU Programmes

AMPEU has implemented EU programmes on lifelong learning since 2009. Its portfolio includes: Comenius (pre-school and school education), Erasmus (higher education), Leonardo da Vinci (vocational education and training), Grundtvig (adult education) and the Transversal Programme Jean Monnet (European integration in the area of lifelong learning).

The State Intellectual Property Office

SIPO is the administrative body with responsibilities for IPR protection. It carries out the procedures for granting industrial property rights (patents, trademarks, industrial designs, geographical indications and designations of origin, topographies of semi-conductor products) and performs the accompanying professional and legislative activity. In addition to its legislative and professional activities, a significant part of SIPO's activities involves provision of information and services relating to intellectual property (IP), co-operation with other institutions to support innovation activity, and co-operation with economic and R&D entities.

SIPO has concluded co-operation and non-disclosure agreements (NDAs) on IP information services and other services as part of its regular activities with HIT/BICRO, Ruder Innovations and the CSF. Co-operation agreements on IP education, according to the IP4INNO methodology, were concluded with BICRO and TERA Tehnopolis. Through its Information Centre (INCENTIV), SIPO provides intellectual property pre-diagnostic services to SMEs (following the methodology of France's INPI), which include estimating the company's innovative and IP potential. SIPO also provides information on various aspects of IP to universities, PRIs, public-private research and technology organisations, and SMEs. Compared to the findings of an international study

of good practices for the support of SMEs in the field of IP covering Australia, Japan, the United States and the EU27 (Radauer et al., 2007), SIPO's approaches in this area appear to be satisfactory while SIPO's collaboration and engagement with the innovation and research agencies and their communities could be strengthened.

Policy intelligence: agenda setting, monitoring and evaluation

The governance of Croatia's innovation system is in flux: the stakeholders have expanded from one to four ministries, four new agencies have been established within six years, funding schemes have been consolidated over the past five years and there is an impending shift from scarcity to abundance owing to the availability of the European Structural Funds. In such a setting, the effective delivery of the functions of government depends on the quality of policy intelligence, effective analysis, and the quality of agenda setting and policy evaluation.

For policy intelligence, the picture is mixed. While there are extensive STI statistics, and the Croatian Bureau of Statistics (CBS) produces regular bulletins on matters of relevance to innovation policy, such as R&D, firm-level innovation, education, the labour market, and the state of various industrial sectors, policy evaluations are infrequent and are not always made public. Whereas BICRO and CSF have systematic *ex ante* evaluation and monitoring of their projects, *ex post* evaluations, particularly at the aggregate level of programmes, including assessment of impacts, are generally lacking. The procedures of BICRO and CSF have not been externally evaluated. ASHE appears to be the only agency to have done this. Nevertheless, there are some advances: the first publicly available evaluation of several programmes (RAZUM, IRCRO and UKF) was performed by the Institute of Economics (2011). In addition, the World Bank conducted a rigorous evaluation of its loan (World Bank, 2012), which may also provide a useful template for future evaluations at the level of programmes.

With respect to the use that is made of policy intelligence information, there is little indication that the detailed statistics produced by CBS are methodically analysed and in some cases that they affect policy at all. The general lack of mention to past evaluations in policy rationales suggests that evaluations do not feed back into policy design. Strategic planning documents (such as the Science and Technology Policy 2006-10 or the Strategic Development Framework for 2006-13) give a cursory overview of headline indicators but do not provide an evidence-based rationale for the identification and selection of priorities. In the absence of such a rationale, priorities are likely to be the outcome of political processes that reflect ministerial and departmental portfolios more than the constraints that prevent the system from achieving its potential. Moreover, orientation and planning documents display a tendency to borrow from internationally popular approaches and instruments that may not be appropriate for Croatia –the most notable example of which has been emphasis on various interface and science-push measures. The result has been a proliferation of objectives all with seemingly equal priority; the magnitude of the challenges is not adequately estimated and the expectations raised cannot be achieved with the modest resources available. For research performance, three types of regular evaluation processes are in place: the evaluation of research projects, the evaluation of individual researchers, and the evaluation of HEIs and PRIs (Švarc and Račić, 2012). Evaluation of individual researchers is linked with their workplace promotion procedures. Judgements are mainly based on bibliometric indicators: the number of scientific papers in relevant journals and the number of citations received. Income from grants or contracts is not considered a performance indicator, nor is the number of patents.

ASHE evaluates the universities, in particular their study programmes, and PRIs. Individual study programmes are evaluated by a combination of national and international evaluators (METRIS, 2011). In addition ASHE evaluates PRIs and HEIs on the basis of self-evaluation reports and follow-on on-site visits by experts appointed by the NCS and NCHE. Typically, only domestic experts take part in these evaluations. However, international experts are involved in the evaluations of the Ruđer Bošković Institute, the Brodarski Institute and the University of Zagreb. As the results of these evaluations are not linked to the amount of institutional funding received, they do not give these organisations incentives to perform.

In the past ten years Croatia's innovation system has undergone changes that would have challenged even countries with more mature monitoring and evaluation mechanisms. Overall, the information base for supporting policies, tracking implementation and measuring outputs and their impact is fragmented. While many positive steps have been taken, including some quantitative evaluations, these are are not, on their own, sufficient for ascertaining the impact of policy and the needs for change.

The establishment of effective evaluation mechanisms (for producing a useful evidence base for policy making and creating incentives for performance) is a long-term process involving not just rules, routines and implementation agencies but also the emergence of a domestic community of evaluators. Linking domestic evaluation exercises and developing common evidence bases would be important for ensuring consistency and continuity in the system. It is important for the effectiveness, legitimacy and credibility of policy for interventions to be, as much as possible, evidence-based.

Monitoring and evaluation should be integrated into policy, particularly the funding cycle. This is presently not the case, particularly for institutional evaluations. The implementation of performance-based contracts can also be linked to evaluation. The proposed shift to address the funding organisations rather than just projects would also benefit from a stronger evaluation culture. The idea would be to examine the goals and strategies of organisations (company, institute, team) and to see how well their projects support the organisation's goals and strategies. This would have an impact on the organisations and their future development, would encourage them to differentiate their missions and would for that reason facilitate coherence in the system.

EU membership will entail a strong demand for reporting, monitoring and related studies. The use of Structural Funds for research and innovation can support the development of policy intelligence systems in line with European standards. To maximise the benefits from the development of such systems, it would be important that they exceed simple reporting requirements and are sufficiently tailored to national needs.

Finally, it would make sense to nurture the development of a strong community of domestic and international experts. In addition to classical peer-based evaluation of grant applications, informed peer-based evaluations are an effective approach to evaluation of institutions. Agencies such as BICRO, CSF and ASHE could jointly develop and maintain a community of experts and contribute to the internationalisation of Croatian research evaluation as regards standards and the building of communities and networks. The Structural Funds can be used to finance such activities and as an opportunity to gain experience with evaluation in practice.

4.3. The policy mix: portfolio and balance of instruments

The following sections examine the policy instruments used and the balance between them. Several types of interventions are typically found across several areas of public policy, including in innovation policy (Bemelmans-Videc et al., 1998; Woodside, 1986; McDonnell and Elmore, 1987): resource transfers (distinguishing between direct funding and taxation and their variations); legislation, regulation and standards; public procurement; transfers of authority and institutional reconfiguration (e.g. creation of new institutions, delegation of responsibilities, nationalisation/privatisation); provision of information (including awareness-raising measures, information platforms, data-gathering and dissemination processes such as systematic audits, peer reviews, statistics and policy intelligence). In assessing the extent to which the policy mix fits the system and deals with its binding constraints, the balance of types of innovation, purposes and target groups is also considered.

Resource transfers: direct funding and tax incentives

The transfer of public resources, typically in the form of direct funding, is one of the most potent instruments at the policy maker's disposal. It is certainly among the most widely used instruments of innovation policy. This is understandable considering the absence of markets for certain types of R&D, the incompleteness of markets for knowledge more broadly, and the pervasiveness of systemic failures. Useful distinctions within the class of funding instruments include the mode of allocation (institutional/competitive), the types of beneficiaries (organisations, individuals, teams or projects), the ownership of beneficiaries (public/private, national/foreign) and the types of costs (human resources, buildings, equipment). Finally, of increasing relevance in recent years is a distinction between direct funding and tax incentives, the latter typically in the form of tax credits or allowances for R&D. Such distinctions can facilitate an assessment of the adequacy of these instruments in dealing with the system's binding constraints.

Funding public research and innovation

As mentioned in Chapter 3 public R&D-performing organisations (HEIs and PRIs) operate under considerable resource constraints. Public-sector researchers in Croatia have relatively fewer resources than researchers in comparable countries. Institutional funding is by far the dominant mode of allocation, and block grants are the primary source of financing of HEIs and PRIs. Block grants cover gross salaries and the material costs of the institutions. In addition, institutions submit investment plans to MSES each year in order to finance additional requirements. Grants are provided for research projects and for junior researchers. The system has limited flexibility for redirecting funds across funding streams for salaries, investment and consumables. There is little competitive funding in both absolute and relative terms and it has been volatile, especially during the crisis. Not only is competitive funding a small share of total funding for HEIs and PRIs[7], the boundaries between institutional and competitive funding are blurred. Even the share that is nominally competitive is not very selective. For a long time, competitive funds (research projects, grants for young researchers and support programmes for scientific publication, etc.) had an acceptance rate of around 90%. In recent years, the acceptance rate has declined to 70% (Švarc and Račić, 2012).

The current funding regime therefore has a number of weaknesses. First, the dominance of non-negotiated institutional funding, and its allocation more or less in terms of HEI or PRI staffing needs, implies the absence of any significant relationship between funding and performance. Yet the legal basis for linking funding to performance and quality exists (EACEA, 2010). Second, systems in which predictable institutional funding

dominates are, in principle, potentially better positioned in terms of the long-term accumulation of human resource capacities, research infrastructures, the funding of stable research teams, centres, etc. In Croatia, these potential advantages have not materialised owing to a combination of limited flexibility for using institutional funding for different purposes and the inability to steer the fragmented HEIs/PRIs (within-organisations and between-organisations, respectively). Third, the small share of competitive funding in the financing of HEIs/PRIs and the high acceptance rate has meant that it has not been possible to exert much leverage and induce a change in behaviour. The competitive funding allocated to scientists and teams has been seen as an occasional addition to regular streams and does not fulfil its purpose of raising quality standards.

In terms of the types of costs supported (human resources, buildings, equipment), attention has focused on increasing the number of researchers. Relatively little attention has been paid to the development of other types of human resources important for innovation (such as professional/vocational skills, master's education) and to investments in infrastructure.

The lack of support for equipment and infrastructure can create important problems for capital-intensive disciplines, such as engineering, physics and chemistry. Specific measures taken by MSES have led to some improvement over the last decade, as reflected in the amounts of R&D funding per R&D personnel. A Register of Capital Equipment (above EUR 30 000) was established to open facilities and equipment to sharing (Švarc and Račić, 2012), in response to the fragmentation of HEIs/PRIs. However, comparisons of resource endowments per R&D personnel with countries of similar income per capita suggest that the deficit remains. Indeed, a majority of participants in TEST were motivated to apply in order to purchase equipment for scientific and education purposes, the second most-cited reason for applying after gaining experience of collaboration with industry (Švarc et al., 2011). In addition, the onset of the crisis had the strongest impact on capital expenditures (see Chapter 3). Opportunities to address current deficiencies in infrastructures, equipment and new buildings will be available in the coming programming period for the Structural Funds (see below).

In many disciplines, the costs of research infrastructures are often too high for individual countries to support. This makes international resource pooling for new infrastructures and the opening up and mutual sharing of existing ones increasingly attractive. The EU's European Strategy Forum on Research Infrastructures (ESFRI) initiative, for instance, aims to facilitate multilateral co-ordination for better use and development of research infrastructures, by providing a forum for national delegates to meet and seek synergies. Some of its activities are reported in the Roadmap for Pan-European Research Infrastructures. To make the best use of limited resources, Croatia should develop systematic means of identifying suitable international initiatives and performing cost-benefit analyses of participation in international infrastructures. This would require wide stakeholder participation and consideration of the extent to which they substitute or complement existing and foreseen projects in Croatia.

The stalling of capacity expansion in capital-intensive infrastructures in HEIs, the suspension of measures for training young researchers, and the insufficiently strategic use of resources by PRIs have all constrained the systematic mobilisation of resources and are symptomatic of the volatility of STI budgets and their dependence on funding from the World Bank and the EU. While EU funding is bound to increase by an order of magnitude, it will not continue indefinitely and its use for sustained capacity building remains a challenge. Ultimately, regular national streams of funding will prove crucial to the long-term development of the system.

Direct and fiscal support for business-sector innovation

Many governments opt to support R&D in the business sector with resource transfers either directly in the form of grants for R&D and related investments or indirectly in the form of tax incentives (see also section on fiscal measures below). Though in the national setting such funding is often relatively small in terms of relative magnitudes, it can make an important difference to individual companies, especially those at critical stages of their growth and development (e.g. when entering formal research activities). Box 4.1 shows government-funded BERD in Croatia and the comparator group, with its magnitude and calculations on the distribution of funding across sectors. Direct government funding of business R&D is low by international standards, in both absolute (EUR 3.26 million) and relative terms (0.86% of GERD). This puts Croatia at the bottom of the comparator group. When one also considers state support via tax incentives, about EUR 18 million of total state funds (or 5.5% of GBAORD) (CBS, 2012) were directed to the business sector. This suggests a somewhat more positive picture, yet Croatia is still a long way from what most countries in the comparator group spend on direct funding alone. The concentration of public funding to a few industrial sectors contrasts with the high sectoral dispersion of BERD and is another indication of its limited relevance.

Box 4.1. Magnitude and distribution of government funded BERD in Croatia in international perspective

A natural response to the limited availability of funding would be to concentrate funding as much as possible. In fact, public support for private R&D in Croatia is already quite concentrated. In terms of the distribution of government funding of business R&D across NACE sectors, calculations on the number of "equally sized" sectors (derived from a Herfindahl index[8]) are suggestive (table below). Unlike unitless summary measures of concentration or dispersion, the number of equally sized sectors can be interpreted intuitively; the greater (smaller) the number of sectors the more equal (concentrated) the distribution. Estimated at about three and a half equally sized sectors, only Estonia had a distribution of public R&D support concentrated on fewer sectors. Moreover, this high degree of concentration contrasts directly with the broad spread of overall BERD across industrial sectors. As no explicit sectoral criteria are applied to the disbursal of direct funding, the discordance between the dispersion of BERD and the concentration of direct funding may indicate the uneven appeal of direct public funding instruments across sectors. Despite the high degree of concentration and because of the small amount of overall funds, funding per sector is around EUR 1 million. This is not only the smallest amount among the countries considered but also four times smaller than that of the second-smallest, again, Estonia.

	Government-funded BERD 2009 in current prices, EUR millions (% of GERD)	Number of "equally sized" sectors receiving government funding (=1/HHI) over 2008-09	Government-funded BERD per equally sized sector in 2009 (current prices, EUR million)	Proportion of innovating enterprises receiving public support (Sixth Community Innovation Survey, 2008)
Czech Republic	185.79 (8.87%)	6.2	29.9	17%
Estonia	9.71 (4.92%)	2.3	4.1	13%
Hungary	94.52 (8.86%)	12.9	7.3	27%
Austria	558.72 (7.47%)	5.3	104.5	40%
Poland	73.46 (3.5%)	3.5	21.0	18%
Slovenia	49.97 (7.61%)	6.4	7.8	24%
Slovak Republic	8.793 (2.9%)	n/a	n/a	14%
Finland	119.78 (1.77%)	9.0	13.4	35%
Croatia	3.26 (0.86%)	3.4	1.0	28%

Source: OECD, based on Eurostat (2012), Statistics Database.

Direct support

BICRO is the main source of support for the business sector; its instruments, as mentioned, are strongly oriented towards technology-based start-ups, transfer centres, incubators and R&D centres, contract research with HEIs/PRIs, support of the proof-of-concept phase and of participation in EUREKA. There is also a small-scale grant scheme operated by MoEC. While these instruments are still operational, consultancy for high-technology SMEs and subsidies for pre-commercial R&D have been terminated. Venture capital (VENCRO) was considered but has not been implemented, mainly owing to the lack of sources of finance and of interest among potential private partners.

The portfolio of funding schemes and services provided by BICRO intends to "unlock" the innovation potential of public-sector research by supporting interface-type measures. BICRO's programmes have been largely co-financed by a World Bank loan, and this has conditioned their continuity. Despite the resource constraints, BICRO's business support seems to have obtained a number of successes in terms of firm and employment creation and leveraging private co-funding. However, these successes have not sufficed to raise the national innovation capacity, as they address a narrow set of stakeholders. The innovation grants of MoEC have so far addressed this gap in policy coverage only very partially as they have been too small, though current plans to increase their size may change this. HAMAG-INVEST also focuses on SMEs and operates loan guarantee schemes and, more recently, support for general consultancy services. In recent years it has increasingly used regional development agencies or business centres to deliver its services. Innovation is at best an implicit issue on HAMAG-INVEST's agenda and there is no evidence of its impact on raising innovation capacity.

Various sources (see Chapters 1 and 3) attest that business funding in general and for innovation in particular is hard to come by. The prevailing policy approaches have been shaped by a rather narrow view of innovation that emphasises specific modes: research-based innovation, the commercial exploitation of public sector research, and a preference for high-technology SMEs. National innovation policy has not yet adopted a broader notion of innovation and has not extended its instruments to address challenges such as the absorptive capacity of firms. As a consequence, the majority of business firms that account for most economic activity in Croatia have not been addressed sufficiently, including less knowledge-intensive firms, firms performing non-research-based innovation and established and/or larger companies.

As is common in many smaller EU countries, funding for intermediate and later stages of business growth (such as mezzanine and equity capital) are largely absent, and there may be too few local investors to create a sustainable venture capital community. Past efforts to provide funds for economic cooperation (co-financed by HBOR) have not addressed this. There are some positive developments though, such as the emergence of a Croatian Business Angel Network (CRANE) and of active start-up communities in urban centres such as Zagreb, Osijek and Rijeka. Notably, a regional fund for the Western Balkans has been established by the European Investment Fund (EIF), the European Commission (EC) and the European Bank for Reconstruction and Development (EBRD), under the name Enterprise Development and Innovation Fund (see www.wbedif.eu). In the near future, the SF can be mobilised to support familiarisation with novel financial instruments.

Support for business innovation – especially the long-term accumulation of in-house innovation capabilities in a much greater number and variety of firms – cannot rely exclusively on international funding but will have to come to a substantial extent from

national budgets. They will have to increase by at least an order of magnitude just to match the commitments of other new EU member states. There are good reasons for channelling such support principally through a specialised agency with a proven track record and for making much more use of direct funding while ensuring adequate monitoring and rigorous evaluation.

Support for innovation in large firms, including the subsidiaries of multinational enterprises (MNEs), would have to be usefully linked to the broader support initiatives of the newly established Agency for Investment and Competitiveness, a potential candidate for collaboration with BICRO. The experience of Ireland's IDA with customising instruments to specific target groups (high-technology and other knowledge-intensive multinationals in particular) may be usefully drawn upon as a model for attracting more knowledge-intensive employment (see Ó Riain, 2004; Collins and Pontikakis, 2006). In expanding its mission beyond R&D and commercialisation of science, BICRO can better support innovators' efforts to reach new international markets. Co-ordination with the State Office for Trade Policy may reveal opportunities for synergies.

There are some indications that Croatia possesses higher shares of knowledge-intensive employment in services than in manufacturing (see Chapter 1). Policy makers increasingly recognise that these sectors are more innovative than previously thought. In contrast to manufacturing, most innovations in services seem to be non-technical and result from incremental changes in processes and procedures that do not require much formal R&D (OECD, 2005). This indicates the need for differentiated policy approaches. Services innovation can be significant in Croatia, especially in its burgeoning tourism sector, but also in sectors connected to ICTs, such as software and communication, as well as business consultancy services, retail and the utilities sectors. In extending the innovation policy mix to support innovation in services more broadly, it may be worth considering embedding service innovation in generic innovation policies, such as R&D tax credits or grants (e.g. in the Netherlands the R&D tax credit now covers the development of software), and integrating service innovation in support measures (commercialisation policies) aimed at science-industry interactions (OECD, 2012b).

There are many policy gaps in support for the business sector, including support for low-capability firms, for non-research driven innovation of various kinds (e.g. in services, notably in the tourism sector), for the adoption of process innovation (such as standards and regulations or other processes with notable productivity improvements), for skills and training and for the employment of skilled human resources, and for facilitation of firm-firm networks to take advantage of the capabilities and leveraging ability of larger firms and affiliates of MNEs (each considered below).

Fiscal measures

Fiscal measures to promote private investments in R&D include tax relief and the exemption of custom duties for importing research equipment. The regulations on reduced taxation of profits for R&D in companies are formulated in the Law on the Amendments and Supplements to the Scientific Activity and Higher Education Law (Official Gazette No. 46/2007). These regulations harmonise the regulations on the taxation of R&D with EU rules. They allow companies to reduce the tax base for eligible costs of scientific and developmental research projects by 150% for fundamental research, 125% for industrial research and 100% for development research (provided the total amount of relief is equal to or lower than 100%, 50% and 25%, respectively). The terms are even more generous for SMEs (Aralica et al., 2011). Eligible costs include

(insofar as they are incurred in the course of/are deployed exclusively for) personnel, equipment and property, costs of obtaining technical know-how and licensing patents, consultancy and additional overheads and operating costs (Aralica et al., 2011).

R&D tax incentives are significantly larger than the respective direct resource transfers in the form of grants and other funding measures. For example, in 2009 direct subsidies amounted to less than a third of the aid granted by the tax incentives (Table 4.8). However, the overall scale of resource transfers to support R&D in the business sector, including tax incentives, is still exceptionally low by international standards (see table in Box 4.1, col. 1).

Table 4.8. State aid for research and development and innovation, 2007-09

	2007		2008		2009	
	HRK millions	EUR millions	HRK millions	EUR millions	HRK millions	EUR millions
A1 grants	4.9	0.7	46.9	6.5	31.6	4.3
A2 tax advantages	156.0	21.3	162.6	22.5	107.5	14.6
Total	160.9	21.9	209.5	29.0	139.1	19.0
- % of horizontal aid	24.1		31.6		21.1	
- % of total state aid (less agriculture and fisheries)	2.0		3.5		2.8	
- % of total state aid	1.4		2.2		1.6	
- % of GDP	0.05		0.06		0.04	

Source: Aralica et al. (2011) "Evaluation of tax incentives aimed at stimulating R&D Projects in the business sector: Preliminary results", Institute of Economics, Zagreb, p. 8, originally from Croatian Competition Agency.

The current tax incentives for R&D seem to benefit a small number[9] of medium-sized to larger firms, providing support for maintaining or increasing their R&D investment in Croatia (Aralica et al., 2011). They provide much less support for smaller, less R&D-oriented firms and innovation more broadly. This may be partly due to the complexity of the application procedure in Croatia or may reflect similar difficulties that smaller firms have in benefiting from such instruments in other countries too. A better understanding of the reasons for their uneven appeal seems necessary and can be the topic of a dedicated study.

The Act on Investment Promotion and Development of Investment Climate which came into force in September 2012 foresees a variety of tax incentives for investments in tangible and intangible assets, many of which are of direct relevance to innovation activity such as purchase and modernisation of equipment, training costs, business support services as well as the development of product and process innovations. The minimum investment threshold covered by the Act is EUR 150 000. Reductions in the corporate profit tax rate by 50%, 75% and 100% are foreseen for investments of up to EUR 1 million, 3 million and 3 million, provided that the investments also lead to the generation of employment (5, 10, and 15 new posts respectively).

In the recent past, OECD and EU countries have increasingly employed tax incentives to support innovation in the business sector. Like direct funding, they address the tendency of the market to devote fewer resources to innovation than would be socially desirable. It is often thought that they are more advantageous than direct funding in that they allow firms, rather than government, to decide which R&D projects to finance

(OECD, 2012c). Tax incentives may also influence the location of internationally mobile R&D. While public support to business R&D via tax credits therefore has specific advantages, it is not necessarily allocated where they are likely to have the greatest social return. Tax incentives for R&D can have drawbacks which may be more pronounced in countries with nascent innovation systems.

- A key issue for policy for emerging innovation systems is how to design and customise support to the different needs of various segments of a developing business sector in order to encourage more firms to innovate, and support more of the innovating firms in their efforts to upgrade their capabilities and become internationally competitive. Tax incentives for R&D may not be the best way to perform these tasks as they are more difficult to target.
- Pure R&D tax incentives correspond to a rather narrow subset of inputs to a specific type of innovation. They do not cover non-R&D-based forms of innovation and downstream parts of the process linked to commercialisation and widespread use. The current framework for fiscal incentives in Croatia is somewhat broader in its coverage of inputs, but like the rest of innovation support, was mostly concerned with R&D-based innovation. In that respect, the introduction of tax incentives for wider innovation investments, as foreseen in the recent Act on Investment Promotion and Development of Investment Climate could provide valuable experience.
- R&D tax incentives are much less relevant to start-ups, which typically have few or no profits to be taxed. For companies with liquidity constraints, tax incentives may not have a timely impact. In terms of tax incentives, SMEs are generally at a disadvantage as they often perform non-R&D-based forms of innovation and even those that perform R&D are unlikely to meet the requirement of *exclusive* use of eligible personnel, buildings and equipment for R&D. OECD analysis has shown that tax credits may favour less dynamic incumbents at the expense of dynamic young firms (OECD, 2013b).
- R&D tax incentives may not bring about a meaningful and lasting change in the innovation behaviour of firms as some companies may simply claim tax credit for activities that they would do in any case.

In light of the above, there may be a need to reconsider tax incentives, based on an overall appreciation of their opportunity cost and other possible impacts. In their current form they may not be equally relevant to parts of the business sector (such as non-R&D innovators of all kinds and start-ups) and may not fully exploit the potential for spillovers in the commercialisation and production stages.

Funding skill development

Skills are a relatively neglected area in terms of the use of resources to support the business sector. This is an area of direct relevance to the business sector and one of the main barriers to innovation according to the latest CIS. A recent OECD survey found that it was cited as a greater barrier than the availability of external funds (see Chapter 3). The current partial conceptualisation of innovation has also affected support for the provision of relevant skills. BICRO and HAMAG-INVEST do not engage in skills upgrading within firms, except indirectly through accreditation of consultants and support for companies to hire accredited consultants. By virtue of CSF's mission, it focuses support on research skills and international scientific mobility, which are more relevant to the

public than to the business sector. Some potential for relevant skills provision exists in AMPEU, notably the initiatives connected to lifelong learning and to vocational education such as the Leonardo da Vinci programme and Grundtvig. The current impact of these programmes is not known. Some TEMPUS projects attempt to fill gaps in the provision of entrepreneurship and other business education at universities, and some also cover skills in professional and vocational education. Given the low budgets involved and the focus of these projects on curriculum development, it is doubtful that they would be sustainable in the absence of a steady supply of national funding.

A supply-push approach to skills may not work if the business sector's demand for such skills is dampened by a lack of in-house activities (in design, architecture, engineering, marketing, ICTs and R&D) that could make use of such skills or even the inability of management to appreciate the potential benefits from innovation in a business environment that emphasises other sources of profitability. One way to kick-start such activities and stimulate demand is to provide public support for knowledge-intensive employment (e.g. the insertion of a "first engineer", an "innovation assistant", etc., into SMEs). The aim would be to sustain such employment in business firms long enough for the initiation of the kinds of knowledge-intensive activities (in design, engineering, marketing, information technology) that can lead to profitable innovation or at least demonstrate its potential to do so. This would be especially relevant for firms that have systematically engaged in new-to-the-firm innovation (e.g. adopted international quality standards such as ISO qualifications or upgraded their information gathering and logistics operations with ICTs) and wish to engage in new-to-the-market innovation but lack the necessary in-house capabilities. This appears to be the case of a substantial proportion of the Croatian business sector. Public support for the employment of graduates with the needed skills could be a first step in that direction. For companies with more developed innovation capacities, employment of researchers can be crucial for developing internationally appealing products and services. Slovenia's experience with programmes to support the employment of young postgraduates in industry may be useful. These include a dual mentorship (an academic and an industry-based researcher) by the Slovenian Technology Agency (TIA) and, for more established researchers, the "Co-financing of employment of researchers in enterprises" scheme of the former Public Agency for Entrepreneurship and Foreign Investments (JAPTI) (OECD, 2012a, p. 163).

Strengthening professional and vocational education, addressing evident short-comings in the supply of specialised graduates (see Chapter 3) as well as promoting on-the-job training and lifelong learning for those already in employment would increase the pool of qualified human resources. Extending the scope and duration of industrial placements would be one way to improve the economic relevance of tertiary education. However, as the ability of companies to absorb students is limited, extending the length of placements may also imply rationing them to the better-performing students, which may, on the long-run, help improve the attractiveness of such initiatives to companies. Other examples of instruments to support the development of business-relevant skills include job shadowing and service learning (Box 4.2).

Box 4.2. Different forms of workplace learning

Workplace learning includes a diverse set of practices ranging from brief periods for observing a workplace to structured, long-term apprenticeships leading to a qualification or diploma.

- Job shadowing involves very short periods of time – usually days – in which students follow a worker to learn about a job. This often involves younger students and serves the purpose of exploring possible careers. In Canada, ninth-grade students shadow an adult close to them in real-life work settings ("Take Our Kids to Work", www.thelearningpartnership.ca/page.aspx?pid=250). In Italy, vocational education and training (VET) secondary schools team up with local enterprises to set up "simulated learning enterprises" on school premises to encourage students to acquire the skills needed by those enterprises.
- Service learning involves voluntary work by students, usually in non-profit organisations, to provide a service and learn as well. In the Flemish Community of Belgium, for example, some students in part-time VET programmes participate in such learning.
- Internships are short periods of time during which students work in actual workplaces, usually for no or nominal wages. They may be governed by a special contract. In Austria, the Flemish Community of Belgium, Chile, Hungary, Italy and Mexico, students in school-based upper secondary VET programmes may participate in internships, although not all do so.
- Apprenticeships are a more structured, dual-track approach, combining part-time, workplace-based training in a company with classroom instruction in a vocational school, usually over a period of years, leading to a qualification. Germanophone countries (Austria, Germany, Luxembourg and Switzerland) have well-developed apprenticeship systems They also exist in Australia, the Flemish Community of Belgium, Denmark and the Netherlands.

Source: OECD (2012d), *Better Skills, Better Jobs, Better Lives: A Strategic Approach to Skills Policies*, OECD Publishing, doi: 10.1787/9789264177338-en.

Funding of linkages

Croatian research and innovation policy has emphasised the commercialisation of public research and the creation of interface structures at the periphery of HEIs/PRIs. Accordingly funding measures have been directed at the science-industry interface: technology transfer offices, incubators, technology parks, research centres, science-industry co-operation and technology-based companies. TEHCRO has focused on technology infrastructures and incubators, including the Biosciences Technology Commercialisation and Incubation Centre (BIOCentre), RAZUM on stimulating and supporting academic spin-offs, and IRCRO on funding collaborative R&D projects between firms and HEIs/PRIs.

However, Croatia lacks instruments to support larger-scale, more systematic science-industry collaborations. Many countries have such instruments. These include competence centres (Austria, Estonia, Sweden), collaborative research centres (Australia), centres of excellence and regional research centres (Czech Republic), open access centres (Lithuania) or top institutes (the Netherlands). While their missions vary, all have a long-term orientation based on a coherent research agenda and systematic involvement of research partners from industry, the public sector and academia. Such facilities offer Croatia a number of opportunities and should be considered an option for EU Structural Funds investment to achieve a stronger and more systematic link between HEIs and PRIs, by making use of their respective advantages (training of young researchers, access to

research infrastructures), and involve companies operating on international markets, such as subsidiaries of MNEs.

The spatial and/or thematic concentration of research and innovation activity in cluster-type arrangements (whether called 'clusters' as in the recent past or under the guise of triple helix, regional smart specialisation strategies or in the context of public-private partnerships) is likely to play an important role in the future policy mix. Clusters typically act as a low-threshold, flexible instrument for capacity building, by providing access and supporting networking mainly at regional level. The kinds of activities promoted by clusters and related instruments support science-industry interaction mainly by co-ordinating and leveraging existing structures and resources. As clusters are inherently co-ordinating and facilitating mechanisms, their role and impact very much depends on their embeddedness into existing networks and their access to major actors. Existing institutional infrastructure at the policy implementation level (BICRO and HAMAG-INVEST) and at the institutes themselves in the form of various intermediaries (technology centres/parks, development agencies, incubators) seems receptive to such approaches. However, clusters sometimes tend to duplicate rather than complement existing structures. Managers of incubators as well as managers of technology and transfer centres and parks engage in networking within their own realm. One reason is that they compete for the same, limited, mainly public resources. It will be important to ensure that the activities of clusters are complementary and have strong institutional backing.

International evidence from the CIS suggests that when firms collaborate in their innovation activities they do so primarily with other firms. The promotion of inter-firm (or firm-firm) networks can have a lasting influence on demand for knowledge-intensive employment and can stimulate innovation activity. While the EU FP does this to some extent and will do so more upon EU membership, this may not be enough in the absence of complementary national policy instruments. First, the FP focuses on pre-competitive research and not on marketable products or services. Second, it requires companies to engage in R&D that is typically close to the global frontier, which contrasts to the current needs of most Croatian SMEs for new-to-the-firm and new-to-the-industry innovation. These firms will require national support measures (possibly co-funded by the SF) to create and sustain collaborative linkages to develop intermediate products, marketable products, and supplier-client joint processes. Large subsidiaries of MNEs operating in high-technology industries or large domestic, sometimes state-owned enterprises with good innovation records have in some cases pulled networks of suppliers and clients into more knowledge-intensive activities by fine-tuning their intermediate product procurement procedures and by engaging in joint training and other forms of collaboration. International experience suggests that MNEs' affiliates (see examples in OECD, 2007) may sometimes find inter-firm network relationships with local suppliers profitable in terms of long-term cost reductions and may be willing to partly finance schemes for developing them.

Sectoral support

Croatia provides a considerable amount of sectoral support to industry, primarily to sectors that are deemed socially significant (e.g. owing to their contribution to employment) or strategically significant as areas of current or future national comparative advantage. However, this support is insufficiently linked to innovation.

An overview of state aid during 2008-10 (Table 4.9) by sectors and/or social objectives, shows that public support for business research, development and innovation (RDI) represents only 1.6-2.1% of total public support for the business sector. By comparison, agriculture and fisheries (42.71%, 2010), transport (16.25%, 2010) and shipbuilding (13.26%, 2010), taken together, account for almost three-quarters.

In the EU framework (including for competition), now fully applicable to Croatia, R&D and innovation policy will become a major channel of support to industry, including to sectors that have been seen as nationally important in Croatia for various reasons. In addition, EU membership means that new sources of support to the business sector will become available through the Structural Funds, albeit less directly.

Table 4.9. State aid by aid categories, 2008-10

Sectors	2008		2009		2010	
	EUR millions	Share (%)	EUR millions	Share (%)	EUR millions	Share (%)
Agriculture and fisheries	500.5	37.81	500.2	42.24	549.9	42.71
Industry and services	823.3	62.19	684.1	57.76	737.6	57.29
Horizontal objectives	91.8	6.93	89.7	7.58	87.3	6.78
RDI	29.0	2.19	19.0	1.60	23.0	1.79
Environmental protection and energy saving	5.2	0.39	8.8	0.74	3.7	0.29
SMEs	23.9	1.80	31.1	2.63	23.5	1.82
Training	9.5	0.72	7.3	0.62	66	0,51
Employment	18.9	1.43	5.8	0.49	12.8	0.99
Culture	5.3	0.40	5.0	0.42	7.1	0.55
Support to access to finance during financial and economic crisis			12.8	1.08	10.7	0.83
Specific sectors	663.8	50.14	521.0	44.00	568.9	44.18
Steel production			0.3	0.03		
Transport	201.1	15.19	178.4	15.06	209.2	16.25
Shipbuilding	261.9	19.79	157.1	13.26	170.7	13.26
Tourism	23.7	1.79	22.4	1.89	21.6	1.68
Public service broadcasting	147.9	11.17	154.4	13.04	162.3	12.60
Other sectors	18.6	1.41	8.1	0.68	1.2	0.09
Rescue and restructuring	10.4	0.78	0.4	0.03	3.8	0.30
Regional aid	43.0	3.25	43.5	3.67	42.4	3.30
Aid at local level	24.7	1.87	29.8	2.52	39.0	3.03
Total	1.323.8	100.00	1.184.2	100.00	1.287.6	100.00

Source: Republic of Croatia (2011), Croatian Competition Agency, *Annual Report on State Aid for 2010*, December.

Many countries are using innovation policy as part of a wider "directional" industrial policy to build strengths in sectors considered especially attractive. Pre-eminent among such tendencies in the EU context is the "smart specialisation" approach, which envisages the use of STI instruments to develop national or regional comparative advantages. Central to the approach is an "entrepreneurial process of discovery", a multi-stakeholder identification of unique STI niches to specialise in. The intention is to promote innovation in the direction of scientific, technological and industrial change.

The EU's smart specialisation strategy allows considerable room for manoeuvre and may be useful in achieving greater coherence in the use of Structural Funds for STI expenditures. In any case, economically profitable diversification will require policies that increase the structural flexibility of the system as a whole and allow it to develop innovative capacities in sectors of high global demand. The challenge is to provide the market (domestic competition, internationalisation) and non-market (regulation, public procurement) stimuli and framework conditions to facilitate diversification and avoid lock-in into sectors of low value added and adverse terms of trade over the long term (such as certain types of tourism and some primary sectors). In light of the obvious limits of long-term industrial planning, policy makers should balance the selection of priority areas or sectors *ex ante* with increased attention to the flow of signals for profitable internationally tradable activities and to the responsiveness of the system to these signals.

Innovation in the tourism sector

Environmental sustainability has been central to Croatian strategic planning on tourism for over two decades (Ministry of Tourism, 2003; Ministry of Tourism, 2013), but innovation does not appear to have been an integral part of this agenda. Despite greater attention to innovation in more recent planning, there is still no visible inter-ministerial co-operation between innovation policy stakeholders and their tourism policy counterparts.

There are good reasons to believe that both the environmental and the economic sustainability of tourism depends on innovation. Tourism has relatively low costs of entry and therefore tends to become a sector of considerable proportions (in terms of contribution to exports, employment, value added) in countries with favourable natural endowments, such as Croatia's EU partners in the Mediterranean area. As few countries possess such natural advantages, the sector can be highly profitable. However, without continued innovation tourism can be subject to rapid demand swings owing to a combination of changes in consumer tastes over time and, as more countries overcome the low barriers to entry, the emergence of lower-cost locations. Moreover, excessive dependence on tourism may result in adverse effects like those in countries rich in mineral exports such as oil and gas. There is some evidence that small countries or regions that depend heavily on tourism have suffered adverse demand shocks, a decline in manufacturing (as its comparative advantage deteriorates and the currency appreciates), and even increases in rent-seeking and institutional deterioration (Capó et al., 2007; Sheng, 2011; Shong et al., 2012). There are some tentative indications – especially with respect to currency appreciation and an associated industrial decline (Broz and Dubravčić, 2011) – that this could pose a challenge for Croatia. The above underscore the crucial need, and role of innovation policy, to foster more balanced structural change through diversification to higher value added economic activities across the services sector and across manufacturing.

Within the tourism sector, given these considerations, a focus on innovation becomes an economic imperative. Innovation may also help to reduce the strong seasonality of current demand for tourism, which, among EU countries, is greatest in Croatia and Greece (Eurostat, 2010). Policy could usefully focus on the existing momentum of environmentally sustainable tourism. A concerted drive towards innovation in tourism, with a further focus on environmental sustainability (green innovation), could also have other long-term positive impacts, notably in the areas of energy, water, waste and biodiversity (OECD, 2013a).

Essential parts of a drive for green innovation in tourism services would include: increasing industry engagement to showcase the benefits of innovation in tourism, greener destination planning and co-ordination with fiscal and government investment policies, including facilitation measures for private finance (OECD, 2013a). A key policy challenge is to convince industry stakeholders, in a sector that is highly profitable at present (partly owing to heavy investments in the past that are now written off) that investment in innovation is necessary for long-term sustainability and not just for environmental reasons. An important part of such an effort in Croatia would expand the agenda of innovation implementation agencies and their funding instruments to cover innovation in services and identify specific opportunities for collaboration with businesses in other sectors as well as HEIs/PRIs, in terms of marketing, design and R&D (see examples in Box 4.3). Green innovation in tourism may also be a profitable sectoral focus for a possible competence centre.

Box 4.3. Examples of policy initiatives to promote green innovation in tourism

Switzerland: Federal Act on the Promotion of Innovation and Co-operation in Tourism

Switzerland has supported innovative and sustainable tourism projects for over ten years under the Federal Act on the Promotion of Innovation and Co-operation in Tourism (1997 Innotour Act). The Act was recently reviewed and came into force in a revised form in February 2012. It now stipulates the project requirements in relation to sustainability and only projects that contribute to the improvement of resource efficiency will be supported. The medium- to long-term goal is the separation of economic growth due to tourism from the amount of resources consumed. Under the new Act the Confederation can also specify topics and spearhead certain projects, thereby expanding the possibilities of national tourism policy to promote sustainable tourism.

Portugal: network of co-operation on tourism R&D

Turismo de Portugal has recently launched a project to establish a network of co-operation on tourism R&D, running from 2011 to 2013, in order to mobilise the tourism research capacity of universities. It is the first instrument of tourism policy developed specifically to promote innovation, and in particular green innovation, in tourism. This project will be upstream of innovation processes, producing knowledge on critical issues for green innovation in tourism, in the following areas:

- ICTs: processes with a focus on market access, network management and virtualisation of the value chain, optimisation of management processes, enrichment and / or creation of new proposals for consumption / experience, intelligence, etc.
- Architecture, technology and construction materials, with particular emphasis on the adaptation of creative design, integrated environmental solutions, building energy optimisation, etc.
- Water management and energy management, particularly research solutions for profitable production and consumption and reduced environmental impact for businesses and entertainment equipment.

The network's mission will be to develop partnership projects between the national scientific and technological system and enterprises able to create green innovation.

Source: OECD (2013a), "Green Innovation in Tourism Services", *OECD Tourism Papers*, No. 2013/01, OECD Publishing, doi: 10.1787/5k4bxkt1cjd2-en.

Legislation and regulation

As discussed in Chapter 1, framework conditions are critical for the performance of innovation systems. The legal framework for innovation[10] consists, among others, on the provision and enforcement of IPR, the competition framework and binding regulations. These are complemented by (voluntary) standards (see Table 4.10 below).

IPR play an important role in modern innovation systems. Owing to the public good features of knowledge, innovators are unlikely, in the absence of government intervention, to reap enough of the benefits of their efforts, which are largely captured by society at large (including competitors). This can dampen or destroy potential innovators' motivation to invest in innovation. With property rights for knowledge and a system of enforcement, innovators can recoup more of the benefits of innovation and are thus encouraged to innovate. Patents, copyright (and related instruments such as trademarks and industrial designs) bestow innovators with a temporary monopoly on the economic exploitation of their innovation. In doing so, they inhibit the diffusion and widespread use of the innovation by adding to its cost for potential imitators and users alike. Partly due to considerations on the appropriate balance between the benefits and costs of IPR, countries vary widely in the scope and quality of their IPR legislation and the effectiveness of enforcement. Countries that enforce IPR better have stronger innovation systems, in terms of generating higher shares of economic growth from total factor productivity (Furman et al., 2002; Furman and Hayes, 2004).

Croatian IPR legislation has been aligned with that of the EU for some time (EC, 2006). However, recent European Commission reports highlight the need for better enforcement, for sufficient funding for the Board of Appeals (first instance), and for increasing public awareness of IPR (EC, 2011a, pp. 30-31). Nevertheless, there is little uptake of IPR instruments in Croatia (see Chapter 2), an indication that the domestic market for formally traded innovation is small. The lack of an upsurge in the registration of foreign-owned patents on the eve of EU accession (WIPO, 2013) suggests low expectations for the market's medium-term development.

A strong IPR system needs to be accompanied by a legislative and operational infrastructure that supports market competition (see Chapter 1). Historically, the Croatian business landscape was dominated by state-owned and collectively managed enterprises, some of which were large. Privatisation and the transition to a mixed market economy generally reduced industrial concentration and competition policy has had success in some areas. However, pockets of strong concentration persist in some sectors still dominated by old incumbents (such as utilities where, with the exception of telecommunications, the top firms have maintained their market share). In a small number of new sectors that have attracted MNEs (such as computers and related services, manufacture of tobacco products and retail), concentration has increased over the past decade (Tipurić and Pejić Bach, 2009). The establishment of the Croatian Competition Agency (CCA) and the recent extension of its powers under the Competition Act of 2010 are important steps in securing and maintaining a level field. CCA appears to have sufficient administrative capacity and is monitoring and adjudicating some three dozen cases a year (EC, 2011a). CCA is also monitoring the implementation of state aid (e.g. to the shipbuilding industry) for compliance with EU rules. Greater co-operation between CCA and BICRO/MoE will probably be necessary to ensure that more direct support to business innovation does not contravene EU rules.

An obligation arising from Croatia's EU membership will be the adoption of EU regulations that will affect product characteristics, industrial processes and consumers. From the perspective of innovation and related policies and support measures, this enforced adaptation can spur extensive new-to-the-firm and new-to-the-industry innovation. However, legislation alone does not ensure the correct implementation of regulations. Effective implementation requires mobilising all stakeholders through awareness-raising campaigns, provision of information on specifications, brokerage with specific service providers, and perhaps the direct provision of coaching and advice by specialised government agencies. SMEs face particular challenges for the timely adoption of standards, owing to lack of awareness and of human and financial resources.

In the Pre-accession Economic Programme 2012-14, the Croatian authorities prepared an extensive action plan (Republic of Croatia, 2011). Its Annex III (Structural Reforms Agenda and Achievements) envisages more than 220 regulatory reforms and adaptations in a wide range of policy areas (Republic of Croatia, 2012). Implementation of the requirements of the Floods Directive provides an example of the magnitude of the effort required. The preparation of flood hazard maps and flood risk maps,[11] including the installation of the relevant software and training, will take at least 1.5 years and requires a budget of EUR 1.1 million and the support of the ministries and specialised agencies of a consortium of three EU members. The training of specialists in the Croatian professional community will take another year before the first adaptations and new investments can be made, a process likely to take several years.

It is clear that the large number of regulations to be introduced creates a considerable co-ordination challenge and will require the mobilisation not only of MRDEUF and the MoE (as the relevant sectoral ministry) but also the implementation agencies, including BICRO, HAMAG-INVEST and CCA. The SF can support the implementation of standards, associated infrastructure and the process of extensive adaptation that will accompany them. Expertise from the European Commission, selected national authorities from other EU member states but also standardisation bodies can also be mobilised. Special attention will have to be paid to SMEs and to the regionally balanced implementation of the standards across Croatia (EC, 2012a). Synergies will need to be sought between large-scale projects (e.g. physical infrastructures) financed by the SF and the introduction of associated regulations, in order to maximise the return on the limited administrative capacities.

Public procurement

Public procurement, together with (binding) regulation and (voluntary) standards, address the demand side of innovation (Table 4.10). The preferences of discerning consumers in a large and sympathetic market are vital for the development of an innovative and internationally competitive business sector (Georghiou, 2007). A ground-gaining argument in recent years is that the public sector can use expenditure for its procurement needs creatively to emulate a "lead market", typically a market with demanding early adopters, whose needs and preferences can influence the development of innovations that later come to enjoy general acceptance. In this way, public procurement may stimulate innovation[12]. It may increase the productivity and effectiveness of the public sector; leverage its purchasing power to induce lasting behaviour change in the business sector (e.g. by encouraging non-innovating firms to innovate); and provide a focal point for the development of activities within companies that thrive on innovation, such as design, engineering, marketing, various forms of IT and of course R&D. Employing public procurement for this purpose is frequently spurred by or occurs with

the introduction of binding regulations and voluntary standards. It is therefore important to consider the possibility of interactions between these three demand-side instruments.

Table 4.10. Key features of demand-side innovation policy instruments

Demand-side policy	Procurement	Regulation	Standards
Objective	New product or service	Market uptake, increased competition and social goals	Market uptake, interoperability, transparency
Input	Finance, performance requirements, skills	Legal process, need to co-ordinate	Participation of standards agencies, co-ordination of participants in the standards development process
Participatory incentive	Sales, risk reduction, preferential treatment (e.g. SMEs), attraction of additional private-sector finance	Mandatory	Voluntary
Effects of success	Improved and less costly public services, stimulation of innovation	Reduced market risk, transparency, stimulation of innovation	Reduced market risk, transparency, increased interoperability, increased trade
Possible risks	Insufficient skills in the public sector, lack of co-ordination across government, idiosyncratic demand	Conflicting goals, length of the process	Technology lock-in, inadequate attention to consumer needs (with industry-driven standards)

Source: OECD, based on Aschoff and Sofka (2008), "Innovation on Demand: Can Public Procurement Drive Market Success of Innovations?", *ZEW Discussion Papers*, 08-052, Zentrum für Europäische Wirtschaftforschung/Centre for European Economic Research.

A number of countries already use public procurement as an innovation policy instrument and others are considering it. There are also the EU Lead Market Initiative (covering eHealth, protective textiles, sustainable construction, recycling, bio-based products and renewable energies) and a new action plan of the European Commission for boosting demand for European innovations (EC, 2012b).

There are trade-offs as using public procurement for innovation may not be the most cost-effective way to fulfil the public sector's procurement needs. Indeed, one of the characteristics of lead markets is the willingness and ability of their consumers to pay a premium for innovation (Izsak and Edler, 2011). In practice this means that public procurement for innovation carries costs, which include a potential efficiency penalty in the delivery of public services if the solution is inferior to the best in the market (or the cost of mitigating the penalty with additional procurement). The overall transaction costs (planning, negotiation, co-ordination, monitoring and evaluation) may also be substantial. The short-term efficiency penalty may be more than offset by long-term gains from innovation, provided the instrument remains in place for a sufficiently long period.

To support innovation, government may use its procurement needs in two distinct but complementary ways: it may use directional procurement targeted at specific technologies/sectors, e.g. for the IT industry and services; for recurrent procurement, it may demand changes to achieve persistently higher standards of quality and efficiency through innovation, employment of the highly skilled and demand for knowledge-intensive services such as engineering and design activities, e.g. in ICT and related services. This can be done by specifying the functional requirement of the procured goods and services rather than committing contractors to specific solutions.

There is a range of opportunities for experimentation, not only in Croatia, but also in many EU and OECD countries. General-purpose technologies, such as ICTs and biotechnology, can be supported through specific technologically and/or sectorally focused procurement plans. Process innovations in logistics, training and even planning can be supported through increasingly demanding specifications in terms of the ratio of output to input. Finland and the United Kingdom are using public procurement to support innovation in services, Korea to address social challenges, such as services for an ageing population, and Stockholm's Royal Seaport to create a sustainable city (OECD, 2012b).

Demand for innovation can be stimulated by so-called co-operative procurement, whereby government and the private sector co-finance a large-scale sectoral innovation programme. Such an approach may make sense when the needs of the public and private sectors overlap, as in the case of energy-efficient or environmentally sustainable office equipment. Firms gain from cost-efficiency improvements and government achieves the social goal of environmental sustainability (Georghiou, 2007).

Given the weight of the public sector in the Croatian economy, the foremost objective of public procurement should be to foster competition on the basis of efficiency and quality. Capacity building in less capable actors may be a result of this use of public procurement – and may strengthen competition in the long run – but it should not be the primary policy objective. As part of the income of the PRI sector depends on government procurement contracts, such an approach could foster competition in the sector and raise the quality bar.

However, precisely because of the size of the government sector, the use of public procurement for innovation also poses risks. Policy making in this area should be mindful of the potential for efficiency penalties stemming from e.g. corruption and closed markets, as well as the inability of the central government administration and specialised procurement agencies to manage innovative contracts, with delays, cost spirals and missed performance targets (Georghiou, 2007). To minimise such risks and use public procurement as a vehicle for the creation of competitive markets, several things should be kept in mind:

- The use of procurement for innovation should be linked to other long-term, large-scale national goals, such as national sectoral strategies and major infrastructure projects, including urban infrastructure, environmental projects (wastewater plants, landfills) and transport infrastructure (ports, airports).
- The amount of funding mobilised by procurement must be large enough to overcome the "indivisibilities" associated with R&D-based innovation and the considerable production and follow-on operating costs, such as service and support (Georghiou, 2007).
- The scope of government procurement needs – from ICT and capital-intensive infrastructure to construction and support for service provision – is wide. It will only be possible to fulfil a small part of public procurement needs by individual corporate or other providers. A necessary part of any policy in the area will be the facilitation of competitive consortia of national and international partners from the business sector, PRIs and HEIs.
- A major task of innovation policy is to strengthen the competitiveness of Croatian businesses in an internationally more open domestic procurement market and to facilitate their participation in the much larger European market for (innovative) public procurement, i.e. fulfilling the procurement needs not just of the Croatian

public sector, but of public sectors in other EU states. Enabling businesses to participate in international tenders for innovative products and services can be an objective of general public support measures for R&D and innovation. The possibility of joining European public procurement initiatives (as they materialise) of relevance to the Croatian public sector should also be considered.

- Information exchange and co-ordination between MoE, which has direct responsibility for public procurement, agencies such as BICRO, CSF and HAMAG-INVEST and business firms should be ensured.
- It is of paramount importance to safeguard the integrity of the process with appropriate management of tenders that minimise the risk of mismanagement and define clear penalties all parties that attempt to pervert the process.

Transfers of authority and institutional reconfiguration

The transfer of authority for decision making to other parts of government or outside it has considerable potential to affect the efficiency and effectiveness of policy. Importantly, transfers of authority represent opportunities to enhance the innovation system without necessarily implying a budget burden. Decisions on transfers of authority take a wide variety of forms and intensities, ranging from the complete transfer of executive powers to different organisations to arm's-length co-ordination on a voluntary and *ad hoc* basis. This may also involve the setting up of distinct organisations or their integration (e.g. as in a merger) and the transfer of ownership (e.g. privatisation or nationalisation). Among other considerations, decisions on transfers of authority have to take into account the relevant parties and the nature of the co-ordination[13], as well as its frequency and intensity. International experience shows that specific configurations within the government – such as delegation of executive funding decisions or an advisory role to an intermediate level – can improve the efficiency and effectiveness of policy.

The most significant transfers of authority in Croatia involve the delegation of parts of the orientation, implementation and policy advice functions to operationally independent councils, expert committees and, above all, executive agencies. The most important agencies that now incorporate (parts of) functions that previously belonged to MSES are BICRO, CSF and ASHE. In 2012, the Z-Projects for PRIs/HEIs and initiatives for technology programmes and related activities, particularly science-industry co-operation and commercialisation of research results, were transferred to CSF. This was a major step towards making CSF a more mainstream science funding agency. The current situation is the result of a long process of delegation that has facilitated a better understanding of each agency's target groups, policy learning from leading international practice, and the greater efficiency that comes with specialisation. There is some evidence that it has had a positive impact on the governance of Croatia' research and innovation.

Nevertheless, ministries have maintained strong control over programming decisions and in some cases over implementation. The MoEC for instance still operates an innovation grants scheme separate from BICRO. While decisions on programming, insofar as they are non-routine (e.g. rebalancing the policy mix), are for good reasons kept within ministries, implementation tasks are usually more routine and benefit from being carried out by operationally independent agencies. Likewise, ministries are the natural place for the orientation function as they are the part of government that is most closely aligned with the democratic expression of social interests and most directly subject to parliamentary scrutiny. Councils can have an important say on orientation, in

their expert advisory role, and on implementation in terms of monitoring and suggestion, but otherwise their presence implies a transfer of only "soft" authority.

The establishment of the Strategic Council for Science and Technology (SVEZNATE), to be chaired by the prime minister, appeared a promising way of raising the profile of STI policy making in Croatia and contributing to some long-term stability. However, both SVEZNATE and the National Innovation System Council of MSES (VNIS) are not operational (Švarc and Račić, 2012). In principle, the delegation of part of the orientation and monitoring functions to operationally independent councils of experts is a positive step towards the effective conception and delivery of policy. Some of the councils examined perform functions that are essential in any advanced research system (NCS, SHEFC, CESHE), while others have a more contingent origin and rationale (CHRFC, NCIS).

Their impact depends on the extent to which they are linked to high-level policy-making processes and on how well the boundaries of their roles are defined and understood. The fact that SVEZNATE and VNIS are not yet operational may suggest a lack of political commitment to science and innovation. The present demarcation of their boundaries may also leave room for overlap. In view of the relatively large number of councils and committees and the uncertainty associated with a rapidly changing political and economic landscape it would seem necessary to review the entire system of policy advice to clarify the division of policy functions among the councils and between the councils and other parts of government.

As in many countries with a similar configuration there is considerable scope to extend co-ordination between MSES and other ministries. For example, MSES could co-operate with MoE on policy responses to the challenges raised by regulations, the implementation of which will also require the involvement of BICRO. Moreover, synergies can be sought with measures that promote the adoption of organisational and process innovations. The effective implementation of MoE's many sectoral strategies (energy, food processing, wood processing, metal processing, ICT, etc.) depends on well-conceived and delivered policies regarding education and training as well as R&D and innovation, which requires the co-ordination with relevant ministries and agencies such as MSES and BICRO. Addressing service innovation will require inter-ministerial co-operation between the innovation ministries and agencies and a range of services-sector ministries, such as the Ministry of Tourism, the Ministry of Sea Transport and Infrastructure, the Ministry of Health, and the Ministry of Culture. The councils may also participate. To be meaningful co-ordination needs to span policy functions and take place primarily during the policy programming and implementation phases. At present, where co-ordination exists (e.g. between MSES, MoE and MoEC) it is often confined to the early stages of orientation (drafting of strategies) and/or programming (drafting of measures). There is much scope to extend interactions between ministries (MoE, MoEC and MRDEUF) and agencies (BICRO, HAMAG-INVEST and CSF). The recent merger of BICRO with HIT and the future merger of BICRO and HAMAG-INVEST may help consolidate the portfolio and provide economies of scale and scope in administrative capacities at the intermediary level.

Both BICRO and CSF are considerably underfunded. Raising the profile of BICRO and CSF in the national policy-making community will be a necessary first step towards their fuller empowerment. Both organisations would be well served by an international evaluation / peer review of their organisational structure, relation to government and other agencies, management systems and procedures, evaluation criteria and procedures, and their efforts at and systems for policy learning (monitoring, evaluation of their

programmes and services). ASHE can be seen as a role model for these agencies, given its systematic efforts to evaluate its procedures externally and engage with international peers.

The many sectoral agencies (Croatian Waters, the Croatian Food Agency, the Croatian Environment Agency, the Croatian Energy Agency, or the Croatian Agricultural Agency) have had no obvious innovation mandate though in principle the opportunities are many. They can act as strategic partners of innovation agencies and other innovation-related intermediaries in identifying synergies and developing joint activities including in internationalisation.

At the level of research performance, various attempts have been made to reform universities and to bring about the functional integration of the older universities (see Chapter 3). These attempts have failed and the HEI/PRI sector is held back by considerable fragmentation (within and between organisations, respectively). The inability to deal with these issues compromises the long-term potential of public research in Croatia. The successful implementation of a host of policy initiatives in the public-research sector, including the move towards more competitive funding, the linking of institutional funding to performance, internationalisation and social relevance, all depend on progress in the process of HEI and PRI reform.

Provision of information

A well-functioning innovation system requires a seamless flow of information. The government plays an important role as provider and disseminator of information. For example, awareness of the role of science and technology may help legitimise an increase in resources for research and can encourage the take-up of science, technology and engineering education; publicising the results of evaluations serves a signalling function and may facilitate the allocation of resources to more efficient actors; online databases of individual researchers, research groups and innovating firms help increase visibility and opportunities for interaction.

The views of Croatian society on science offer an indirect impression of the effectiveness of general communication channels. Evidence from the EU Eurobarometer opinion polls suggests that Croatia is relatively sympathetic to science, even if not optimistic about its potential. Overall trust in science increased in Croatia over 2005-10 and is above the EU average (74% and 66%, respectively) (EC, 2011b, p. 455). However, Croatians feel that the capacity of science to improve the environment is not very good (43%, against an EU average of 54%) (EC, 2011b, p. 462).

The goal of raising public awareness of science and technology featured prominently in the last strategic document (Republic of Croatia, 2006), which proposed a number of possible events and inter-ministerial collaborations. Raising awareness is again one of the objectives of the National Strategy for the Development of the Intellectual Property System of the Republic of Croatia 2010-12. Nevertheless, awareness-raising activities do not appear to be frequent, either as stand-alone measures or as part of measures with a different main focus. The European Commission's ERAWATCH and TrendChart joint inventory of support measures lists only one such measure, the CSF's annual Science Award (*Nagrada za znanost*). This award offers national publicity and public recognition for the research activities of undergraduate students and a small monetary prize. Other innovation prizes include the innovation prize offered by the MoEC and the Union of Croatian Innovators.

Croatia provides fewer digital public services than EU countries. It has nevertheless made progress in this area and particularly in the establishment of dissemination infrastructure for research and innovation. By 2010 some 65% of public services were fully available on line (over 80% in the EU), but were less sophisticated than in the EU. In a composite index of the level of sophistication of digital service delivery that takes into account the degree of interaction, the ability to conduct transactions and the degree of customisation and automation, Croatia ranked 28th out of 32 European countries (Capgemini et al., 2011).

In terms of information for research and innovation, Croatia's pioneering SVIBOR platform contained information on projects financed during 1990-95. It was followed by the web-based dissemination platform for Z-Projects. Perhaps the most notable initiative of relevance to research and innovation is the Croatian Scientific Portal (*Hrvatski znanstveni* portal); it has a database of Croatian scientists, a database of Croatian scientific bibliography and online access to Croatian scientific journals and publications. Also noteworthy is the web-based provision of undergraduate student services by the Higher Education Institutions Information System (ISVU), which has extensive national coverage. To attract foreign researchers and facilitate Croatia's participation in the ERA, the Croatian Mobility Centre (EURAXESS) assists foreign researchers engaged in research projects at Croatian universities and PRIs.

In addition to the benefits of digitisation and better service provision in the wider public sector, there are opportunities to improve the sharing of scientific information within the public research system. The outcomes of publicly funded research are often not readily available to the general public or even to other scientists. The result is unexploited opportunities to form links and to transfer insights across different areas of inquiry; it may also limit the public's understanding of science. A related problem is the underutilisation of scientific data, as the lack of established models for sharing means that opportunities to find new uses for old data are not fully exploited and that wasteful duplication may occur. The barriers to access range from administrative barriers (arising from organisational or institutional boundaries that merely retard the rate of transmission) to legal and privacy concerns that raise serious obstacles to the sharing of scientific information. New barriers have also appeared, such as the rising cost of scientific research,[14] the pressure on PRIs to make greater use of IPRs in order to diversify their sources of income, and the reluctance of scientific publishers to permit public access. The situation is not helped by developments in the use of public procurement to stimulate innovation, which include conditions that allow the transfer of IP to suppliers.

At international level there are attempts to promote more "open science" (OECD, 2012c). Policy efforts in this area include transnational initiatives for common data interchange structures as well as the establishment and maintenance of international information infrastructures, which are essential for addressing contemporary social challenges (such as achieving a better understanding of global climate change). Participation in international data infrastructures should be a priority among Croatia's future internationalisation measures. Moreover, within Croatia, efforts are needed to encourage inter-institutional co-ordination and the adoption of commonly understood protocols for the sharing of information. This may require legislation to overcome administrative barriers. Central to efforts to promote openness would be investments in digital storage and dissemination infrastructure and permission to share licences, datasets, designs, software.

Several other areas of research and innovation policy could benefit from awareness raising actions and better dissemination of the results of existing interventions. In particular, the results of evaluations of programmes and measures should always be made public. This would facilitate policy and stakeholder learning.

Related areas that have not so far attracted sufficient attention of Croatia's policy makers include networking, information sharing and co-ordination across a broad range of stakeholders. For instance, when setting up long-term research and innovation priorities and eliciting agreement from a range of industry and other stakeholders, technology platforms may be useful. These are industry-led multi-stakeholder forums that aim to define research priorities, agree on action plans and mobilise funding in a broad range of technologies deemed important for national or regional competitiveness (OECD, 2011b). Technology platforms could help to identify sectoral innovation bottlenecks at an early stage, including the need for associated services (e.g. competence centres, research infrastructures), education, training, standards and government regulation. They could play an important role for Structural Funds programming in light of the need for "smart specialisation" strategies. Examples of additional priority actions, include support for EU Framework Programme and European Research Council applications, support for a national inventory of marketable R&D services offered by HEIs and PRIs, market information services, export brokerage and the provision of technology matching services (OECD, 2013c).

Finally, it would be important to engage in a concerted effort to improve the profile of STI throughout Croatian society. There are notable cases of research and innovation success within HEIs and PRIs and in small and larger companies. Showcasing their successes and highlighting their impact on Croatian society and the economy would raise awareness of current and potential benefits. Recognition of Croatia as a country in which relevant scientific research of high quality takes place and noteworthy innovations are developed would help inspire participation from all segments of society, improve confidence, attract resources and strengthen the standing of STI in the national policy mix. This is particularly important at present, as all indications are that, in Croatia, STI has not yet attained its rightful place at the highest political level, whereas most EU and OECD countries recognise STI as the main motor of sustainable economic growth.

Overall assessment of the policy mix

Croatia has made considerable progress in constructing a research and innovation policy governance apparatus and a variety of modern policy instruments. However, the short history of Croatian research and innovation policy means that the portfolio of instruments is incomplete in some respects. There is also a considerable lack of balance in the instruments, in the emphasis on specific forms of innovation and associated policy approaches. The public research system's inertia, coupled with significant resource constraints, have conditioned the long-term evolution of policy and contributed to these imbalances. Because of the delay of necessary reforms of HEIs and PRIs, the challenges raised by a changing national and global environment have been dealt with by introducing new organisational structures at the periphery of institutions and through a patchwork of *ad hoc* interventions. Progress has been made in spurts, largely owing to external funding (from the World Bank and, more recently, the EU), rather than through a steady and gradual evolution. This has contributed to the lack of a long-term policy outlook and continuity.

The policy imbalance is heightened by a strong emphasis on R&D-based forms of innovation, and more specifically on the commercialisation of public research and support for high-technology projects and high-technology start-ups. While a "science-push" and "frontier-focused" policy approach has been useful for parts of the business sector, it has been less relevant to the needs of the majority of firms. Meanwhile, a number of opportunities to stimulate collaboration with the business sector in terms of skills development, the provision of services and sharing of competences have been missed. Many firms in Croatia appear to be at the critical transition point between no innovation and new-to-the-firm innovation, while the innovating minority lack the resources and in-house capabilities (in engineering, design,[15] marketing, information technology and R&D) needed to move to new-to-the-market and new-to-the-world innovation. There is little in the current policy mix that appeals to non-innovating firms and entices them to change behaviour. Overall the policy mix has not been well suited to the accumulation of wider innovation capabilities within the public and business sectors.

Principal among the issues with the policy mix is a poor endowment. Funds allocated to BICRO and to other relevant institutions, programmes and instruments, even including tax incentives, are exceptionally low by international standards. For its part, CSF has far too small an endowment to have a profound impact on the scientific research community. Fortunately this is likely to be addressed in the future. The Structural Funds can play a crucial role in securing long-term funding for STI, both by contributing directly to STI projects and by freeing up resources previously tied up in other areas, if the planning, coordination and implementation challenges they pose are resolved in time.

In terms of balance between types of instruments, in spite of the lack of public resources, the national policy effort concentrates on resource transfers. While some resources have been devoted to the training of researchers, other types of specialised human resources important for innovation and investments in infrastructure have received relatively little attention. Project-based competitive funding is too low to compensate for the absence of a link between funding and performance in public research. Reform in HEIs and PRIs has not been possible which constrains their ability to develop.

The remaining policy instruments available to policy makers are unevenly utilised. There have been no attempts to use legislation and regulation or to adjust public procurement practices to stimulate innovation. Understandably, considerable policy attention has been paid to transfers of authority, with the creation of councils and executive agencies as a generally suitable intermediary policy-making level. Except for the continuing efforts needed to combat fragmentation in the public research sector and some overlapping responsibilities, the system's institutional configuration is nearly complete. It is now opportune to focus policy attention (and freed administrative capacities in ministries as the result of delegation) on the task of rebalancing the policy portfolio to support the business sector more directly, forcefully and pervasively (aiming at wider capability accumulation rather than just R&D, without downplaying the role of the latter), of making more extensive use of policy instruments (including neglected ones such as regulation and public procurement) and developing synergies among them.

While national policy makers were receptive to international policy approaches and instruments, it appears that these were not always well adapted to the Croatian context. This is likely a reflection of shortcomings in the functioning of the councils and of the ministries' lack of a long-term orientation. In the future, the transfer of internationally popular policy approaches should be accompanied by a critical and detailed evaluation of their suitability to the national context and current needs. Croatia is fortunate and rather

unusual among smaller countries in possessing systemic assessment capacities, a testament to its strong tradition in the social sciences and economics at the Institute of Economics Zagreb, the Ivo Pilar Institute of Social Sciences, and even in the private sector. However, these capacities are not systematically utilised to inform the design of the national policy mix.

4.4. International sources of funding for innovation

Overview

Over the past decade a substantial amount of public funding for innovation in Croatia has come from international sources. The principal sources have been the World Bank and the European Union. World Bank funding has been embedded in national support measures (see the preceding section) and is not dealt with here.

Although Croatia was not yet a full member of the European Union in the period covered by the latest figures, the share of direct funding from the European Commission is roughly equal to funding from national sources. The EU funding mainly concerns participation in FP6 and FP7, which represents a third of total funding; funding from the precursor of the Structural Funds, IPA IIIc / Priority Axis "Research and Development", represents another sixth.

Croatia's ability to accumulate research and innovation capacities in the core actors, to assist the business sector to innovate (in all forms and modes), and to steer the system towards larger-scale or networking projects and long-term research programmes is weak. Such joint activities could raise much more interest in the research-intensive business sector than the current funding programmes, which mainly aim at the creation of technology-based firms and technology transfer from the public to the business sector.

EU Framework Programmes

Croatia participated as a "third country" in the 6th Framework Programme for Research and Technological Development (FP6) in the period 1 January 2002-1 January 2006. In the given period, institutions from Croatia participated in FP6 projects amounting to a total value of EUR 6 million. As of 1 January 2006, Croatia became associated to FP6, paying a share to the overall budget and having the same rights and access to funding as the member states. According to MSES, under the entire FP6 (spanning the period 1 January 2002 - 31 December 2006), Croatian-based institutions were parties to project agreements of a total value of EUR 15.1 million. The agreements involved a total of 134 projects and participation of 154 partners from Croatia.

The Republic of Croatia has been participating in FP7 as an associated country since its beginning in 2007. According to MSES, by 18 October 2012, 273 Croatian partners contracted 218 projects with co-financing by the European Commission of EUR 53.9 million. The success rate of projects with Croatian partners stood at 17.32 per cent, while in the case of EU Member States it equalled 21.86 per cent. The area with the largest number of projects (30) with Croatian partners is "Research for the Benefit of SMEs", whose aim is to strengthen the innovation capacity of small and medium-sized enterprises and their contribution to the development of new technology-based products and markets.

The next framework programme, Horizon 2020, differs from its predecessors in a variety of respects, mainly a larger budget, a strong focus on research excellence, and the explicit adoption of "societal challenges" as a strong thematic orientation. Its budget will

increase from about EUR 50 billion to EUR 75 billion and will be allocated according to three major pillars: i) excellent science (EUR 24.6 billion, of which EUR 13.3 billion is earmarked for the European Research Council, ERC); ii) industrial leadership (EUR 17.9 billion); and iii) societal challenges (EUR 31.7 billion). There is also about EUR 5 billion for the European Institute of Innovation and Technology, the Joint Research Centre and Euratom Regulation.

Although the FP accounts for a significant portion of public R&D expenditure in the EU, new member states (the post-2004 entrants, referred as EU12) receive relatively little FP funding. Evidence suggests that the new EU member states receive five to ten times more funding of R&D from the Structural Funds than from FP7 (EC 2011b, p. 255). Moreover, as regards the FP, the EU12 typically suffer from several related problems: a relatively small number of world-class research actors, the existence of established networks ("clubs") with high entry barriers, and a certain reluctance on the part of institutes to enter international collaborations for fear of brain drain, particularly to better-endowed EU member states in north-western Europe (EC, 2010).

Croatian participation to Horizon 2020 will also depend on the responsiveness of national policy. National coaching seminars to assist in the development of Croatian-led Horizon 2020 project applications, the provision of guidance and support to their successful submission can make a difference in combating the abovementioned participation deficit common to new EU members. Ultimately though, the benefits that Croatia can expect to derive from Horizon 2020 will depend on improvements across the system notably the increased integration into international scientific networks and improvements in the quality of public research.

Other European programmes and intergovernmental research organisations

Croatia has participated in the EUREKA programme since 2000. So far, Croatian organisations have participated in ten completed and seven running projects (www.eurekanetwork.org/croatia/about). The total funding of Croatian participation is EUR 1 075 million from national sources (BICRO Annual Report 2011). In 1992 Croatia became a full member of COST. It has participated in over 250 projects and is currently involved in 70.

With regard to intergovernmental research organisations, Croatia officially joined the European Molecular Biology Laboratory (EMBL) in 2006 as the organisation's 19th member. In co-operation with EMBO and with the support of a grant from the CSF (EUR 300 000), Croatian life scientists have set up a research laboratory. In the very early days of Croatia's research policy (1991), it signed a co-operation agreement with CERN. It renewed it in 1998. A separate memorandum defines the participation of Croatian scientists. Co-financing of participation is on a functional basis, that is, MSES's financial contribution is provided only for specific experiments. These conditions are considered very favourable because Croatia pays only for actual work. MSES allocated around EUR 70 000 in 2003. The funds are intended for the travel costs of scientists from Croatia and for minor equipment. The main collaborating institutions are the Ruđer Bošković Institute, which plays a co-ordinating role, and the Technical University of Split.

Harnessing opportunities from EU Structural Funds

The Structural Funds form part of the EU's so-called Cohesion Policy instruments, whose main long-term objective is the convergence of incomes between and within member states. In practice this is done through resource transfers, which, following some

alignment with general EU orientation, are usually programmed at the national level and carried out at the regional level. Historically the SF has given lower priority to STI investments. Most EU member states have shown a strong preference for investment in transport, environmental and other capital-intensive infrastructure, as well as funds to mitigate the effects of industrial restructuring, including support for re-training and urban regeneration.

Partly because of the SF's stated objectives and partly because of its past focus, the magnitude of the opportunity it presents for STI policy is often not fully appreciated. Even if the development of STI capacities is a secondary objective, the SF allocations invariably constitute sizeable amounts of public funding for innovation. In terms of R&D funding, for example, over 10% of public funds across the EU27 can be traced back to the SF and 20% comes from EU sources if FP funding is included (Barré et al., 2013). In terms of broader innovation expenditures, SF may rival (or for less well-off EU member states, eclipse) national STI funding. The share of SF devoted to research, development and innovation represents about 160% of the national public R&D budget (GBAORD) in Latvia and Lithuania, about 120% in Estonia, Poland and the Slovak Republic, and 60-80% in Bulgaria, the Czech Republic, Hungary and Slovenia (EC, 2011b).

In the recent past, Croatia's research and innovation policy has been very unstable, in terms both of funding and implementation. Structural Funds can help to increase budgetary stability as they cover a lengthy period of up to ten years: one to two years for preparation, seven years for implementation and up to two more years for finalisation. By their nature the SF should mainly address systemic aspects of the national innovation system (such as capacity accumulation up to the threshold of self-sustainability) rather than short-term tasks. In other EU countries they have been used to support reforms that would otherwise not have been feasible, such as the implementation of structures or systems with long lead times.

The SF present an unparalleled opportunity to overcome indivisibilities, spur institutional reform and foster sustainable capacity building. It is therefore important to identify long-standing problems in the wider research and innovation system that require a long-term perspective and would benefit from additional support. With reference to the earlier examination of major gaps and bottlenecks in the Croatian STI policy mix, the following areas seem especially profitable targets for SF planning:

- *Addressing the evident need to increase investment for research infrastructure and equipment.* The challenge will be to identify investments of wide appeal and complementarity and to support only investments that form part of coherent long-term research programmes. Research facilities jointly operated by HEIs and PRIs and wherever feasible, business enterprises, could provide a wide range of associated business support services in design, prototyping, marketing, IT and logistics, along the lines of competence centres. At present, only the BIOcentre comes close in terms of the requisite scale. Such facilities can be viable candidates for investment, but will have to be carefully tailored to the Croatian context. There are indications that at least some R&D-performing enterprises would be interested in using specialised research infrastructures, and there may be unexploited opportunities for cost-sharing with the private sector in both existing and planned infrastructures. It will be important to integrate research centres, infrastructures and related programmes as much as possible into the innovation system.

- *Redressing the imbalances in human resources for innovation* (in favour of science, technology, engineering and mathematics; in favour of professional undergraduate education in polytechnics and master's programmes at universities) by strengthening the capacity of education providers to set up study programmes and develop funding models that ensure sustainability. SF programmes addressing these issues should be linked with relevant developments in the higher education sector, including reform of governance and implementation of performance-based contracts.
- *Introducing an explicit innovation dimension in the various sectoral and regional development strategies/initiatives*, including the development of the islands and coastal areas (i.e. green tourism innovation, discussed earlier) and others possibly related to energy policy. Ensure that innovation policy stakeholders such as BICRO are among the institutional "owners" of such programmes, and co-operate with sectoral agencies such as Croatian Waters, the Croatian Food Agency, the Croatian Environment Agency, the Croatian Energy Agency, or the Croatian Agricultural Agency. Collaboration should go beyond the drafting of plans to include a say in monitoring and evaluation and the development of joint activities, including internationalisation. The success of such a pervasive approach will hinge on the identification of project managers who can collaborate with those who represent and operate the sectoral policies.
- *Providing support for service innovation with a dedicated competence centre*. A possible focus on green innovation in tourism can be considered. Alternatives include themes recognised as contemporary social challenges in Europe such as changing demographics, sustainable mobility and energy efficiency. A thematic focus may strengthen the centre's social relevance and its profile, not only in Croatia but eventually internationally.
- Seeking synergies between SF investments in large infrastructures, the introduction of binding regulations and associated firm-level innovation. The SF could finance related needs for training, coaching and the development of information platforms. Mobilise SF to familiarise users with novel financial instruments in collaboration with BICRO and HAMAG-INVEST.

Experience with the use of Structural Funds for STI investments in other new EU member states (particularly the Czech Republic, see Box 4.4) suggests that the following are important sources of success:

- Give policy ownership to innovation policy makers and implementation agencies. This is crucial for several reasons. Clear ownership can be linked to accountability and the delivery of specific outcomes within a given time. SF may also be used to strengthen the administrative capacities of innovation agencies, and can support recruitment, training and the accumulation of experience that may also prove valuable in national programmes. The agenda addressed by the Structural Funds should be aligned with that of national programmes and actions. The relevant actors (or "policy owners") should interact.
- Seek commitment to achievements that performers can directly influence by proper management, but do not expect them to agree on the impacts on the economy or society (which they are mostly unable to manage). Balance financial rewards for good performance with corresponding penalties.

- Be mindful of the tendency of open consultation exercises to generate long wish lists that are difficult to implement. If they are used, their input should not be binding. Use such exercises as an information-gathering mechanism and one of the many types of input to long-term planning and prioritisation based on a holistic assessment of the system's binding constraints.
- Frame the discussion on the need for infrastructure around possible outcomes from their use in terms of the concrete impact on research, innovation, education and business (rather than vaguely on the economy) and a clear identification of likely users. Make such investments conditional on long-term, credible research and innovation programmes of wide stakeholder appeal.
- In strategic planning, take two complementary levels into account: one is interventions and the intended improvement of the research and innovation system. The second is active planning for policy learning. Policy learning requires a rigorous system of policy intelligence, including rules and procedures for planning, monitoring and evaluation. The evaluation of all kinds of proposals will create a demand for field experts. If the recruitment and involvement of these experts is well managed, it will create a community of potential partners for collaboration.
- Seek to have more proposals than it is possible to fund and encourage competition to improve the quality of ideas. The criteria for selection should give greater weight to the quality of the proposal (including qualifications and performance, in particular the entrepreneurship of key staff) than to cover a set of pre-determined priority areas. As a general principle, keeping the number of decision-making criteria small and focusing on well-understood target groups can help improve the efficiency of delivery.
- Pay attention to the establishment of appropriate management structures. There should be clear responsibility for the execution of the research programme and the achievement of results, and a clear set-up of supervisory and advisory bodies committed to quality and performance through supervision and advice. Inter-ministerial co-ordination should not lead to diffusion of responsibility.

Box 4.4. The Czech operational programme research and development for innovation

The Czech government decided to focus on innovation and established a special operational programme for research and development for innovation (OP R&DfI) for 2007-13. The programme is based on a SWOT analysis of the Czech innovation system and is embedded in a number of relevant planning documents, including the National Development Plan 2007-13, the National Strategic Reference Framework and various innovation policy frameworks.

OP R&DfI 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. Two-thirds are allocated for upgrading the Czech research landscape within Priority Axis 1 (Centres of Excellence) and Priority Axis 2 (Regional Research Centres), each with EUR 800 million and covering the whole country except the capital city of Prague.

PA 1 supports the creation of a few large centres of excellence. 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 currently being implemented. Some centres of excellence are very large and will be employing up to 900 staff, such as the Brno-based CEITEC in life sciences and material sciences and the European Research Infrastructure Project ELI (Extreme Light Infrastructure). …/…

Box 4.4. The Czech operational programme research and development for innovation
(continued)

PA 2 funds comparatively smaller regional R&D centres, with a mainly sector-specific, application-oriented and demand-driven mission. These centres help local firms and other users to innovate strategically and to perform their mission better. In successive rounds in 2009 and 2010, 37 initiatives were selected from 96 proposals. The centres are now starting their operational activities.

Both kinds of centres are being established at existing universities and PRIs, primarily the Czech Academy of Sciences, preferably in the form of co-operation between institutions. They are not distinct legal entities but have their own management, rules and procedures. The use of Structural Funds is therefore expected to lead to a physical and organisational restructuring of the Czech university and public research landscape. New buildings and scientific equipment receive about one-third of the money each; another third goes to new research staff, graduate schools and mechanisms to strengthen governance and research management.

The process of selection and implementation was highly structured:

- Applicants had to present an attractive research agenda, supported by the credibility and track record of key staff and a clear understanding of and access to their target groups (academia, industry, public institutions, etc.). Investment in infrastructure had to be justified in terms of the research agenda.
- An evaluation was performed by national experts (20% of weight) and international experts (80%) and included a consensus meeting and an evaluation report of about ten pages. There were essentially six criteria: quality of the research agenda; credibility of the key staff; attractiveness for and access to the target group; management; human resource policy (esp. regarding young researchers) and budget and funding.
- Recommendations were made by a combined national and international panel. The government adopted the recommendations in all cases.
- After a green light from the evaluation panel and adoption by the government performance contracts were negotiated for the period ending in 2018 at the earliest. A very important aspect in these performance contracts is that the performance indicators exclusively cover the types of outcomes that can be managed directly by the centres.
- The negotiation of performance contracts led to savings of a total of EUR 200 million out of EUR 1.6 billion owing to the cancellation of equipment that was not justified by the research programmes. These savings were re-invested in other research centres that were considered "good enough" in the evaluation process. At the same time, the volume of performance increased by about 30% in terms of numbers of publications, income from contracts and grants, and completed PhDs.
- In addition to regular audits each centre will be evaluated two to three years after its start, mainly to identify bottlenecks, adjust parts of the research agenda and performance indicator levels, but particularly to inject additional motivation and advice.
- For the five largest centres the scientific/executive director was recruited with the help of search committees, composed of national and international members. The search process provided many valuable insights into the international scientific community's perception of the Czech research system. A number of expatriates could be motivated to return.

Source: Fritz Ohler, Technopolis Austria.

4.5. Strategic tasks of innovation policy – a functional assessment

Croatia does not yet have a mature innovation system. Its notable progress in putting together elements of such a system, important though they are, has not yet resulted in substantial economic benefits. The realisation of such benefits will hinge on simultaneous efforts across the various interdependent components of Croatia's innovation system: the framework conditions for innovation, the absorptive capacity of firms, the governance and funding of public research, mechanisms to facilitate the emergence of critical mass, and internationalisation. These efforts will have the anticipated impact only if they are implemented in a co-ordinated fashion.

Improving framework conditions for innovation

International experience shows that economies and societies that thrive on innovation have some common characteristics: a stable macroeconomic environment favourable to investment, dependable legal institutions, and an efficient public sector that facilitates the functioning of markets. In the years before the global financial and economic crisis, Croatia had a comparatively good macroeconomic environment, with solid growth, contained inflation and stable exchange rates. Returning the economy to a stable state is a necessary first step in restoring conditions favourable to the required long-term horizon of innovation policy.

Trends in trade and FDI suggest that the Croatian economy is less open than comparable economies. While this will change as a result of EU membership, it will be important to foster further internationalisation and prepare the economy for the effects of increased international competition. Industrial planners will need to anticipate structural change, while regulators will need to ensure a level playing field at home as a stepping stone to an internationally competitive business sector. At the same time, improvements in the investment climate and in public-sector efficiency will be needed to encourage knowledge-intensive investments and reduce transaction costs. A concerted push towards the online delivery of public services would do much in that respect and would increase transparency and, over the long term, trust in the system.

Strengthening the human resource base for innovation

Croatia has a well-educated population, with a secondary education attainment above the EU27 average. HEIs in Croatia have pronounced strengths in social sciences, law and humanities, as reflected both in the structure of tertiary graduates and in scientific output by discipline. However, the skills profile of the Croatian workforce may limit its potential for innovation in the business sector. Businesses find the lack of qualified personnel an important barrier to innovation. Compared to similar countries, Croatia has few students and graduates in mathematics, science and engineering and low levels of on-the-job training and lifelong learning. There are also indications that the quality of science and mathematics education trails that of comparable countries.

Education in HEIs will need to be further aligned with the needs of the labour market. The recent establishment of the Interdepartmental Working Body for Labour Market Monitoring with help from the European Training Foundation, is therefore a positive development. Systematic skills needs analysis and coordination with industry will be needed. A specific policy task will be to identify the skills constraints that hinder innovation in the Croatian business sector. The relative increase over time in the share of

services firms suggests that these needs may be changing, and it will be important to align the education and training system in a timely fashion.

Traditional strengths in the social sciences, law and the humanities could be mobilised by reinforcing the economic relevance of study programmes and increasing the intensity and diversity of links with industry. Strengthening professional and vocational education and addressing evident shortcomings in the supply of master's and other specialised graduates will be necessary. In addition, current efforts to promote entrepreneurship throughout secondary and tertiary education should be continued.

Greater emphasis would need to be placed on the alignment of tertiary education with the need for innovation in the business sector. Strengthening technical disciplines and improving the economic relevance of the social sciences and humanities (by seeking to link them with entrepreneurship, marketing, logistics, and IPR in both education and service provision) would be important steps. More broadly, public-private co-funding of postgraduates, the development of application-oriented curricula, the introduction of new types of formal education such as sandwich courses (with placements of up to a year), more effective industrial placements and professional doctorates (with distinct criteria for advancement) may also be helpful.

An important means of strengthening human resources for innovation will be to capitalise on the unique design, engineering, production and logistics capabilities of MNEs. Facilitating mobility between sectors, extending the scope and duration of industrial placements and forming long-term arrangements for the joint provision of training and education between MNEs and HEIs seem sensible courses of action.

International researcher mobility is low and will need to be encouraged. At the same time, provisions and incentives are needed to encourage the return of researchers to Croatia and attract international talent.

Improving the governance of the innovation system

Overall governance

Aspects of innovation policy governance have improved over time, notably with the drive towards "agencification" (ASHE stands out as a positive example) and efforts to install evaluation mechanisms. However, overall governance suffers from limited co-ordination, piecemeal programming and lack of continuity. The need for improved co-ordination has become more pressing with the increase in the number of innovation policy actors, as the portfolio is currently spread across three ministries (MSES, MoE and MoEC) and several agencies. Limited co-ordination has affected the quality of programming, which has been further hampered by a lack of functional specialisation (incomplete "agencification") and an inability to plan over longer horizons owing to weak political commitment and volatile budgets. The volatility of R&D budgets was especially pronounced over the last decade, seemingly on a biennial cycle of double-digit growth followed by sharp contractions of the same magnitude, linked to the weak position of STI in the government's budget portfolio and the consequent dependence on external funds to fulfil even basic functions. Policy intelligence is weakly developed both in reach and in quality (a lack of evidence-based systemic analysis and consequent prioritisation).

Because of the imbalance between the proliferation of initiatives with ambitious targets and the low level of resources, policy effectiveness has been low. This has arguably damaged the credibility of STI policy, raising doubts about its true economic

promise. EU accession is a historic opportunity to upgrade the role and position of STI policy in the government's portfolio, as it will *de facto*, become the preferred channel for support to the business sector. Institutional reconfiguration to place STI policy at the highest levels of political authority will be necessary however. It will be crucial to address the gap left by the non-operation of key councils.

EU accession will also provide much needed budgetary stability through the SF but will need to be complemented by a rise in national funding. In the forthcoming programming period, the long-term orientation of the SF programmes will need to be adequately linked with national programmes for sectoral support and innovation. Better co-ordination may also reveal opportunities to use novel instruments to stimulate innovation including public procurement, regulations and standards.

"Agencification" can help to improve policy effectiveness by professionalising the delivery of policy. The completion of this process should have high priority to ensure a clear division of labour, stability, operational independence and ministerial governance mechanisms.

Policy mix and specific instruments

Despite the lack of public resources, the national policy effort has concentrated on resource transfer instruments and has placed strong emphasis on "bridging" public and private research, while falling short as regards resource mobilisation at the core of either public or business research. The limited project funding has been under conditions that do not stimulate competition. This policy focus has been conditioned by a rather narrow view of innovation as science-driven, frontier-shifting R&D. This view contrasts with the true potential of innovation as a pervasive activity that applies to all types of companies and all parts of society.

Overall, the range of policy instruments available to policy makers remains underutilised. No attempts have been made to use legislation and regulation or public procurement as triggers of innovation. The preoccupation with institutional reconfiguration (including the establishment of new intermediary organisations and transfers of authority) has been appropriate but has stopped short of substantial reforms of the governance of HEIs and PRIs, including the mechanisms of their steering and funding and incentives and career paths for researchers. As a consequence, much of the activity of institutions such as CSF constitutes temporary responses rather than efforts to address long-term challenges, in large part because of fragmentation in the older universities and between PRIs.

These imbalances will have to be addressed. The emphasis in funding should shift from the periphery of organisations (bridging and similar instruments) to capacity building within their core (HEIs, PRIs and the business sector), from a narrow concept of innovation to a broader one that emphasises ancillary capabilities, especially within firms, and finally from piecemeal solutions (e.g. for the training of researchers) to the dependable delivery of previously missing system functions.

Governance of universities and PRIs

Governance and funding arrangements for HEIs and PRIs are complex and inefficient. The management of the largest, oldest and most significant universities is fragmented, with control in the hands of the legally independent faculties. There is considerable overlap in PRIs' missions, target groups and disciplinary focus, which

persists despite recent attempts at consolidation. Moreover, in both HEIs and PRIs, funding arrangements are inflexible and disconnected from any notion of performance, and there are few incentives to plan strategically and develop individual organisational profiles. Attempts to reform the sector were met with strong resistance from academics and were abandoned.

The fragmentation in the universities hinders the development of the inter-disciplinarity that is often necessary to respond effectively to economic and social concerns. It makes it difficult to derive benefits from the lateral transfer of ideas in scientific research. Co-ordination bottlenecks due to fragmentation may lead to the duplication of support functions or uneven coverage. They discourage the pooling of resources and the drafting of university-wide plans for investment, participation in major research initiatives, and the development of a common identity and mission. Fragmentation also hinders the needed linking of institutional funding with performance via negotiated performance-based and future-oriented contracts.

Principal among the responses to the challenges facing universities would be increased autonomy and accountability for the accomplishment of public purposes. This presupposes that the larger and older universities will become governable as single entities and that their incentives to perform, plan ahead and differentiate would be strengthened. Appropriate instruments include monitoring of performance or outputs and the establishment of performance reporting and periodically negotiated performance-based contracts for both universities and PRIs.

The process of reform can be facilitated by a shared understanding of the opportunities for a significant increase in resources through the co-ordinated mobilisation of the SF. The SF provides an important opportunity to establish new research infrastructures with a well-defined research agenda, mission, target groups, and governance, ideally within HEIs and PRIs, thereby boosting their capabilities.

Evaluation

Although Croatian scientists are more "productive" than their peers in comparable countries, there are indications that research in the country suffers from a quality deficit. For instance, Croatian scientific publications and patents receive fewer citations on average than those of comparable countries. It is likely that this partly reflects resource constraints and the inefficient governance arrangements of HEIs/PRIs. Strengthening evaluation and making performance as a determinant of funding would provide the right incentives, legitimise increased funding and may uncover institutional bottlenecks to the improvement of quality and performance.

There has been progress in the establishment of formal evaluation mechanisms, e.g. ASHE's remit to evaluate HEIs and PRIs. However, for the evaluation of research and innovation programmes and support measures, external evaluation mechanisms are not systematic, not always made public, and there is no evidence that they are an input to policy learning. Efforts should focus on systematising policy evaluation and adequately using the findings, on the pooling of evaluation capabilities and the installation of system-wide norms, the accumulation of experience by a domestic community, and on linkages with international communities of professional evaluators.

Fostering innovation in the business sector

Croatian businesses innovate less frequently and commit fewer resources to innovation than their EU27 counterparts. It is fair to say that their propensity to innovate is weak. Part of the reason is Croatia's industrial structure, with a preponderance of small firms that tend to be in sectors that are known for lower rates of innovation. At the same time, business R&D expenditure is lower even than in countries with similar industrial structures and has declined in real terms and, especially, as a share of GDP. The modest resources Croatian businesses devote to R&D translate into fewer patents than in countries with comparable resource commitments. This is likely due to structural and institutional factors such as the lack of MNE headquarters, the dominance of a rather disconnected public research sector and the lack of appeal of IPR. This may have much to do with the kinds of R&D performed in Croatia, which is often linked to the activities of MNEs that ultimately choose to patent elsewhere. Features of the current tax credit scheme may also favour patenting outside Croatia.

Public support for business-sector innovation has mostly focused on the interface between public research and businesses, mostly favouring a one-way transfer of ideas from public research to the market. The rationale for this approach may be traced back to a widely held view that the country has a strong but underused science base. The contrast between this view and the weak economic outcomes of public R&D motivated efforts to strengthen linkages and transfer mechanisms. However, when compared to other countries, Croatian science lags behind. Moreover, the business sector has little capacity to absorb the kinds of knowledge produced in university and PRI research settings. Evidence from a variety of sources supports the view that the binding constraint is not at the interface but at the core of public sector and, especially, business-sector innovation capacities.

Support in terms of public-private R&D interface measures has been helpful to a small number of firms and has led to a few success stories in terms of spin-offs and commercialisation. It has however meant that policy support has left aside the majority of Croatian firms which are still taking their first steps in innovation. For these firms innovation activity largely consists of new-to-the-firm innovation in the form of adoption of processes, physical investments in equipment and machinery, and associated adaptations. Among the minority of firms that innovate, the challenge is to progress to the next steps, which include new-to-the-market, new-to-the-industry and new-to-the-world innovation. Even in these cases, there is a poor fit between the needs of firms and the type of policy support provided.

The most pressing limitation is the small amount of resources devoted to direct (via grants) and indirect (via tax credits) support for business R&D and innovation. To give an idea of the magnitude of the shortfall, resources will have to increase several times just to match the commitments of other new EU member states. Success in raising the innovation potential of the business sector will hinge on the adoption of a wider concept of innovation and the deployment of a wider range of support measures (covering education, training, firm-to-firm networks, etc.), in order to appeal to a greater variety of companies and to have the potential to have a lasting impact on firm innovation behaviour.

Strengthening the links in the innovation system

There are few links between the business sector, the universities and PRIs and they have not had a substantial impact. Croatia trails internationally in terms of co-operation on innovation among firms and between firms and other institutional actors. Co-publication data suggest that university-industry collaboration is about half as frequent in Croatia as it is on average among EU countries. The weak links with industry are also apparent in the structure of the income of HEIs and PRIs.

In part this reflects the limits imposed by a system that devotes few resources to R&D and innovation and in which business innovation capacities are weak. Such limits can be understood in terms of the infrequent, small-scale innovation activity and highly concentrated R&D activity in relatively few business firms. In this context there are few potential partners for collaboration and few opportunities for identifying projects of common interest. Lack of links with industry also reflects public research actors' inability to respond to the needs of industry and society, owing to insufficient incentives for individual researchers and to organisations' lack of flexibility to mobilise and combine resources.

Such a situation is common in many developing innovation systems and can be described as a "low-level equilibrium", with little effective demand for and supply of innovation-related services. In the business sector, this is due to a lack both of interest and of ability. In Croatia, many firms derive profits in markets that are not very competitive, which effectively dampens the attractiveness of innovation. Strengthening competitive pressures and promoting an export orientation would do much to increase the attractiveness of innovation. In addition, the ability of firms to make use of innovation is constrained by a lack of in-house capabilities and associated activities in design, engineering, marketing, IT and other knowledge-intensive activities. Overcoming this situation will require changes in the incentives, organisation and governance of HEIs/PRIs, such as interventions to strengthen competition and to facilitate the accumulation of in-house capabilities in business firms. More extensive spillovers from the activities of strong R&D and innovation performers, such as multinational subsidiaries, would also help.

The adoption of a definition of university-industry linkages that goes beyond science-push R&D activities would be a necessary first step in achieving a stronger impact on the behaviour and capabilities of participants and on the economy more generally. In addition to R&D collaboration, linkages worthy of promotion would include regular consultation on the content of skills, the introduction of sandwich courses with longer (up to one year) work placements, joint workshops, industry involvement in doctoral schools, development of professional doctorates with distinct criteria for advancement and tailored HEI study programmes for those already in employment (part-time/summer courses) including in entrepreneurship. Government co-funded and HEI-led on-the-job-training schemes at the premises of multinational subsidiaries may help increase the incidence and impact of knowledge spillovers and may be worth attempting.

Fostering critical mass, excellence and relevance in public research

The new universities founded over the last decade have facilitated the expansion of higher education and resulted in a more geographically balanced distribution of tertiary education and research capacities. Many PRIs also cater to a wide range of missions and disciplines. However, universities and PRIs still suffer from resource constraints, especially for research. Judging by the number of scientific publications, universities and

PRIs have improved their performance over the past decade, although their publications have a lower impact than in comparable countries. In terms of disciplines, engineering and some other technical disciplines have experienced a relative decline.

The ability to steer the system towards more large-scale and long-term research is hampered by a lack of resources, volatility in funding, and sub-optimal institutional and governance structures. Moreover, public organisations have few incentives to perform and to plan strategically. The highly fragmented management of the older universities, the fragmentation of PRIs, and inflexibility in the use of various funding streams compound the problem.

Policy has paid much attention to commercialisation of public research (such as incubators, spin-offs, technology parks) at the expense of systematic capacity building at the core of public research organisations. As a result, Croatia has little experience in handling large, long-term research investments, unlike other countries with developing innovation systems that have experimented with and acquired experience in large-scale research programmes linked to economic (often sectoral), social or systemic challenges, such as competence centres and doctoral schools (typically with 50-150 researchers over a period of 7 to 12 years).

A rise in R&D intensity and more broadly in the incidence of economically useful innovation requires strategic planning and can only happen once a backbone of specialised human resources, coherent research programmes with a long-term orientation, and associated investments in infrastructure are in place – all of which take time. Competence centres and doctoral schools can play a role, provided they are anchored to meaningful long-term research programmes. The introduction of performance-based budgeting and greater autonomy in HEIs and PRIs are important pre-conditions for taking a more focused, long-term outlook.

While important steps have been taken to improve the quality of research, with the founding of ASHE and various systematic evaluation exercises, there is much room for improvement. Competitive funding accounts for a small share of total funding. CSF should have significantly more funds for its competitive funding programmes and its mission should be focused on the promotion of scientific excellence by fostering within-country competition and increased international collaboration.

Care will need to be exercised in the geographic distribution of capacities for R&D and innovation. One the one hand, dedicated development agencies or equivalent functions provided by incubators, business centres, technology transfer offices and chambers of commerce can help businesses develop their innovation capacities irrespective of their location. On the other hand, proximity to industrial centres, usually close to large cities, is important for economically useful innovation; typically these are the places where suppliers, clients and a host of service providers (including HEIs and PRIs) provide the stimuli and support for innovation. In light of the limited resources available, it may be preferable to favour a clustering of investments on technological capacities near industrial centres, ideally on locations with good international links. Nevertheless, regionally targeted measures and associated agencies and organisations will be needed to integrate innovation actors from all regions in the national and European institutional framework and help them access markets, playing the role of "first-stop shop" rather than "one-stop shop".

The Structural Funds provide a unique opportunity to bring about lasting change in all of these dimensions. They can be used to support the emergence of large-scale activities, provide stability and continuity, and establish mechanisms (for competitive funding and evaluation) to promote scientific excellence. It will be important to ensure that the planning and monitoring capacities at MRDEUF are sufficient to cope effectively with the unprecedented demands imposed by the SF. Coordination between MRDEUF and the innovation policy stakeholders (especially the implementation agencies) is necessary and should be strengthened.

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

Cross-country studies suggest that integration in international scientific and innovation networks is associated with high R&D productivity (Varga et al., 2012). The Croatian innovation system has become more internationalised over the last decade, but there is significant scope for further internationalisation. Indicators on international mobility and scientific co-publications indicate that Croatia is not as internationalised as one would expect given its size, geographic location and links to the EU.

Internationalisation has not been very visible on the national STI policy agenda. With the exception of a few *ad hoc* initiatives such as those for personnel mobility, the Unity through Knowledge fund and support for EUREKA participation, few policy interventions address this issue. It may be worth developing an internationalisation strategy for R&D and innovation to which specific initiatives can be attached in terms of funding (FP, European Research Council), mobility, participation in international infrastructures and provision of sufficient support for an export-oriented business sector.

Notes

1. This section draws extensively on Švarc (2006).
2. See art. 17 of the modified Law on incentives for the development of small business, voted in May 2013: http://www.zakon.hr/cms.htm?id=385 (in Croatian).
3. MoEC is active in so-called business clusters which are organised bottom-up, while MoE is implementing so-called competitiveness clusters, which are set up in a top-down fashion, linking to the industrial policy and sectoral policies (12 priority sectors are determined by the industrial strategy, and a nation-wide competitiveness cluster is then set up in each of these priority sectors).
4. BICRO has s made notable efforts to strengthen awareness among companies on IPR matters. In cooperation with SIPO, BICRO has realised several workshops and produced guidance publications covering various aspects of IP (introduction to IP, searching through free patent databases, trademark and industrial design protection, copyright in ICT etc.). BICRO also participates to the EU IPR Helpdesk Ambassadorship program.
5. The synthesis of these empirical observations is due to Prof. Martin Bell, SPRU, University of Sussex.
6. Examples include the Swiss National Science Foundation (SNF), the Austrian Science Fund (FWF), the Dutch Organisation for Scientific Research (NOW) and the Academy of Finland.
7. A minor share of the total budget of PRIs and HEIs is derived from contract research and grants from funding agencies (15.8%, PRIs and 19.9%, HEIs, 2010), including 4.9% (PRIs) and 2.8% (HEIs) from abroad.
8. The Herfindahl index (HFI) is a measure of concentration of a quantity (in this case R&D funding) across sectors, calculated as the sum of the squares of the shares p of each NACE sector i out of the national total (HFI=$\Sigma pi2$). Here is reported the equivalent number of equally sized sectors that would give rise to the calculated index value (=1/HFI) which, unlike the unitless index, has a more intuitive interpretation. HFI was calculated on the basis of 52 discrete sectors that were either 3-digit NACE or the nearest higher level aggregation available. The Slovak Republic is excluded as more than 10% of government funded BERD was not apportioned to specific sectors.
9. Although over 270 companies used tax incentives, 90% of the total tax incentives concerned 9 companies in 2008 and 27 in 2009.
10. The changes in legislation and regulation discussed in this section are distinguished in terms of their pervasive impact on the rules of the game affecting the behaviour of actors in the innovation system.
11. This is a project funded by the Twinning Financing Programme to develop flood hazard maps and flood risk maps for Croatia. The Croatian partners are the Ministry of Regional Development, Forestry and Water Management, Croatian Waters; the EU partners are the Netherlands (Ministry of Economic Affairs, Agriculture and

Innovation, Dutch Government Service for Land and Water Management, Regional Water Authority Brabantse Delta and the DLO Agricultural Research Service), France (Ministry of Ecology, Sustainable Development, Transport and Housing (MEDDTL), International Office for Water) and Austria (Austrian Environment Agency, Federal Ministry for Agriculture, Forestry, Environment and Water Management, Via Donau).

12. A notable Croatian example is Dok-Ing, an innovative manufacturer of robots which started with a public procurement contract which arose from the need for demining robots after the war in Croatia.

13. Literature on the systemic nature of innovation emphasises the crucial importance of the configuration of actors in the system and the synergies, interactions, flows and linkages between them. In contrast to the market failure rationale for government intervention, such an approach highlights the importance of systemic problems that go beyond the scope of markets, and can be linked to co-ordination failures between and within decision makers in governments, the business sector and the public research sector (OECD, 1997; Woolthuis et al., 2005; Kubeczko and Weber, 2007). The idea of co-ordination failures is broad and may include instances of "too little" co-ordination, co-ordination of the wrong kind, or even "too much" co-ordination. Indeed, co-ordination has costs – in terms of time and effort to open communication channels, build and maintain working relationships etc. – that have to be balanced against its potential benefits. In some cases the costs of continuous co-ordination are high enough to justify setting up organisational boundaries, which, in addition to saving on continuous co-ordination costs, have the added advantage of efficiency improvements due to the division of labour.

14. A process driven by the increasing complexity and sophistication of science, the co-ordination costs implied by specialisation and more extensive divisions of labour, and a move towards interdisciplinarity, the combined effect of which is reflected in, for example, the increase over time in the incidence of co-authorship.

15. The importance of capability accumulation in design has been recognised in various EU policy documents (including the Innovation Union 2020 report). Actions taken at the European level include the launch of the *European Design Innovation Initiative,* which has a list of recommendations for raising the profile of design (http://ec.europa.eu/enterprise/policies/innovation/policy/design-creativity/edii_en.htm).

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