ERAWATCH Country Reports 2012:
Former Yugoslav Republic of Macedonia

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This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). ERAWATCH is a joint initiative of the European Commission's Directorate General for Research and Innovation and Joint Research Centre.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context.

The first draft of this report was produced in December 2012 and was focused on developments taking place in the previous twelve months. In particular, it has benefitted from the comments and suggestions of Carlo Gianelle from JRC-IPTS.

The report is currently only published in electronic format and is available on the ERAWATCH website. Comments on this report are welcome and should be addressed to jrc-ipts-erawatch-helpdesk@ec.europa.eu.

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EXECUTIVE SUMMARY

In 2010, the Gross Expenditures on Research and Development (GERD) of the Former Yugoslav Republic (FYR) of Macedonia as a percentage of Gross Domestic Product (GDP) was 0.221%, significantly increased from 2009, when it was 0.199%. In absolute value, GERD of the country increased from €13.27m in 2009 to €15.38m in 2010. Nevertheless, when compared to the EU-27 average of 2.01% in 2010, country’s GERD was significantly lower and reflects an under funding of country’s Research and Development (R&D) sector.

The main trends during the period of 2008-2010 were the increase of absolute and relative shares of government funds and the decrease of the same shares of funds from the business sector. The share of the funds from abroad in 2010, 16.7%, was on almost the same level as it was in 2008. In 2010, the governmental sector was still the biggest contributor to the total R&D expenditures by funding sources with 64.3%, while the funds from the business sector were 18.0%. Compared with 2009, the government funds increased by 48.2% in 2010, with the business R&D funds being decreased by 16.6%. The main structural change in GERD by performing sector is the decrease of business intramural expenditures for R&D (BERD) from 28.5% in 2008, to 11.2% of GERD in 2010. Higher Education Sector (HES) and the government sector are the main R&D performing sectors in 2010 in the country with the shares of 44.6% and 44.2% of GERD respectively.

In 2012 the government of the FYR of Macedonia adopted the Innovation Strategy of the FYR of Macedonia for 2012-2020 (ISRM 2012-2020), prepared by the Ministry of Economy. In the same year, the Ministry of Education and Science prepared and adopted the National Strategy for Scientific R&D Activities 2020 (NSSRA 2020) and the National Programme for Scientific R&D Activities 2012-2016 (NPSRA 2012-2016). Both of the strategies along with the programme clearly define national R&D and innovation (RDI) priorities and propose an action plan for their implementation. While the ISRM 2012-2020 primarily fosters the innovation capabilities of businesses horizontally, NSSRA 2020 and the NPSRA 2012-2016 are more citizen-centric. At the same time the government reorganised the political and operational levels of the R&D and innovation systems through establishment of two new committees, the Committee for Technological Development (CTD) and Committee for Entrepreneurship and Innovation (CEI), and renewal of the National Council for Entrepreneurship and Competitiveness (NCEC) as a governmental advisory bodies. The structures of the committees, ministers from the ministries involved in R&D and innovation, along with the participation of all important stakeholders in NCEC, show high commitment of the government for supporting innovation and strengthen the operational capacity for implementation of the programmes with involvement of all stakeholders.

The ISRM 2012-2020 recognise the strategy of smart specialisation as a sound basis for building up the national system of innovation, but it takes a neutral stance regarding sectors and doesn’t impose sector specialisation. The structural challenges of the Macedonian RDI system are as follows:

- Inefficient governance of the innovation system;
- Lack of quality human resources for RDI;
- Weak science-industry linkages;
- Low capacity for innovation by the companies; and
- Absence of a national roadmap for building quality research infrastructures (RIs).

The absence of dedicated institutions that are clearly responsible for the innovation in the country, without proactive involvement of all stakeholders in the development and implementation of RDI policies creates a mismatch between the supply and demand side for
innovation support and a disconnection of research and business sectors. The available RDI statistics show a very low quality of human resources and the HES as the main provider of researchers. RDI data also shows the small capacity of the private sector to become directly involved in R&D and innovation activities, and to establish linkages with scientific institutions. The overcoming of these discussed weaknesses of the national RDI system is not feasible without investments in quality RIs. For better utilisation of the existing and the new RIs, the country needs a national roadmap for building higher quality RIs.

The national research and innovation priorities are defined in the two strategies prepared and adopted in 2012, namely the ISRM 2012-2020 and NSSRA 2020 with the NPSRA 2012-2016. The ISRM 2012-2020 enables effective national innovation system, co-created by all stakeholders and open to the world, through actions in the following fields of intervention: enhancing the business sector’s propensity to innovate; strengthening human resources for innovation; creating a regulatory environment in support of innovation; and increasing knowledge flows and interactions between innovation actors. The NSSRA 2020 focuses on thematic priorities that cover the development of an open society and competitive economy, the development of low carbon society, sustainable development, security and crisis management and socio-economic and cultural development. The NPSRA 2012-2016 defines more precisely the coordination, implementation and financing of scientific and research activities, human resources, RIs, international cooperation and synergies with the business sector. The priorities defined in the policies adopted by the government in 2012 are partially matched with the discussed structural challenges. The specific policies are mainly well defined, but the existing inherited weaknesses such as unavailability of sufficient funding from both public and private sources had a negative influence on the overall effectiveness of the measures, which in turn slowed down their implementation and caused an absence of significant results.

The total budget for scientific and research activities and technological development for 2012 was decreased by 11% when compared to 2011. The shares of this budget that support the routes for (1) stimulating greater R&D investments in R&D performing companies and (2) attracting R&D performing companies (and universities) from abroad were significantly decreased by 78% and 52% respectively. On the contrary, within the R&D budget, the funds for the instruments that stimulate R&D in the public sector were increased by 7.7% in 2012. This route is additionally financially supported by the government with two new measures introduced in 2010, Equipping Laboratories for Scientific Research and Applicative Activities (ELSR), and the obligation of public universities to allocate 40% from tuition fees to R&D activities.

The economic growth of the country through the investments in education and science is the ultimate goal of main governmental programmes and RDI policies. The policies and measures envision increase of RDI expenditures and incentives, integration of the national R&D system in the European Research Area and alignment of the national R&D targets with European targets. However, the policies are mainly a declarative commitment of the government as of present, since the available R&D figures show that the both public and private funding is very low. Consequently, the effects of scientific and R&D related activities on the national economy are not significant, and it is therefore hard to establish a direct relationship between RDI investments and economic impacts. The only exception is the growth performance of the indicator Medium and high tech product as a percentage of total product export, which according to the IUS 2011 was 11.1%, due to the Foreign Direct Investments in the medium and high tech sectors in the country.

The short-term evolving direction of the national policy mix is an increase of funding to companies through dedicated policies and measures that will efficiently increase their absorptive capacity for R&D, innovation and new technologies; and also will support science-industry linkages. Since there is an on-going large investment in research laboratories, the short-term imperative of the country should be to define a national roadmap for RIs, in order to maximise
their utilisation. The development of an efficient monitoring system for the implementation of the RDI policies and measures could be regarded also as short-term direction for evolving the national policy mix. This is in line with the need for permanent monitoring and internal and external evaluation of the ISRM 2012-2020. Medium-term evolvement of the national policy mix should be increasing the quality of the HES and human resources capable of RDI activities.
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1 INTRODUCTION

The Former Yugoslav Republic (FYR) of Macedonia is a small country with a total area of 25,713 square meters, and population estimated to 2.06 million inhabitants in 2011. The country was granted candidate country status for European Union (EU) membership in 2005, and High Level Accession Dialogue with the European Commission (EC) was launched in March 2012. If the country joins the EU, the country’s surface area will be 0.6% of the EU total surface area, and the country’s population will be 0.41% as a share of the total EU population. In 2009, the Gross Domestic Product (GDP) of the FYR of Macedonia declined for 0.9% when compared to 2008, a modest recession when compared to EU average drop of 4.3%. The economy began to recover in 2010 when its GDP grew by 2.9%, this recovery continued into 2011 with real GDP growth rate of 2.8%. For the same year, 2011, the EU countries experienced real GDP growth rate of only 1.5%. Macedonian GDP reached €7.5b in 2011, which means that GDP per capita in 2011 was €3,640 or only 14% of the EU-27 average. As a member of EU, the country’s GDP would represent only 0.059% of EU GDP. The Macedonian unemployment rate in 2011 was 31.4%, much higher than the EU-27 average of 9.7%. In 2010, country’s Gross Expenditures on Research and Development (GERD) was €15.38m, representing 0.006% of EU-27 GERD. As a percentage of GDP, it was 0.221%, significantly lower in comparison to the EU-27 average of 2.01%, which reflects an under funding of country’s Research and Development (R&D) sector. Compared to the 2009, GERD in the both terms, absolute and relative, was increased significantly in 2010 for 15.9% and 11.1% respectively.

The public sector is the main funding sector for R&D activities in the country with 64.3% of GERD in 2010, much higher than the EU average of 34.6%. Compared to 2009, the public R&D funds in the country in nominal value were significantly increased from €6.68m to €9.90m in 2010. On contrary, private R&D finding was decreased from €3.32m in 2009 to €2.77m in 2010, representing 18.0% of GERD. The share is significantly lower when compared to the corresponding EU average of 53.9%. Furthermore, the negative trend for private R&D funding was registered for the whole period 2008-2010, since in 2008 it was €5.65m, or 37.4% of GERD. In 2010, the funds from abroad covered 16.7% of the total R&D spending in the FYR of Macedonia. The private non-profit sector’s contribution was insignificant in research funding as its share of expenditures on R&D was 1.0% for the year 2010.

Higher Education Sector (HES) and the government sector are the main R&D performing sectors in the country with the shares of 44.6% (HERD) and 44.2% of GERD (GOVERD). The decreasing trend of business intramural expenditures for R&D (BERD) in the period 2008-2010 is the main structural change in GERD, since it has decreased from 28.5% of GERD in 2008, to 11.2% of GERD in 2010. When compared with corresponding EU averages for GOVERD, HERD and BERD (13.7%, 24.6% and 61.7% respectively), FYR of Macedonia have significantly lower share for BERD and much higher shares for GOVERD and HERD.

The national R&D system is characterised by the modest availability of quality research infrastructures (RIs) and the low quality of human resources regarding the output of publications, citations and patents. In order to support and improve the existing RIs in the country, the government of the FYR of Macedonia through the Ministry for Education and Science (MES) launched a four-year project Equipping Laboratories for Scientific Research and Applicative Activities (ELSR) in 2010. Since the start of the measure until August 2012 the government has announced that 85 contracts for scientific laboratories with different state universities and public scientific institutions have been signed and 79 laboratories have been installed. For 2012 the dedicated funds in the state budget for this measure amounted to €2.25m. Also the government initiated the establishment of the Macedonian Academic and Research
Network (MARNet) as an independent institution in 2011 and the Macedonian Point for Internet Traffic Exchange (MatrIX) within MARNet. According to the internal report of the government, MARNet is an independent institution and MatrIX enables secure, reliable and efficient usage of domestic and international network resources by the research community in the country.

The total number of researchers in the FYR of Macedonia has increased from 1,254 researchers in 2009 to 1,429 in 2010, while the number of employees in R&D on an indefinite and definite period has increased from 2,050 in 2009 to 2,237 in 2010. The increase of researchers has been recorded in the government and higher education (HE) sectors. The biggest share of the researchers is employed in HE, 75.7%, while the business sector comprises only 1.3% of the total number of researchers.

The share of the population aged 30-34 having completed tertiary education was 17.1% in 2010, a significant increase from 2009, when it was 14.3%. The new doctorate graduates per 1,000 population aged 25-34 in 2011 were 0.63, which is under the EU-27 average of 1.5. However, the number of candidates who received a PhD diploma in 2011, 197, was increased by 25% when compared to 2010, mainly due to the increase of diplomas in social sciences. The human resources in science and technologies as a share of total labour force in the country were 24.1% in 2010, which is a slight increase when compared to 2009.

According to the SCImago Journal & Country Rank portal, which includes the journals and country scientific indicators developed from the information contained in the Scopus database (Elsevier B.V.), the FYR of Macedonia is ranked on the 91st place out of 226 countries, with a total of 593 published documents for the year 2011. In this regard, FYR of Macedonia scored lower than any EU country and some of the countries in the region such as Croatia (5,793 documents, ranked on 47th place) and Serbia (5,667 documents, ranked on 48th place). According to the State Statistical Office of the FYR of Macedonia (SSORM), the overall number of scientific publications in 2010, 1,462, was decreased by 7.6% when compared to 2009.

In 2011, a total of 405 patent applications were filed with the State Office of Industrial Property of the FYR of Macedonia (SOIP), 37 national and 368 foreign. The number of filed patent applications in 2011 compared to 2010 was increased by 11.2%. In the same year the SOIP received a total of 4,906 trademark applications, where 71.1% were under the Madrid Agreement, and the rest were filed to the SOIP. In the structure of the total number of applications 80.1% were foreign. The total number of applications was increased by 4.3% compared to the previous year. Regarding the applications for industrial design, in the course of 2011, a total of 803 applications were filed to the SOIP. The total number of the filed applications for industrial design in 2011 increased by 5.7% compared to the previous year.

Since the majority of researchers are employed in the HES, the rank of the universities is a relevant indicator of the quality and excellence of knowledge production. The best ranked university from the country is the biggest and the oldest university “Ss. Cyril and Methodius” (UKIM), which for the year 2012 is ranked on 1,247th place from 11,998 universities according to “Webometrics Ranking of World Universities”. The rank of the university has significantly improved, since in 2011 it was ranked on the 1,468th place.

The overall result in the Innovation Union Scoreboard (IUS) 2011 is that the FYR of Macedonia is one of the modest innovators with a below average performance. Relative strengths are in Human resources, Innovators and Economic effects. Relative weaknesses are in Open, excellent and attractive research systems, Finance and support, Linkages & entrepreneurship and Intellectual assets. High growth is observed for Population with completed tertiary education, International scientific co-publications, Community trademarks and Medium-high and high-tech product exports. A strong decline is observed for Non-EU doctorate students and R&D expenditure in the public sector. Growth performance in Human resources, Firm investments and Economic effects is well above average.
The FYR of Macedonia has a small open economy in which exports and imports account for a considerable part of GDP. The economy has an unfavourable structure since it is based on traditional sectors that are by nature not knowledge-driven. Furthermore, the national industry builds its competitiveness on a relatively inexpensive workforce which also negatively influences the demand for knowledge. According to SSORM, the private intramural research funding in 2010 was €1.72m. The total funding was mainly directed towards the Manufacture of pharmaceutical products (99.6%) and the Manufacture of textile products (0.04%). However, in 2010 the computer and IT-related sectors along with the sector for composite materials had a considerable participation in R&D and innovation activities in the country. Additionally, in 2011, the export of the product supported catalysts with precious metal has the biggest share of 12% in the total export value of the country. The specialisation of the country for this product is a result of Foreign Direct Investments (FDIs) in appropriate medium and high-tech industry sectors, which have a positive impact on knowledge demand. These industries and products are the main drivers for knowledge demand in the country.

The research and innovation system of the FYR of Macedonia and its governance is presented in Figure 1.

**Figure 1 : Overview of Macedonian research and innovation system**

The Parliament is the highest ranking policy-making authority in the country and together with the Parliamentary Committee on Education, Science and Sport is entitled to formulate and promulgate laws and policy documents of extreme importance. The government of the FYR of Macedonia is the highest executive body responsible for preparation and implementation of national research policies. The main advisory and expert bodies for R&D, implementation of industry policy and innovation are the governmental National Committee for Development of
Scientific Research and Technological Development and the National Council for Entrepreneurship and Competitiveness (NCEC). Additionally, the government has three advisory committees: the Committee for Competitiveness, the Committee for Entrepreneurship and Innovation (CEI) and the Committee for Technological Development (CTD). The committees advise the government during the preparation and evaluation of the corresponding policies and programmes.

On the operational level, the main ministries involved in R&D and innovation policies are the MES and the Ministry of Economy (ME). Up to the prototyping of the products and services, the overall responsibility for developing and administering country’s science and innovation system is concentrated in the MES. The minister at the MES has the Scientific Council at his disposal. In addition, other ministries are also active in the field of research and innovation policies with a focus on their specific sector-oriented responsibilities.

The European Information and Innovation Centre in the FYR of Macedonia (EIICM) was established in 2008 as a country’s partner in the Enterprise Europe Network. The Agency for Promotion of Entrepreneurship in the FYR of Macedonia (APERM) is a state-owned institution, established to realise the programmes regarding measures and activities for the promotion of small-business entrepreneurship. The implementation of specific educational policy measures also involves various government agencies, such as the Vocational and Education Training Centre (VETC), the National Agency for European Educational Programmes and Mobility (NAEEPM) and the Adult Education Centre (AEC).

Invest Macedonia is the governmental agency for foreign investments and export promotion of the FYR of Macedonia, which is in charge of attracting new foreign investments in the country and supporting the expansion of foreign companies with already established operations. The Directorate for Technological Industrial Development Zones (TIDZs) is a representative authority of the government of the FYR of Macedonia and administers all zones in the country. The zones in the country act as a nucleus for the development of innovation-based industries and the development of partnerships, strategic connections, and joint ventures with international corporations, domestic companies, universities, and centres for applied research. The SOIP is responsible for raising the awareness and knowledge for protection of the intellectual and industrial property rights.

Faculties and public research institutes, as units of state universities, are the main actors at the research performer level. The subsequent biggest performer is the Macedonian Academy of Sciences and Arts (MASA) through its five departments, which are also considered as a part of the government sector. The R&D units in the industry sector, small and medium enterprises (SMEs) and the different forms of science-industry cooperation like technology parks, business start up centres and incubators, are also a significant R&D performer in the country. The main performers within the business sector are the largest companies.

The FYR of Macedonia has no formal regional research policy, because it is a relatively small country with its research capacity mainly concentrated in the capital, Skopje. Nevertheless, through policies and measures adopted in the last few years, the government is making an attempt to decentralise higher education and the research infrastructures.
2 RECENT DEVELOPMENTS OF THE RESEARCH AND INNOVATION POLICY AND SYSTEM

2.1 National economic and political context

Since 2006 the ruling party that composes the coalition government has been the Internal Macedonian Revolutionary Organisation – Democratic Party for Macedonian National Unity (VMRO-DPMNE). This long timeframe has given them a strong ground for implementing their economic programme in which the ultimate goals are the improvement of the national competitiveness and company productivity through support of science, education, R&D and innovation. The framework of the main governmental activities which affect the research and innovation system in the country is the Programme of the Government of the FYR of Macedonia (PGRM) 2011-1015 in which one of the main strategic objectives is the investment in education, science, innovation and information technology as an element of a knowledge-based society. This commitment of the government directly caused the reorganisation of the R&D and innovation governance structure in 2012 through establishing the new CTD, renewing the NCEC and supporting university spin-off companies. New measures and projects for further improvement of the business climate and competitiveness were launched in 2012, along with the intensive international promotion of the country as an attractive investment destination. As a result of these policies, FDIs in 2011 in the country were doubled when compared with the year 2010 (€160m in 2010 and €337m in 2011), with a tendency for this trend to continue in 2012. Part of the FDIs was in the medium and high-tech industry sector, which according to SSORM in 2011 increased the participation of the medium and high-tech product in the total country’s export to 28%.

2.2 Funding trends

The main R&D funding indicators for the FYR of Macedonia for the period 2009-2011 in comparison with the corresponding EU-27 averages are presented in the following table:

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>EU27</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth rate</td>
<td>-0.9</td>
<td>2.9</td>
<td>2.8</td>
<td>-0.3 (2012)</td>
</tr>
<tr>
<td>GERD (% of GDP)</td>
<td>0.199</td>
<td>0.221</td>
<td>n/a</td>
<td>2.03% (2011)</td>
</tr>
<tr>
<td>GERD (euro per capita)</td>
<td>6.45</td>
<td>7.47</td>
<td>n/a</td>
<td>510.5 (2011)</td>
</tr>
<tr>
<td>GBAORD - Total R&amp;D appropriations (€ million)</td>
<td>6.68</td>
<td>9.90</td>
<td>n/a</td>
<td>91,277.1 (EU27 total 2011)</td>
</tr>
<tr>
<td>R&amp;D funded by Business Enterprise Sector (% of GDP)</td>
<td>0.042</td>
<td>0.025</td>
<td>n/a</td>
<td>1.26 (2011)</td>
</tr>
<tr>
<td>R&amp;D performed by HEIs (% of GERD)</td>
<td>32.5</td>
<td>44.6</td>
<td>n/a</td>
<td>24% (2011)</td>
</tr>
<tr>
<td>R&amp;D performed by Government Sector (% of GERD)</td>
<td>46.4</td>
<td>44.2</td>
<td>n/a</td>
<td>12.7% (2011)</td>
</tr>
<tr>
<td>R&amp;D performed by Business Enterprise Sector (% of GERD)</td>
<td>21.1</td>
<td>11.2</td>
<td>n/a</td>
<td>62.4% (2011)</td>
</tr>
<tr>
<td>Share of competitive vs institutional public funding for R&amp;D</td>
<td>0.33</td>
<td>0.38</td>
<td>0.44</td>
<td>n/a</td>
</tr>
</tbody>
</table>

s - EUROSTAT estimate

Data Sources: EUROSTAT, March 2013; SSORM, January 2013
The national research system of the FYR of Macedonia is under-funded, with a dominant role of the public research sector in the period 2008-2010 both as an R&D funder and an R&D performer. In 2010, GERD as a percentage of GDP was 0.221%, significantly lagging behind the EU average of 2.01%. After a substantial increase from 0.175% in 2007 to 0.225% in 2008, in 2009 GERD as a percentage of GDP decreased to 0.199%.

With the Action Plan for 2008, adopted by the MES, the R&D target was to increase the funds for scientific research by approximately 35% per year until the EU target of spending 3% of GDP on R&D was achieved (Dall E., 2008). The target was not achieved. On the contrary, in 2009 GERD as a percentage of GDP was decreased compared with 2008. In the National Strategy for Scientific R&D Activities 2020 (NSSRA 2020) and National Programme for Scientific R&D Activities 2012-2016 (NPSRA 2012-2016), a new targets are proposed for the country. According to these targets, the country’s expenditures in R&D as percentage of GDP should be 1% in 2016 and 1.8% in 2020, with 50% of the GERD performed by private businesses.

The main structural change in GERD between 2008 and 2010 is due to the significant decrease in intramural BERD from €4.3m in 2008 to €1.72m in 2010. In the same period, BERD as a percentage of GDP decreased from 0.065 to 0.025, while the participation of the business sector in GERD was decreased from 28.5% to 11.2%. The leading performing sector in the country in 2010 is HES with 44.6% of GERD, a significant increase when compared to 32.5% in 2009. The participation of the government sector as a share of GERD was slightly decreased from 46.4% in 2009 to 44.2% in 2010. The structure shows the low capacity of the business sector for R&D, since the participation of the business sector in total GERD for EU countries was 61.5% in 2010. The decreasing trend in BERD is regarded as a direct effect of the world economic crisis, since it was mostly felt in the real estate sector in 2009. The total Government Budget Appropriations or Outlays on R&D (GBAORD) as a percentage of GDP in 2010 in the country were increased to 0.14 compared to the years 2008 and 2009, when they were 0.1. However, GBAORD as a percentage of GDP is almost five times less than the EU 27 average.

The GBAORD in 2010 were €9.90m, a significant increase of 48.2% when compared to 2009. A closer approximation of the budget outlays for R&D is the budget line for “science” in the national budget, along with the budget line for MASA. In 2012 the science budget line comprised three types of funds; the first type is an outlay for direct transfers, i.e. institutional support to horizontal research performing public institutes; the second type provides funds for the main R&D funding instruments, and the third type is the financial support for the measure ELSR, which is competitive-based. Competitive-based share of the science budget line for 2012 is 66%, significant increase when compared to the share for 2011 of 44%. The increase is mainly because of the considerable funds dedicated for the measure ELSR. The total budget line for MASA is based on institutional funding. There are separate block budget lines toward state universities which mainly consist of non-direct R&D expenditures for General University Funds (GUF), however here the R&D portion is neglected.

The government of the FYR of Macedonia strengthens the R&D and innovation through tax incentives and subsidies. The emphasis in the period 2008-2011 was on tax incentives, which were proposed as measures in the main national policies that include R&D and innovation. In 2012 two projects that include subsidies have been started, the project “Scientific Subsidies”, and the project “Creative Subsidies”. Nevertheless, there is no evidence regarding the financial dimension of these measures in terms of money and implications for R&D activity in the country.

Collaborative funding is realised through the Programme for Technological Development (PTD) which supports science-industry linkages, know-how and technology transfer, and direct
collaboration of the business sector with the public sector. The funds for the PTD were significantly decreased in 2012 when compared to 2011 by 78%, while the funds provided for direct collaboration with the public sector dropped by 31% in 2012 when compared to 2011.

According to the latest available data from the SSORM, the most important source of funds for research activities in the country in the period between 2008 and 2010 was the government sector. The government sector share in the funding was 45.9% in 2008, 50.3% in 2009 and 64.3% in 2010. While the relative share of government funds has significantly increased in the period 2008-2010, the share of funds from the business sector have an incremental decrease. This share in the total R&D funding for the same period decreased from 37.4% to 18.0%. The share of funds from abroad in 2010, 16.7%, was on the same level as in 2008, and decreased from 24.5% in 2009. The most important international programmes for the country are FP7, CIP and EUREKA, which enable the institutions and organisations from the country to get involved in more advanced R&D programmes. The country’s RDI system is also supported with the projects financed by USAID, GIZ and OECD. The private non-profit sector’s contribution was insignificant in research funding as its share of GERD was in the 0.2%-1.0% range for the period 2006-2010.

The research programmes from the MES are mainly generic and lack a sectoral or thematic character. However, in the period before 2012, the following sectors were prioritised: textile, Information and Communication Technology (ICT), tourism and wine. Various methods and mechanism have been used for supporting of these sectors. A more dedicated focus on thematic areas can be expected in the following period, since the NPSRA 2012-2016, adopted in 2012, envisions several thematic areas.

2.3 New policy measures
In the year 2012 the government of the FYR of Macedonia adopted, or revised the following policy measures:

- In June 2012 the government adopted legislation for university spin-off companies’ projects. The measure is part of the PGRM 2011-2015. According to the programme up to €20,000 in grants are envisioned for co-financing spin-off companies. There is no evidence if such a company has been established in the country.

- In order to significantly improve the national RDI system, in 2010 the government launched the measure ELSR. The measure was envisioned in the PGRM 2008-2012 and PGRM 2011-2015. The dedicated funds for the measure were €7.33m for 2012, but due to the economic crisis and the budgetary restrictions adopted by the Parliament in April 2012 the funds for this measure were significantly decreased to €2.25m. However, according to the governmental reports, the implementation of the measure in 2012 followed the initial schedule, only the payment of the equipment was reprogrammed.

2.4 Recent policy documents
In the course of 2012, the following policy documents are adopted:

- In October 2012 a separate Innovation Strategy of the FYR of Macedonia for 2012-2020 (ISRM 2012-2020) was adopted by the government. The strategy was prepared by the ME with support from the OECD. One of the main strengths of the policy is the involvement of all relevant stakeholders from the country in its preparation. This strategy takes into account the country’s current state of development to ensure that policies to promote innovation are both focused and relevant for the country. The strategic objectives of the policy concerning the business sector’s propensity to innovate, quality of the human resources and knowledge flows are in line with the structural challenges of the national system.
• The NSSRA 2020 was prepared by the MES. The strategy went through broad public discussions organised in the second half of 2011 and the first half of 2012, and proposed new R&D targets for the country.
• The changes of the Law on Scientific and Research Activities (LSRA) were adopted by the government in April 2012. The purposes of the changes are increasing the efficiency of the work of the Scientific Council, defining the competitive criteria for promotion of the centres of excellence, financing large projects of national interest and mandatory check for the originality of scientific publications.

2.5 Research and innovation system changes
Since end of 2011 the government of the FYR of Macedonia has strengthened the governance structure of the national R&D and innovation system through the establishment of new committees and agencies. In this period the both committees, CEI and CTD were established as governmental advisory bodies. The main priorities of the CEI are the improvement of the competitiveness of the national economy, as well as improvement of employment and economic activity through development of entrepreneurial spirit, especially by young people. The prime-minister acts as a president of the committee. The establishment of the CTD is envisioned in the Law on Encouragement and Support of Technological Development (LESTD), adopted in 2011. After its establishment in 2012, the committee managed to prepare the proposal for a four-year PTD. Since the committee consists of six ministers from the ministries involved in R&D and innovation and the vice-president of the government of the FYR of Macedonia responsible for economic affairs as a president of the committee, the operational capacity for implementation of the programmes should be significantly increased. In order to improve the competitiveness of the national economy, in April 2012 the government established the NCEC. In December 2012 on the proposal of the CEI and the NCEC the government founded a new fund for innovation and technological development. In 2013 the fund will be financially supported only by the government.

The new ISRM 2012-2020 envisions establishment of a new Technology and Innovation Agency (TIA) in 2013. The new agency is expected to further strengthen the governance of innovation.

2.6 Regional and/or National Research and Innovation Strategies on Smart Specialisation (RIS3)
The FYR of Macedonia hasn’t spelled out the priorities for areas of specialisation. The ISRM 2012-2020 recognises that successful economic development does not necessarily coincide with an increasing share of production in high technology sectors. High value added activities can also be found in traditional sectors and innovation can help firms move from low-value added activities to high value added activities. Hence, instead of trying to artificially develop specific sectors such as high technology sectors, the innovation policy of the country takes a neutral stance regarding sectors. It is up to complementary policies to direct resources towards sectors where endowments and capabilities offer the greatest potential for moving up the value chain, thereby facilitating smart specialisation.

The FYR of Macedonia is currently a part of the Western Balkan (WB) Regional R&D Strategy for Innovation, which is regional initiative for development of a joined strategy that integrates the strategies of all countries involved, and additionally sets regional priorities and measures. The ultimate goal is the country to become a part of the Balkan Innovation Fund, and other joint activities.
2.7 Evaluations, consultations

The overall innovation performance measurement system in the FYR of Macedonia was established through the inclusion of the country in the IUS. In IUS 2011, the country is assessed as one of the modest innovators with a below average performance. High growth is observed for Population with completed tertiary education (10.2%), International scientific co-publications (16.7%), Community trademarks (12.7%) and Medium-high and high-tech product exports (11.1%). A strong decline is observed for Non-EU doctorate students (-11.1%) and R&D expenditure in the public sector (-6.1%).

There isn’t any official evaluation of the innovation support programmes in the observed period. However, as a part of the regular yearly reports the responsible ministries submit annual reports to the government for the majority of the innovation measures.

In the report for the measure ELSR, which comprised the biggest share of the public R&D funds for 2012, it is stated that the measure received positive feedback from the research community and that there is a high interest by the public research institutions to receive funding from this measure. Since the start of the measure until August 2012, 79 out of 190 planned laboratories were installed and 85 contracts for scientific laboratories with different state universities and public scientific institutions were signed.

For the purpose of preparing the ISRM 2012-2020 and NSSRA 2020, in the period 2011-2012 broad consultations were undertaken with all important stakeholders. The consultation processes were coordinated by the responsible ministries, ME for the ISRM 2012-2020 and MES for NSSRA 2020. Each ministry first sent a draft version of the strategy to all university units, MASA and business associations such as chambers of commerce, and after the ministry collects comments and suggestions from these bodies. The ministry decided which suggestions will be adopted for the final version of the policy.

2.8 Policy developments related to Council Country Specific Recommendations

Not applicable.
According to the **IUS 2011** the FYR of Macedonia is categorised in a group of modest innovators. The performance index for the country is 0.252, significantly below the EU average of 0.539. The growth performance of the country is above the EU average at 2.3%, but this is still below the average growth performance of the modest innovators group at 4.4%. Bulgaria, which is growth leader among the modest innovators, has a growth performance of over 8.5%, and is the only country from the region that belongs to this group. The other countries from the region, such as Serbia and Croatia, belong to the group of moderate innovators with performance indexes of 0.282 and 0.310 respectively, and growth performance above 4.1%. The position of the country is a consequence of the marginalised position of the RDI system since its independence in 1991, and low participation of private companies in the creation of R&D and innovation policies. Conversely, neither the government nor academia have provided a challenge to the business sector to get involved in R&D and innovation activities and policy developments. The main Innovation Union indicators for FYR of Macedonia are presented in the following table:

### HUMAN RESOURCES

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>New doctorate graduates (ISCED 6) per 1000 population aged 25-34</td>
<td>0.63*</td>
</tr>
<tr>
<td>Percentage population aged 25-64 having completed tertiary education</td>
<td>17.1</td>
</tr>
</tbody>
</table>

### Open, excellent and attractive research systems

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>International scientific co-publications per million population</td>
<td>117</td>
</tr>
<tr>
<td>Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### Finance and support

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D expenditure in the public sector as % of GDP</td>
<td>0.155</td>
</tr>
</tbody>
</table>

### FIRM ACTIVITIES

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R&amp;D expenditure in the business sector as % of GDP</td>
<td>0.025</td>
</tr>
</tbody>
</table>

### Linkages & entrepreneurship

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public-private co-publications per million population</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### Intellectual assets

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCT patents applications per billion GDP (in PPSC)</td>
<td>0.22</td>
</tr>
<tr>
<td>PCT patents applications in societal challenges per billion GDP (in PPSC) (climate change mitigation; health)</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### OUTPUTS

### Economic effects

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium and high-tech product exports as % total product exports</td>
<td>28*</td>
</tr>
<tr>
<td>Knowledge-intensive services exports as % total service exports</td>
<td>29.35</td>
</tr>
<tr>
<td>License and patent revenues from abroad as % of GDP</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Data Source: **Innovation Union Scoreboard 2011**

*own estimations according to the data provided by SSORM
**Inefficient governance of the innovation system**

The weaknesses related to the governance of the innovation system are presented in several governmental reports and independent analysis. The absence of dedicated institutions that are clearly responsible for the innovation in the country, and proactive involvement of all relevant stakeholders in shaping and implementing the innovation policy creates additional difficulties such as a mismatch between the supply and demand side for innovation support and disconnection of research and business sectors (Institute Ivo Pilar, 2010; Radosevic S., 2009). The absence of general governance in the overall system of innovation along with the weaknesses of the systems for financial support of innovation by both public and private sectors are noted in the European Innovation Scoreboard (EIS) in the FYR of Macedonia 2010 (CONTESTI, 2011).

According to the comprehensive analysis of the national innovation system (OECD, 2012), which was conducted to support the development of the ISRM 2012-2020, the governance structure of the innovation system does not provide efficient legal and policy arrangements for a supportive environment in private sector and university–enterprise cooperation. On the performer level, the research and innovation activities are concentrated amongst few actors. The largest actor, UKIM, comprises 63% of the total research and teaching personnel in the state university sector in 2011, while only few private companies reported private intramural R&D expenditures in the country (SSORM, 2012). The monitoring system for innovation is still not implemented well, both in terms of institutions that monitor innovation activities, and in indicators used to monitor innovation.

In order to overcome these challenges, since the end of 2011 the government has re-organised the governance structure of the national RDI system with a focus on political and operational levels. In this period the government established two new committees, the CTD and CEI, and the NCEC as governmental advisory bodies. However, there is no clear evidence that so far actions have significantly improved the efficiency of the governance of the national innovation system. Further strengthening of the innovation governance is expecting through the new TIA, envisioned in the ISRM 2012-2020. The establishment of the TIA is scheduled for 2013.

**Lack of quality human resources for RDI**

According to the IUS 2011, the FYR of Macedonia has relative strength in Human resources, mainly because of the increasing trend of the indicators New doctorate graduates per 1,000 population aged 25-34 and Population aged 30-34 having completed tertiary education. Nevertheless, both indicators are significantly below the EU average. The performance of the country for the indicator New doctorate graduates per 1,000 population aged 25-34 is only 42% of the EU average in 2010, while the performance of the indicator Population aged 30-34 having completed tertiary education is 51% of the EU average. However, in the period 2009-2011 when the number of candidates who received a PhD diploma was increased by 65.6%, the total number of researchers was increased by only 4.5%. Also, the total number of employees in R&D on indefinite and definite period in the country was 2,237 in the year 2010, or 0.35% of the total employment in the country, much lower than the EU average of 1.04%. Additionally, the Intellectual assets dimension from IUS 2011 for the country indicates the low quality of the national innovation system with all scores in a range from 1% to 6% of corresponding EU averages. In the Global Competitiveness Report (GCR) for 2012-2013 (World Economic Forum, 2012) Inadequately educated workforce in FYR of Macedonia is ranked as a second problematic factor for doing business in the country.

Regarding the fact that there has been almost no inflow of researchers and university professors from abroad due to the under-developed educational and research systems in the country, the domestic HES has been the only supplier of researchers and academic employees at universities. On the other hand, the international position of the Macedonian HES is very weak, and it is
listed only on “Webometrics Ranking of World Universities” where in 2012 the “Ss. Cyril and Methodius” university was ranked on 1,247th place and the other universities were ranked after 4,500th place from 11,998 universities. For the same reasons, an outflow of quality researchers and professors was recorded in the period following the independence of the country in 1991. This circumstance additionally decreased the quality of human resources in the country for research and innovation.

**Weak science-industry linkages**

IUS 2011 assesses FYR of Macedonia as a weak performer in Linkages & entrepreneurship, and the EIS 2010 in the FYR of Macedonia stresses out that one of the main structural challenges of the national innovation system is the weakness of business-university linkages. According to the GCR 2012-2013 on the indicators for university-industry collaboration in R&D the country is ranked on the 105th position from 144 countries. From the survey conducted in the framework of the EIS 2010 study, only 17.3% of the surveyed companies can be classified as product innovators for the period 2007-2009, and only 14.5% of the products are innovated in collaboration with other companies or institutions (universities, research centres, etc.). This percentage for SMEs is 9.6%. This problem is additionally strengthened by: the low number of researchers employed in the private sector (only 1.3% of the total number of researchers in 2010), the weak system for financial support of innovation, and the focus of the HES on education rather than research. The most heavily discussed aspects of the national R&D and innovation systems in the country are the old fashioned universities’ curricula which are not in line with the needs of the industry and the lack of know-how and technology transfer to the business community (Polenakovik R. & Pinto R., 2010). The need for coordination of education and research with the changing needs in the field of labour is also recognised in the National Strategy for Development of Education in the FYR of Macedonia 2005-2015 (NSDEM 2005-2015).

The structure of R&D expenditures in the country also shows weak linkages between the science and business sectors. In the period 2008-2010 all R&D money spent by the business sector is from its own sources, which means that no funds were recorded from government or abroad (ERAWATCH Network, 2011). Also in 2009 the intramural business expenditures represented 84.5% of the total business R&D funds, whilst only 15.4% was spent by the HES. The corresponding figures for 2010 show strengthening of the linkages, since HES spent 35% of the total R&D funds provided by the businesses.

Furthermore, according to the ISRM 2012-2020, the collaboration between businesses and research institutions, which could increase the commercialisation of research, is also very limited and could be improved. It can be concluded that besides the noted improvements, linking education and research with the labour market and establishing and strengthening linkages between universities, businesses and industry is still a very important structural challenge for the country and its policy makers.

**Low capacity for innovation by the companies**

The business sector comprises only 1.3% of the total number of researchers, and performs only 11.2% of GERD in 2010. When compared to 2009, both figures are decreased from 1.5% and 21.1% respectively. According to the EIS 2010, the lack of innovation by the Macedonian companies is a strong structural challenge that inhibits its own innovation development. The survey results for the three year period from 2007 to 2009 (CONTESTI, 2011), show that only 17.3% of the surveyed companies have introduced innovative products or services and more than 74% of the enterprises have neither introduced completely new or significantly improved manufacturing, goods-producing, or service-based methods; nor have they introduced new or significantly improved logistics, delivery or distribution methods for supplies, goods or services. In the paper (Polenakovik R. & Pinto R., 2010) the authors note that only few companies have
their own R&D departments, while firms typically consider R&D expenditure as an unnecessary cost without due consideration for the long-term effects of innovative products, processes and services resulting from R&D activities.

These facts reflect the small capacity of the private sector to become directly involved in R&D and innovation activities. It also shows its insignificant competitiveness when it comes to inclusion in European research networks and projects. According to the SSORM, for the period 2006-2010 the business sector did not report any funding from abroad. Consequently, encouraging the active role of the private sector to stimulate its own R&D investments and its involvement in research is another big challenge for the research policy in the country.

Low R&D and innovation figures, along with a low awareness for innovation in the FYR of Macedonia are illustrated in the comparative analysis of the innovation capacity in the Western Balkan Countries (WBC) (Institute Ivo Pilar, 2010). The same study notes that the low technological competences and absorptive capacity of the companies for new knowledge and for adapting imported and purchased technologies creates a lack of interest for research and innovation. Furthermore, according to the GCR for 2012-2013 on the indicators for innovation and sophistication factors FYR of Macedonia is ranked on the 110th position from 144 countries. More specifically, the indicators Company spending in R&D and Firm-level technology absorption rank the country on 123rd and 133rd position respectively.

An OECD’s analysis (OECD, 2012) reveals the insufficient propensity to innovate in the business sector as one of the main weaknesses of the national innovation system. The results from an OECD survey conducted in 2011 show that only few of the companies realise the need for innovation, which experience hurdles when trying to engage in R&D activities; and half of the companies do not offer any form of training to their employees and rely more on internal knowledge for innovation.

**Absence of a national roadmap for building quality research infrastructures**

One of the main characteristics of the national R&D system in the FYR of Macedonia is the modest availability of quality RIs when compared to international standards. The outdated and inadequate scientific infrastructure and low level of investments are noted in the comparative analysis (Institute Ivo Pilar, 2010). The NSDEM 2005-2015 also points out the need for increased participation in international research and innovation networks and for strengthening RIs, along with a balanced and flexible system of cooperation among the stakeholders in R&D and innovation.

Poor RIs and low availability of cutting-edge RIs influence the finest researchers to leave the country which in turn makes the domestic research market unattractive for foreign researchers. RIs are key instruments in the creation of new knowledge and the strengthening innovation activities. While most EU countries have begun to identify their national RI needs, the Macedonian RIs are in an indigent state. As a result, the country is not seen as an attractive place where domestic and foreign researchers can perform advanced research.

The vague situation regarding RIs development in the country results from the lack of an official national roadmap. The guiding document for current RI investments is the PGRM for the period 2011-2015. This document neither proposes areas for specialisation nor provides guidelines on how the budget will be allocated. On the other hand, the government is in a process of equipping 190 research laboratories for public universities and institutes with a total value of €60m until 2014. Since the start of the measure until August 2012, 79 laboratories were established. Therefore, the establishment of a national roadmap for quality RIs can be regarded as a structural challenge for the FYR of Macedonia, since it would influence the brain drain, which is one of the biggest problems in the country and could increase the utilisation of new RIs.
4 ASSESSMENT OF THE NATIONAL INNOVATION STRATEGY

4.1 National research and innovation priorities

Since the end of the year 2011 the government of the FYR of Macedonia, through its responsible ministries, has been in a process of preparation and adoption of two strategies that clearly define the priorities on which the R&D and innovation systems in the country will be focused in the period until 2020. The first strategy is the ISRM 2012-2020, prepared by the ME, and the second strategy is the NSSRA 2020, along with the NPSRA 2012-2016.

The ISRM 2012-2020 aims at developing the national economy able to compete on international markets through its skilled labour and innovative companies. The strategy should drive competitiveness and economic development based on knowledge and innovation, thereby creating high value employment and prosperity for Macedonian citizens. According to the strategy, by 2020, the FYR of Macedonia should have an effective national innovation system, co-created by all stakeholders and open to the world. In order to fulfil this vision, the following four strategic objectives have been defined:

- Enhancing the business sector’s propensity to innovate;
- Strengthening human resources for innovation;
- Creating a regulatory environment in support of innovation;
- Increasing knowledge flows and interactions between innovation actors.

The primary goal of NSSRA 2020 and the NPSRA 2012-2016 is to create a knowledge-based society through increased expenditures for research and technological development (1% of GDP by 2016 and 1.8% of GDP by 2020), with 50% participation by the private sector. The NSSRA 2020 defines only general thematic priorities which are mainly influenced by the Europe’s 2020 agenda. The NPSRA 2012-2016 defines more precisely the objectives, content and scope of scientific research. The programme focuses on following thematic priorities:

- The development of an open society and competitive economy via support to socio-economic development, economic policies, structural reforms, education, research, information society, and the overall development of the national innovation system;
- The development of low carbon society through energy efficiency, renewable energy sources, sustainable transport and implementation of clean technologies;
- Sustainable development, including sustainable management of natural resources, quality of air, water and land;
- Security and crisis management; and
- Socio-economic and cultural development.

The Industrial Policy of the FYR of Macedonia 2009-2020 (IPRM 2009-2020) defines more precisely the priorities for development of applied research and innovation in the Macedonian industry. They concern collaborative approaches for enhancing competitiveness (business research, government collaboration, alliances, networks and clusters), SME development and entrepreneurship, human resource development and knowledge creation, internationalisation, commercialisation of new products, investment enhancement and intellectual and industrial property rights.

The priorities and objectives of the strategies are based on: previous analysis of strengths and weaknesses at the national level by the responsible ministries, the level of basic R&D and innovation statistics and indicators compared with the EU and SEE countries and conclusions of the broad public discussions by relevant stakeholders. The priorities are based mainly on
weaknesses in R&D and innovation financing in the country, quantity and quality of human resources, RIs and research in private companies.

The priorities defined in the NSSRA 2020 and the NPSRA 2012-2016 are more citizen-centric as they were subjected to a broad public discussion. On the other hand, the ISRM 2012-2020 primarily fosters the innovation capabilities of businesses horizontally, taking a neutral stance regarding sectors without imposing sector specialisation. It also more strongly fosters the linkages between the innovation actors. Even though several attempts are being made to increase those linkages in the country, there is room for improvement.

The NSSRA 2020 discusses some social challenges like clean energy, security of the citizens, disease prevention, eco-products and organic food. Some of these challenges are also defined in the IPRM 2009-2020. Strengthening the know-how and technology transfer to the industry and open innovation concepts are part of the LESTD adopted in 2011, and the Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities (DNSHE), adopted in 2010. Through the PTD the LESTD favours basic research projects with increased co-financing up to 100% of the total projects’ expenses. The DNSHE sets out the policy for mandatory involvement of industry professionals in the universities’ educational and R&D activities. This policy also includes compulsory internships for students in industry or government institutions. The public sector innovation aspects are discussed in the National Strategy for e-Inclusion 2011-2014, whose goals refer to Internet availability and the availability of other ICT to all citizens.

The sectors such as textile, ICT, tourism, agriculture and energy are selected in the IPRM 2009-2020 as the perspective regarding the long-term orientation of the industry towards higher value-added products and services and their international positioning. The ICT sector is considered as a sector that can accelerate the development and growth of other sectors, whilst the textile sector is one of the major industries in the country as it employed 35% of the industrial employment in 2011 and participated in the total country export with 17% in 2011. For these sectors, there are separate policies adopted by the government: Strategy for the Development of the Textile Industry 2008-2020, Strategy for the Development of the Energy Sector 2030, National Strategy for the Development of Tourism 2009-2013, and Export Promotion Strategy for Software and IT Services Industry, published in 2011.

There is no official evaluation of any research or innovation policy. One reason for this situation is the absence of dedicated national R&D and innovation policies in the period before 2012. The ISRM 2012-2020, adopted in 2012, includes action plan for the period 2013-2015 and for each policy measure there are list of expected results and list of indicators for implementation and realisation. Additionally, the strategy has well established evaluation and monitoring procedures which include permanent internal and periodic external evaluations of the policy as a whole and its specific measures. Regarding the IPRM 2009-2020, its first major ex-ante evaluation was expected in 2012. However, the document is still not available. The others R&D and innovation policies which were embedded in governmental programmes don’t include ex-ante evaluation criteria.

In order to increase public and private R&D funds, in 2012 the government strengthen the implementation of the measures introduced in 2010 and increased the funds for several instruments. However, the total budget for scientific and research activities and technological development for 2012 was decreased by 11% when compared to 2011. A structural analysis of this budget shows that the government decreased the support for the routes for (1) stimulating greater R&D investments in R&D performing companies and (2) attracting R&D performing companies (and universities) from abroad, since the budgets for appropriate instruments in the year 2012 when compared to 2011, were decreased by 78% and 52% respectively. On the contrary, within the R&D budget, the funds for the instruments that stimulate R&D in the public sector were increased by 7.7% in 2012, amounting to €1.47m. This route was additionally
fostered by the government with two new measures introduced in 2010, ELSR, and the obligation of public universities to allocate 40% from tuition fees to R&D activities. The dedicated funds for the measure ELSR were €2.25m for 2012. It is very difficult to estimate the direct financial effects of the obligation of public universities to allocate 40% from tuition fees to R&D activities, but it is notable that the self-financing budget segment for the HES with €52.6m in 2012 was 59% of its total budget.

The structural challenges are partially addressed by the national policies that include R&D and innovation priorities in the FYR of Macedonia. The challenges which have a lack of quality human resources for RDI, weak science-industry linkages and low capacity for innovation by the companies are well addressed and consistent with the defined priorities. The challenge inefficient governance of the innovation system is not completely addressed, mainly because performing level of the innovation system is partially affected by the policies. The challenge the absence of a national roadmap for building quality RIs is not consistent with the adopted priorities for the country.

4.2 Evolution and analysis of the policy mixes

Since 2008, the government of the FYR of Macedonia has expressed a high degree of commitment for strengthening R&D and innovation. The strategic priorities in the four-year PGRM 2008-2012 and PGRM 2011-2015 are investments in education, science and information technology as the main components of a knowledge-based society. Furthermore, the programmes, along with the NSDEM 2005-2015, focus on quality higher education through investments in RIs, use of information technology, investments in science and innovations, and improving the quality of the curricula. The NSSRA 2020 and the NPSRA 2012-2016 also aim at facilitating the transformation of the country into a knowledge-based society and define the objectives, content and scope of scientific research. The IPRM 2009-2020 and the ISRM 2012-2020 compliment the previous policies, drive competitiveness and economic development based on knowledge and innovation and define framework for an effective national innovation system, co-created by all stakeholders and open to the world. Furthermore, the ISRM 2012-2020 pays particular attention to increasing the innovative capabilities of SMEs and is hence in line with the national SME policy based on the European “Small Business Act”. Therefore, the strategic, coherent and integrated policy framework that promotes research and innovation as a key policy instrument to enhance competitiveness can be considered as strength of the national system.

The need to improve the innovation governance system in the country is noted in several policy and analysis documents (Institute Ivo Pilar, 2010; Radosevic S., 2009; CONTESTI, 2011). The lack of systematic governance prevents the effective monitoring and review of the policies and subsequently monitoring and review of the implementation of the programmes and measures. This weakness of the national RDI system has been noted in the reports provided by the implementation bodies where the number of financed projects and dedicated funds are stated, but there is a lack of depth analysis for the quality of realisation, achievement of the projects’ stated goals and their larger impact in the industry and the country. The weakness is considered through the changes of the governance structure proposed in the ISRM 2012-2020, which contribute to a strategic, realistic and coordinated approach to innovation policy. Despite the complexity of innovation policy, a clear allocation of responsibilities for specific policy levels, measures and activities are sought. Moreover, an important role is given to stakeholder consultation and in-built policy learning processes based on monitoring and evaluation.

The national policy documents define innovation in a broader scope that concerns organisational changes, processes and service improvements, which gives options to institutions and businesses
to get funding for different types of innovation and contribute to the overall improvement of innovations in the country. However, the R&D and innovation policies and measures adopted in the period before 2011 are mainly focused on the supply-side and have neglected aspects of demand that might stimulate or enable R&D and innovation in the country. In this period, the most popular tools used within demand-side innovation policy in the country include awareness raising activities, in addition to regulations and standardisations.

Demand-side measures encourage innovation and the development of new technologies (OECD, 2011). As such measures require important financial resources, their implementation is demanding and their overall effect does not necessarily justify the cost, especially in small open economies such as Macedonian economy. However, according to the ISRM 2012-2020 there is still scope for a demand-side approach in the country aimed at incremental, rather than radical innovation. Therefore, the strategy envisions modification of public procurement practices by introducing functional requirements rather than detailed specifications. Such an approach is suitable for complex projects that require the optimisation of multiple parameters at the time of development and have costly maintenance such as transport infrastructure, refurbishments of public buildings in an energy-efficient way and ICT systems. Introducing functional requirements and making the contractor responsible for the whole lifecycle of the project will incentivise innovation.

As education, science and innovation are placed as a strategic priority in the programmes of the government, they too devote funds to these areas. However, there are no clear results-based financial policies for the distribution of the public R&D and innovative funds among performing units. Additionally, although the Law on Higher Education envisions the establishment of a Council for financing higher education which will determine the criteria for financing, such a body has not yet been established. The largest investment in the period 2010-2012 was made to improve the RIs at public universities and institutes. However, it is not clear what leverage affect these investments of the government in RIs and educational institutions have on the private investments in R&D and innovation. The PGRM 2011-2015 envisions specific R&D and innovation measures, such as fiscal incentives offered to foreign investors for investments in new technologies, co-financing (up to 50%) of the investment for inventions and patents that have the potential to become effective, grants (up to 50,000€) for encouraging technology transfer, scientific subsidies for all scientific workers who will publish scientific papers in an impact factor magazine and subsidies for creative activities in the field of music, dramaturgy, painting, sculpture, acting, film directing and linguistics. However, there is no evidence about the number of companies or individuals that have used these measures, the size of the dedicated funds for these measures and their impact on the RDI activities in the country.

The provided funding is in sync with the defined priorities, but the focus is still not on excellence in research and education. However, the efforts of the MES on improving the project evaluation for funding, public presentation of the project results, evaluation of the quality of the R&D in the higher education and stronger criteria for promotion of professors through dedicated policies and measures, can be regarded as strength to the country’s R&D and innovation systems. The country is missing legal, financial and social frameworks for research careers offering attractive conditions to both men and women. Additionally, there are no clear incentives to attract leading international talent, except for two attempts. The first one is employment of foreign professors in the University for Information Science and Technology "St. Paul the Apostle" in Ohrid, and the second attempt is Stop Brain Drain project which provides additional 30% of the wage for every engineer, technologist and IT expert who after completing studies abroad will return and find a job in the country. Unfortunately, the expected results regarding the attraction of quality international staff were still not achieved. Concerning the Stop Brain Drain project, no effect is reported since the project was launched in 2012. There is also no framework in the country that
will enable the portability of the researchers funding. One reason for the absence of a legal solution for this portability might be the lack of migration by researchers between institutions.

By identifying education as a strategic priority and by identifying the need for more graduates and postgraduates, the government opened new universities and dispersed some study programmes from the existing universities to other smaller cities in the country. The emphasis in this measure is on technical sciences, engineering and ICT. In 2012 the government introduced a state quota for II and III study cycles, i.e. masters and doctorial studies. This has additionally contributed to an increase of the graduate and postgraduate students in the country, but in the same time there is a weakness on the quality of the generated graduates and postgraduates. The weakness of low quality human resources for research and innovation is noted in the PGRM 2011-2015, which caused several changes to the LHE in 2010 and 2011. The implementation of these changes makes universities to restructure their curricula according to the principles of the Bologna declaration and to include courses and modules that focus on innovation and entrepreneurship. The ISRM 2012-2020 envisions additional measures for making tertiary education more innovation-oriented. Overall, the ability of the education system to produce the right mix of skills could be regarded too, as strength by the national research and innovation systems.

The current policy documents, including the ISRM 2012-2020 state and promote the development of partnerships between various stakeholders in innovation and R&D. However, there is still lack of infrastructure and framework for their establishment. The partnerships between the industry and the universities are on very low level and the development of university spin-offs or funding provided by business angels is in very early stages of development. The issue on IPR is more complex and not very transparent, as the enforcement of IPR is not well managed. With the development of the Strategy for Intellectual property of the FYR of Macedonia 2009-2012, several actions have been implemented that improves the management of IPR. According to the IUS 2011, the FYR of Macedonia has the worst performance for Intellectual assets indicators, with the scores in a range from 3% to 6% of corresponding EU averages. Furthermore, there is neither infrastructure nor framework for establishing trans-national partnerships or collaboration. The international funding programmes like FP7 and previously TEMPUS are the main programmes through which these partnerships have been established, but the majority of the partnerships exist only for the duration of the projects.

Policies which promote innovation, entrepreneurship and enhance the quality of the business environment are envisioned in the governmental strategies, but due to the structural weaknesses of the private sector regarding R&D and innovation, they are inefficient and have a very limited impact on the research and innovation systems of the country. Therefore, promoting private investments in research and innovation can be regarded as a weakness of the national policy mix.

The small number of clearly thematic and sector-oriented programmes might undermine the understanding of the companies and institutions for which programmes to apply or whether their innovation ideas/projects are appropriate for the programme. Notwithstanding the majority of measures are not sector specific, textile companies, educational institutions, SMEs and innovative ICT companies are targeted with specific measures. In addition, the government offers support in establishing a company by co-funding the establishment, but there is no clear focus on innovative start-up companies as the funds are given for any idea. The lack of business angel networks or venture capital funds restricts the development of innovative start-ups. Therefore, it is not surprising that the Access to financing is first ranked problematic factor for the FYR of Macedonia in the GCR 2012-13, while the Finance and support indicators are regarded as a weakness of the national innovation system in IUS 2011. It can be concluded that there is a lack of high quality, simple and easily accessible public support for innovative start-up companies, and this can be considered as another weakness on behalf of the country’s innovation system.
For the majority of procurements there are no incentives to stimulate innovation neither in the public sector nor in the delivery of public services. The main procurement criterion is price. Furthermore, there is no public procurement of innovative solutions to improve public services, like dedicated budgets and joint procurement. The only exception is the Public Procurement of Innovative ICT based Products and Services in Education, which is an excellent opportunity for the country to experience the benefits of this type of policies. However, the ISRM 2012-2020 envisions a measure that adapts public procurement practices to encourage innovative solutions. Starting from 2013, the public procurement practices will be enhanced by introducing functional requirements instead of detailed specifications, mainly for complex projects that require the optimisation of multiple parameters at the time of development and have costly maintenance.

4.3 Assessment of the policy mix

The policies that were adopted by the government in the period 2009-2012 are based on the analysis of the main RDI figures and strengths and weaknesses of the R&D and innovation systems, which are mainly presented as a part of the policy documents. The general opinion is that the analysis confirmed the structural challenges of research and innovation systems. The specific policies were defined for the majority of the structural challenges, but the implementation of these policies has been slowed down due to the low capabilities of the private sector for performing RDI activities, inefficient governance structure, incoherent policy mix and the unavailability of sufficient funding from both public and private sources. There is no evidence for positive impact of policies adopted in 2010 and 2011 regarding research and innovation systems. The only exception is the increase of the participation of medium and high tech product in the total export product in 2011, which according to the IUS 2011 has very high growing performance of 11.1%. However, the increase is mainly due to the participation of the value of one product, supported catalysts with precious metal, in the total export value with 12%. This product is produced by two companies established in the country through FDI.

The ISRM 2012-2020 addresses the inefficiency of the governance of the national innovation system in the following areas of intervention: policy coordination, dialogue between the public and private sectors and academia and evaluation and monitoring of policies. A coherent approach and effective policy coordination are ensured by institutional mechanisms, such as committees, inter-ministerial working groups and dedicated agency. Since the end of the year 2011, the government has established two new committees, the CTD and CEI, and the NCEC as governmental advisory bodies. The structures of the advisory bodies show high commitment of the government for supporting innovation, and enable significant increase of the operational capacity for implementation of the programmes with involvement of all stakeholders. The establishment of the TIA as dedicated agency is expected for 2013. It is envisioned as independent, centralised one-stop shop for innovation support, with the mission to ensure a more efficient capacity building through technical assistance and twinning projects with relevant innovation agencies. The ISRM 2012-2020 proposes to increase knowledge flows and interactions between innovation actors through fostering business networks and clusters, embedding foreign-owned and innovative firms into the national innovation system, supporting cooperation between research institutions and businesses and strengthening the linkages with the Diaspora. The strategy gives very efficient framework for evaluation and monitoring of the policies. For these purposes internal and external evaluations are envisioned.

As a part of its programmes for the periods 2008-2012 and 2011-2015, the government developed several policies that would affect the quality of human resources for R&D and innovation. The policies aim towards the strategic goal of having 25% of the population with higher education and to enable a larger group of students to enrol at universities. Therefore, in the period 2008-2012 the government opened new universities and faculties in bigger cities with decreased-to-no tuition fees; a new university in Ohrid designed to include foreign professors
and provided international scholarships for students at one of the Top 100 world universities or Top 20 European universities from the Shanghai Jiao Tong University ranking. These policies have impacts on the quantitative statistics for human resources, but have not contributed to the qualitative statistics to a satisfactory extent (Josimovski S., Trenesvka K., 2011). Therefore, while the number of doctoral, master and tertiary graduates was significantly increased in 2011 when compared to 2008, the knowledge production of the research performers haven’t experienced such increase, and the universities from the countries were not ranked at the most recognisable ranking lists in the world. In direction of improving the quality of human resources, the changes to the Law on Higher Education (LHE) in 2010 and 2011 enabled adoption of stronger criteria for recognition of a HEI and stronger scientific criteria for promotion of professors. Furthermore, the government in 2012 launched a project that provides a state quota for post graduation study programmes for II and III study cycles, i.e. masters and doctoral studies that are especially significant for the social and economic development of the country. In 2012 the government also increased the fund for the measure that provides subsidies for scientific works published in a journal with an impact factor. The lack of human capital for RDI is a strong structural challenge, because it could take a long time to reach the appropriate goal. Hence, it is still too early to evaluate the effects of these measures since their implementation has just started. Strengthening human resources for innovation is also one of the objectives of the innovation strategy. Therefore, in the action plan 2013-2015 new measures are envisioned, which are mainly towards increasing the quality of the education and its adaptation in order to develop skills needed for innovation.

The weak science-industry linkages are noted in the main policy documents that refer to this area. The concrete policy actions that affect this challenge are noted in the DNSHE, adopted in 2010. The DNSHE sets out the policy for mandatory involvement of industry professionals in the universities’ educational and R&D activities and also includes compulsory internships for students in industry or government institutions. The memoranda for cooperation between the main universities and chambers of commerce can also be considered as a contribution towards mitigation of the weakness. Additional measures envisioned in the PGRM 2011-2015 encourage the universities to establish companies based on science or technology. The legislation for university spin-off companies’ projects adopted in June 2012 by the government refers to this challenge. The effects of these actions are not evident for two reasons: besides the research output of some faculties, research output from public research institutions currently has a limited potential for commercialisation (Government of the FYR of Macedonia, 2012a). Secondly, companies and more particularly SME’s show a weak absorptive capacity with respect to academic research and would possibly not benefit so much from co-operation (CONTESTI, 2011). Therefore, according to the policies proposed by the ISRM 2012-2020, the collaboration between businesses and public research institutions may focus on training, technology adaptation, testing and manufacturing extension services. This will enable research institutions to become more aware of the needs of businesses while avoiding putting too much burden on their research capacities.

The challenge of low capacity for innovation by the companies is addressed by several policies and measures. The newest policies are embedded in the LESTD, adopted in 2011, PGRM 2011-2015, IPRM 2009-2020 and ISRM 2012-2020. LESTD is realised through the PTD, which opens the door for enterprises to apply for government co-financing of up to 50% of industrial research and development project expenses which can include an innovative component. If the project addresses basic research, the government co-financing is up to 100%. Furthermore, the IPRM 2009-2020 is accompanied by measures such as: Programme for Support of the Textile Industry; Innovation Voucher Counselling Scheme; Programme for Competitiveness of the National Products and Services; Programme for Support and Development of Clusters’ Associations; Programme for Development of Entrepreneurship, Competitiveness and
Innovation of SMEs; and Public Procurement of Innovative ICT based Products and Services in Education – e-content. These measures raise the awareness for stimulating applied research, development and innovation in the industry, at the same time stimulating commercialisation of new products and services in the field of product design and transfer of new technologies. However, the inherent shortcomings of the national economy and the private sector as an R&D performer and innovator, limits the effectiveness of all these actions. The ISRM 2012-2020 proposes policies which in particular aim at upgrading the innovation capacities of existing firms and fostering the creation of innovative business start-ups. For this purpose, measures which facilitate the access to loans and equity finance of innovative companies are envisioned.

Through the ELSR, the government has increased the quality of the RIs for public universities and institutions and until August 2012 has invested in constructing 79 sophisticated laboratories within the universities’ settings. In 2012 the government obliged the public institutions to open the laboratories for external users, including businesses. Since only a small number of businesses have created research laboratories, the availability and accessibility of RIs could be prerequisites for resolving other structural challenges as individual companies can create the necessary conditions to generate and/or adopt new knowledge. This sets the necessary infrastructural basis for developing a knowledge-based economy, oriented towards innovation and R&D. Furthermore, these infrastructural capacities are in many areas surpassing the quality of research facilities in the surrounding countries. However, to cover the operational costs and to ensure the long term sustainability of the laboratories, the government funding needs to be complemented by funds from the business sector and from international projects. It is therefore necessary to prepare and implement a programme to ensure the sustainability of the laboratories. Additionally, the measure neither proposes areas for specialisation nor does it provide guidelines on how the budget could be allocated. The investment of infrastructure without having a clear roadmap could create a situation of large dispersion of investments in different sectors and themes without achieving the ultimate goals. Therefore, isolated measures can not compensate for the absence of a national roadmap for RIs.

The assessments of the effectiveness of the specific policies to address the structural challenges are presented in the following table:

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Policy measures/actions addressing the challenge ¹</th>
<th>Assessment in terms of appropriateness, efficiency and effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inefficient governance of the innovation system</td>
<td>• Policy coordination mechanisms envisioned in the ISRM 2012-2020; • Establishment of dedicated Technology and Innovation Agency; • New Committees (CEI and CTD); and • Renewal of NCEC.</td>
<td>These measures ensure an efficient framework that could positively affect the governance of the innovation system. TIA is not yet established, so its efficiency and effectiveness will largely depend on the role and the power this entity will have.</td>
</tr>
<tr>
<td>Lack of quality human resources for RDI</td>
<td>• International scholarships for students at one of the top 100 World universities or top 20 European universities from the Shanghai Jiao Tong University ranking;</td>
<td>The measures are partially appropriate, since the ultimate goals are well defined, but the way how the goals should be achieved is not clear; and the funding schemes are missing for part of the measures.</td>
</tr>
</tbody>
</table>

¹ Changes in the legislation and other initiatives not necessarily related with funding are also included.
| Weak science-industry linkages | Mandatory involvement of industry professionals in the universities’ educational and R&D activities; |
|                               | Includes compulsory internships for students in industry or governmental institutions; |
|                               | Memoranda for cooperation between the main universities and chambers of commerce; |
|                               | Project “Techno-Starters and spinouts”. |

These measures are appropriate for this structural challenge. However the effectiveness and efficiency of these actions are not evident, since the traditional sectors have low absorption capacities for RDI, the SMEs as dominant type of enterprises are the modest innovators, the private sector has a very low number of researchers and there are only few companies in the country which consider R&D and innovation as a main driver for achieving competitiveness. The implementation of the actions is mainly dependable on the proactive role of the universities. Additionally, the measures are not supported by dedicated funding schemes.

| Low capacity for innovation by the companies | Programme for Technological Development; |
|                                            | Programme for Support of the Textile Industry; |
|                                            | Innovation Voucher Counselling Scheme; |
|                                            | Programme for Competitiveness of the Products and Services; |
|                                            | Programme for Support and Development of Clusters’ Associations; |
|                                            | Programme for Development of Entrepreneurship, Competitiveness and Innovation of SMEs; and |
|                                            | Public Procurement of Innovative ICT |

These measures support companies in performing R&D and innovative activities and provide additional funding for RDI projects. However, the inherited shortcomings of the private sector as R&D performer and innovator, limit the effectiveness of all these actions. Furthermore, the dedicated funds are very low.
| Absence of a national roadmap for building quality RIs | Equipping Laboratories for Scientific Research and Applicative Activities | The focus of this measure is on providing quality RIs, and doesn’t address the absence of a national roadmap for RIs. The absence of this roadmap decreases the effectiveness and efficiency of the measure. |
5 NATIONAL POLICY AND THE EUROPEAN PERSPECTIVE

The intention of the government of the FYR of Macedonia to integrate the national R&D system in the ERA and to align the national R&D targets with the European targets is presented in the main national R&D and innovation policies and programmes adopted in 2011 and 2012. This declarative commitment of the government doesn’t coincide with the available R&D figures which show that public funding is very low both relatively and absolutely. The only exception to this observation is the ongoing investment in laboratories for scientific research and applicative activities in the public institutes and state universities. In addition, the private sector has low absorption capacities for research and innovation, at the same time having a lack of resources for research and weak linkages with the research organisations. The majority of Macedonian enterprises are focused on obtaining competitive advantages based on low cost production factors. They neglect the competitive strategies sustained by creating products with a high level of added value which is obtainable by applying the results of research, development and innovation activities (CONTESTI, 2011; EIS, 2010). The direct relationship between investment in scientific and R&D related activities and the positive effects on the national economy has been noted only in the case of FDIs in the medium and high-tech industry sectors, which significantly increased the participation of the medium and high-tech product in the total export in the country for 2011.

Along with several structural weaknesses of the systems, the FYR of Macedonia as a modest innovator is characterised with low R&D and innovation intensity. Access for financing is the most problematic factor that affects companies’ activities, as the public research sector remains the main performing and funding sector of the research activities in the country. Without any significant progress, the scarce budget resources only ensure the maintenance of the research sector. The low demand for knowledge in the private sector, the low quality of produced knowledge and the presence of brain drain are now the biggest challenges for policy makers in the country. Conversely, the number of researchers is extremely low, particularly in the business sector where the usage of public funds for innovation and participation in public-private linkages is almost nonexistent.

The directions for evolving the national policy mix are determined by the ultimate goals of the government on one side, and the available resources along with the structural weaknesses of the R&D and innovation systems on the other. The first short-term direction, which should be regarded as crucial, is to increase the funding of the companies through dedicated policies and measures that will efficiently increase their absorptive capacity for R&D, innovation and new technologies. The measures should support establishing linkages with science, employing adequate human resources, internationalising their activities and fostering cross-border cooperation, which are considered as main weaknesses of the private R&D sector. The companies that perform R&D and innovative activities should be also encouraged to invest in new technologies through tax and financial incentives or through FDIs. One of the goals of the ISRM 2012-2020 is the increase of effectiveness of RDI policies and their monitoring, which is also one of the ERA communication objectives. In order to fulfil this objective it is necessary to establish a more efficient governance structure of the RDI system by increasing the role of all important stakeholders. This could be regarded also as short-term direction for evolving the national policy mix. This is in line with the need for permanent monitoring and internal and external evaluation of the action plan 2013-2015, which is regarded
as a crucial part for the success of the strategy. Also the governance structure should increase the coordination between the national R&D system and the ERA.

The ongoing project for equipping laboratories contributes towards higher feasibility of the evolving directions. However, the laboratories should be framed in a broader national roadmap, which could provide efficient use of the available RIs in the country. Since there is an on-going large investment in research laboratories, the short-term imperative of the country should be to define a national roadmap for RIs, in order to maximise their utilisation. The laboratories are available to external domestic and international researchers, which contributes towards the fulfilment of the ERA communication objectives such as optimal trans-national co-operation and competition and optimal circulation, access to and transfer of scientific knowledge.

Instead of focusing on the quantity of the produced human resources by higher education, policies should encourage production of quality human resources capable of performing world-class research. This can be regarded as a medium-term direction, as quality education usually requires a longer period of time, therefore it is unlikely that quality human resources can be produced in a short term period.

FYR of Macedonia in 2012 for the first time prepared and adopted separate strategies and action plans on R&D and innovation. The strategies are based on the profound assessment of R&D and innovation potentials, and the development of R&D and innovation is based on country-specific science, technology and production framework conditions. Therefore, it is expected the country to assume more consistent attitude toward the main R&D and innovation targets. In the development of the so far national R&D and innovation policies no foresight exercise was used. The national labour market for researchers in the FYR of Macedonia is unattractive. Its main negative features for the period 2007-2010 were the small number of researchers, low salaries and very low inflow of researchers from abroad. On the other side, the equal treatment for women and men in research guaranteed by the law can be considered as a positive feature of the national labour market, which is in line with the ERA communication priority for gender equality and mainstreaming in research. Additionally, the career breaks, like parental leave or political engagements have no formal detrimental effects on female researchers.

There is no restriction for non-nationals to apply for permanent research and academic positions. However, one of the main obstacles for the employment of non-nationals at the majority of the universities is the required knowledge of Macedonian or Albanian as a teaching language. The issue is partially transcended with the changes in the LHE from 2011, which obligates the universities to have at least one department with English language curriculum in the academic year of 2012/2013. This policy supports ERA communication objective for open labour market for researchers. For further support of this ERA communication objective, the barriers for portability of national grants should be removed.

The total number of tertiary-level students versus the overall population in the country increased from 2.8% in 2010 to 3.1% in 2011. The graduates in natural, technical and technological fields in 2011 participated with 20% in the total number of tertiary education graduates in the country and the deficiency of this type of graduate is registered in the labour market. In order to increase this type of graduate, in 2012 the number of enrolled students in the state universities depends on the surpluses or deficiencies of graduates in specific fields.

The international cooperation in the FYR of Macedonia is mainly realised through bilateral agreements and EU research programmes. The country doesn’t have a separate national strategy for this kind of cooperation. The NSDEM 2005-2015 supports public-private R&D partnerships in the form of collaboration between public academic institutes and private companies. This is not limited to SMEs, and includes companies from all sizes through the funding of competitive calls for projects. The main national measure in the country that supports a cross-border cooperation is the Programme for Scientific and Research Activities (PSRA) which includes several
sub-measures. The main sub-measure that supports cross-border co-operation is bilateral research international projects. The available funds for these projects for 2012 were €65,000, significantly decreased compared to €140,000 for 2011.
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<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AEC</td>
<td>Adult Education Centre</td>
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<tr>
<td>APERM</td>
<td>Agency for Promotion of Entrepreneurship in the FYR of Macedonia</td>
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<tr>
<td>BERD</td>
<td>Business Expenditures on Research and Development</td>
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<tr>
<td>CEI</td>
<td>Committee for Entrepreneurship and Innovation</td>
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<td>CERN</td>
<td>European Organisation for Nuclear Research</td>
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<tr>
<td>CIP</td>
<td>Competitiveness and Innovation Framework Programme</td>
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<tr>
<td>COST</td>
<td>European Cooperation in Science and Technology</td>
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<tr>
<td>CTD</td>
<td>Committee for Technological Development</td>
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<tr>
<td>DNSHE</td>
<td>Decree on Norms and Standards for Establishing Higher Education Institutions and performing Higher Education Activities</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<td>EIIC</td>
<td>European Information and Innovation Centre in the FYR of Macedonia</td>
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<tr>
<td>EIS</td>
<td>European Innovation Scoreboard</td>
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<tr>
<td>ELSR</td>
<td>Equipping Laboratories for Scientific Research and Applicative Activities</td>
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<td>ERA</td>
<td>European Research Area</td>
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<td>ERAC</td>
<td>European Research Area Committee</td>
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<td>ERA-NET</td>
<td>European Research Area Network</td>
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<td>ERDF</td>
<td>European Regional Development Fund</td>
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<td>ERP Fund</td>
<td>European Recovery Programme Fund</td>
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<tr>
<td>ESA</td>
<td>European Space Agency</td>
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<tr>
<td>ESF</td>
<td>European Social Fund</td>
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<tr>
<td>ESFRI</td>
<td>European Strategy Forum on Research Infrastructures</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>EU-27</td>
<td>European Union including 27 Member States</td>
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<tr>
<td>EUREKA</td>
<td>pan-EU Network for Industrial R&amp;D</td>
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<td>FDI</td>
<td>Foreign Direct Investments</td>
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<tr>
<td>FP</td>
<td>Framework Programme</td>
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<td>FP7</td>
<td>7th Framework Programme</td>
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<tr>
<td>FTE</td>
<td>Full Time Equivalent</td>
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<tr>
<td>FYR</td>
<td>Former Yugoslav Republic</td>
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<tr>
<td>GBAORD</td>
<td>Government Budget Appropriations or Outlays on R&amp;D</td>
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<tr>
<td>GCR</td>
<td>Global Competitiveness Report</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>GERD</td>
<td>Gross Domestic Expenditure on R&amp;D</td>
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<tr>
<td>GOVERD</td>
<td>Government Intramural Expenditure on R&amp;D</td>
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<tr>
<td>GIZ</td>
<td>Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation)</td>
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<tr>
<td>GUF</td>
<td>General University Funds</td>
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<tr>
<td>HE</td>
<td>Higher Education</td>
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<td>HEI</td>
<td>Higher Education Institution</td>
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<td>HERD</td>
<td>Higher Education Expenditure on R&amp;D</td>
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<td>HES</td>
<td>Higher Education Sector</td>
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<tr>
<td>HRST</td>
<td>Human Resources in Science and Technology</td>
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<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>IPR</td>
<td>Intellectual Property Rights</td>
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<td>IPRM 2009-2020</td>
<td>Industrial Policy of the FYR of Macedonia 2009-2020</td>
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<tr>
<td>ISP</td>
<td>Internet Service Provider</td>
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Abstract
This analytical country report is one of a series of annual ERAWATCH reports produced for EU Member States and Countries Associated to the Seventh Framework Programme for Research of the European Union (FP7). The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries.

The Country Report 2012 builds on and updates the 2011 edition. The report identifies the structural challenges of the national research and innovation system and assesses the match between the national priorities and the structural challenges, highlighting the latest developments, their dynamics and impact in the overall national context. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. These reports were originally produced in December 2012, focusing on policy developments over the previous twelve months.

The reports were produced by independent experts under direct contract with IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from external experts.
As the Commission’s in-house science service, the Joint Research Centre’s mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.