WESTERN BALKANS REGIONAL R&D STRATEGY FOR INNOVATION

COUNTRY PAPER SERIES

MONTENEGRO

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ACRONYMS

AI	Activity Index
CEEPUS	Central European Exchange Program for University Studies
COST	European Cooperation in Science and Technology
ECTS	European Credit Transfer and Accumulation
EEN	Europe Enterprise Network
EIICM	European Information and Innovation Centre of Montenegro
ERA	European Research Area
ERA	European Research Area
EU	European Union
FP7	Framework Program 7
GBOARD	Government Budget Appropriations or Outlays on Research and Development
GDP	Gross Domestic Product
GEANT	European Academic Network
GERD	Gross Domestic Expenditure on Research and Development
ICT	Information and Communication Technologies
IDF	Investment and Development Fund
IPOM	Intellectual Property Office of Montenegro
IPRs	Intellectual Property Rights
IT	Information Technology
MASA	Montenegrin Academy of Science and Arts
MoS	Ministry of Science
MREN	Montenegrin Research and Education Network
NGOs	Non-governmental Organizations
OECD	Organisation for Economic Co-operation and Development
PCT	Patent Cooperation Treaty
PPP	Public Private Partnership
R&D	Research and Development
RTD	Research, Technology and Development
S&T	Science and Technology
SMEDD	Directorate for Small and Medium-sized Enterprises
SMEs	Small and Medium-sized Enterprises
STEM	Science, Technology, Engineering and Mathematics Disciplines
TTOs	Technology Transfer Organizations
UN	United Nations
UoM	University of Montenegro
WBC	Western Balkans Countries
WIPO	World Intellectual Property Rights Organization
WTO	World Trade Organization

FOREWORD

This *Paper* was prepared under the *Western Balkans Regional R&D Strategy for Innovation* -- World Bank Technical Assistance Project funded by the European Commission (DG ENLARG – TF011064), as part of the *Country Paper Series*.

The *Country Paper Series* aims to provide for each project beneficiary (Albania, Bosnia and Herzegovina, Croatia, Kosovo*, FYR Macedonia, Montenegro and Serbia) a brief profile of the current conditions of the national research system (rather than an exhaustive assessment of the country's national innovation system). Emphasis on selected issues reflected the priorities identified by participants during the implementation of the Technical Assistance.

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DISCLAIMER

The findings, interpretations and conclusions expressed herein are those of the authors and do not necessarily reflect the view of the World Bank or the Government of the respective country.

* This designation is without prejudice to positions on status, and is in line with UNSC 1244 and the ICJ Opinion on the Kosovo Declaration of Independence.

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EXECUTIVE SUMMARY

1. Montenegro is a small country with an economy that is dependent on tourism, related services, and metal processing. The lack of economic diversification and the dependence on external financing generate vulnerabilities that can lead to severe collapses of production and gross domestic product (GDP) during recessions, as was the case in 2009. Innovation is a key tool that can help firms in Montenegro leverage research to develop new products and processes, while also diversifying the economy.

2. The research infrastructure in Montenegro is outdated, with very few labs or research institutes that meet European standards. Moreover, significant under-investment and erstwhile economic sanctions have severely hampered the ability of research institutes to produce research with commercial potential. Financial investment in research remains limited. The small size of the Montenegrin economy prevents substantial capital investments in research equipment and specialized labs. The private sector accounts for only 27 percent of the expenditures on research and development (R&D) – half the European Union (EU) average of 53.8 percent – and does not have significant linkages with local research institutes.

3. Since independence in 2006, Montenegro has undertaken a number of reforms aimed at creating a more suitable environment for research and innovation. Preliminary but crucial, steps have been taken. These include the establishment of quality assurance systems that match European standards, increased regional collaboration in research, increased opportunities for collaboration between research institutes and the private sector, and an improved legal framework.

4. The decision to join the EU, followed by the Stabilization and Association Agreement has given a further boost to the development of the national innovation system and the promotion of R&D. Montenegro has taken steps towards integration into the European Research Area (ERA). The government developed the Strategy for Scientific Research Activities (2008-2016), started the modernization of the education system, and committed to increasing R&D spending.

5. Based on the analysis and positions taken in strategy documents on research and innovation, the top priorities for Montenegro are to:

Strengthen the technological (and research) capacity of the private sector through:

- Collaboration with international partners and research agencies;
- Collaboration with local research agencies through technology parks and Centers of Excellence;
- Increased dissemination of research results to the private sector;
- Better linkages between students with strong academic background and the private sector; and,
- Further inclusion of the private sector into the decision making in the government and at research institutes.

Improve the quality and commercialization potential of research by:

- Continuing to improve the flow of knowledge, and human capital between Montenegro and the rest of Europe;
- Linking project funding to research quality and potential for commercialization;

- Further pursuing joint research initiatives to achieve economies of scale; and
- Investing in lab equipment for applied science and product development.

INTRODUCTION

6. There is growing awareness worldwide of the critical role that innovation plays in economic development. The EU has been at the forefront of the efforts to mainstream research and innovation policy for economic development, urging member countries to spend more and better on research and innovation. In April, 2009, in Sarajevo, Western Balkan countries (WBCs) signed a *Ministerial Joint Statement* in Sarajevo, calling for enhanced regional cooperation to promote innovation. To support the effort in the Western Balkans, the EU contracted the World Bank in June, 2011, to assist the region in developing a Regional R&D Strategy for Innovation.

7. A two-pronged strategy is emerging, following extensive and multiple consultations with public and private sector representatives. This strategy combines: (i) the advocacy of policy reforms at the national level to improve the impact of research and innovation on economic growth and job creation for the long term; and, (ii) joint investments in selected regional initiatives that will help alleviate existing bottlenecks in the short-to-medium term. At the national level, countries will need to substantially enhance R&D investment on a sustained-basis, and transform national innovation systems – the research base, public institutions, the private sector and other market actors, and linkages among them – into more effective, coherent, and competitive systems. Adequate policy frameworks will be crucial to stimulate the emergence of "new ideas," their transfer to industry, and private sector investment in risky and long-term innovative projects.

8. In the context of the recent economic downturn, many developed countries have increased investment in R&D and have used innovation policy as a counter-cyclical instrument to secure new sources of growth. If WBCs do not emulate such efforts and increase investment in knowledge, the gap – both technological and economic – between the Western Balkans and its future EU partners will widen. To avoid this, governments will need to spend more and better in research and innovation.

9. This note describes Montenegro's profile in terms of R&D capacity and discusses the main features of the national research system, its strengths and weaknesses, recent policy trends, and challenges. The first section details the importance of R&D for Innovation (RDI) and economic development and growth. The second section briefly describes Montenegro's economy and challenges confronting it, and the country's research and innovation trends. The third section outlines the actors, governance, financing, and dynamics of current policy programs and instruments (with further background in an annex). The final section concludes by positing possible actions at the national level, as well as areas for collaboration with other WBCs.

THE IMPORTANCE OF INNOVATION

10. The capacities to undertake scientific and applied industrial research, and to transfer, adapt, and assimilate new technologies into economic structures and diffuse them into society, are critical to national competitiveness and growth, as nearly everyone can perceive from the ferocious pace of technological change in consumer goods alone.

11. Ample and compelling evidence confirms this perception. Several international studies demonstrate that R&D spending increases result in a corresponding increase in productivity, leading to per capita income growth and long-term sustained growth for the country. At the country level, R&D explains up to 75 percent of the differences in total factor productivity growth, once externalities are taken into consideration.[2] At the firm level, R&D expenditures are often correlated to higher sales and productivity growth, as well as propensity to export. Furthermore, product innovation resulting from R&D efforts leads to employment growth and more highly skilled and better paid jobs by expanding demand and generating new business opportunities.[3]

12. The potential impact of investments in research and innovation on productivity growth is even higher for developing countries, given the opportunity for catching up associated with larger investments in innovation.[4]

13. Results from a study using firm-level data for the Western Balkans show that innovative firms grow 15 percent faster in sales and 8 percent faster in labor productivity than do non-innovative firms.[5] Business R&D expenditures significantly contribute to growth in sales by 14 percent and labor productivity by 7 percent. Furthermore, when firm R&D, training, and infrastructure services are compared, R&D is shown to have the highest correlation to sales growth.

14. For neighboring countries, similar evidence is reported.[6] Reaching the Lisbon Agenda target, R&D spending of 3 percent of GDP, could generate a permanent increase between 8 and 13 percent in exports for Bulgaria and Romania, for example.

15. Investing in R&D is necessary not only to enhance firms' innovation capacity but also to absorb external technology properly by: screening and identifying technology options; adopting and adapting foreign technology and know-how; and, benefitting from spillover effects from foreign direct investments and from other sources of knowledge transfer. As is well recognized, informal knowledge activities and day-to-day learning are also sources of ideas. Formal R&D is important, however, as it represents a systematic and more effective approach to technological innovation –radical and incremental innovation – in both the manufacturing and non-manufacturing sectors.

16. Public support of research and innovation is critical particularly in the context of stagnant economies. Public investments in research and innovation consistently have been a priority in economic stimulus packages of OECD economies. In this sense, a growing consensus on the importance of counter-

[2] Griliches (1979).
[3] Harrison *et al* (2008).
[4] See Lederman and Maloney (2003) for estimates of social rates of return for R&D.
[5] Seker (2012).
[6] World Bank (2009).

cyclical innovation policies – increasing R&D investment and improving framework conditions – is emerging. Finland and South Korea are at the forefront of this approach, increasing public spending on innovation even in the context of tighter fiscal policies.

17. Building an environment conducive to enduring innovation requires a comprehensive policy agenda and multiple resources, which are often scarce in developing countries. Smart policy design is needed, which requires devising cost-effective and sustainable strategies that will bring results in both the short and long run. Market and coordination failures may hinder progress. The lack of linkages among actors – between public research institutions and the private sector, within and across industries – can prevent innovation investment, thus preventing businesses from reaching their growth potential. Failures in financial services and other specialized resources discourage private investment in innovation and new business creation leading to an inefficient allocation of resources. Interventions are therefore needed at different levels and through different mechanisms, in collaboration with the private sector and other relevant decision-makers.

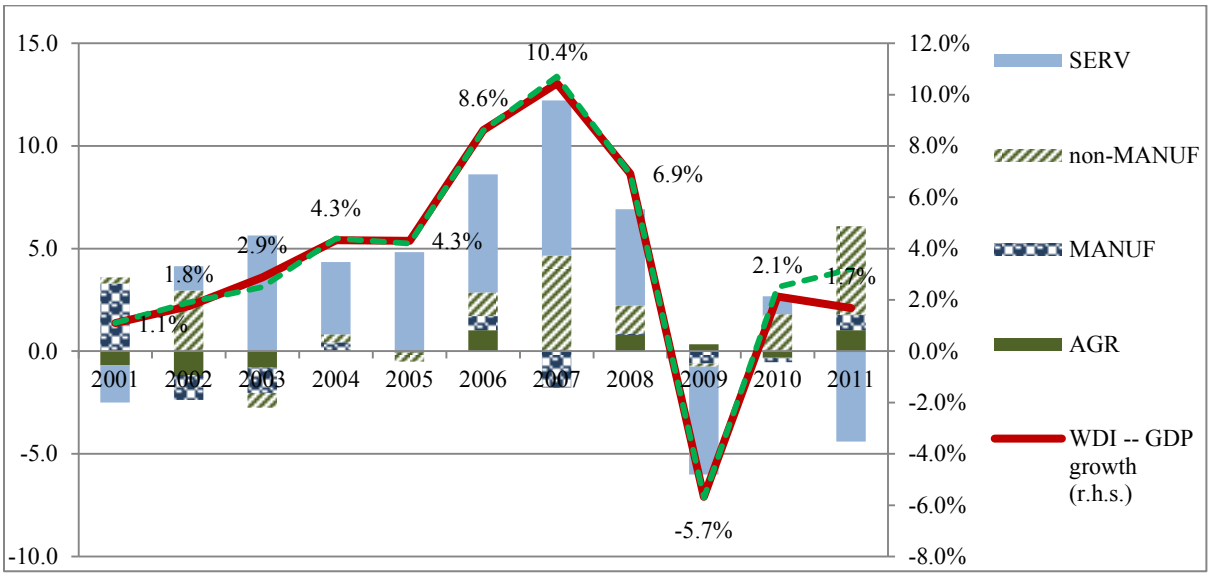
1. WHERE THE COUNTRY STANDS

Economic Performance and Structure

18. As a newly independent country, Montenegro reinvigorated economic and structural reforms, obtained World Trade Organization (WTO) membership, and advanced its EU accession process. A great deal more is needed to complete reforms and restructure the economy in order to enable its effective integration with the rest of the world. Based on progress in institutional, legal, and policy settings, Montenegro opened formal membership negotiations with the European Commission in 2011 and began accession talks in June 2012. On December 18, 2012, negotiations on the Science and Technology chapter were provisionally concluded. On a parallel track, Montenegro became the 156th member of the WTO in 2011.

19. Following the end of regional conflicts and the lifting of United Nations (UN) sanctions in 2000, economic growth gradually accelerated during the 2001-2008 period. Unfortunately, this progress was interrupted by the global crisis. The initial revival of growth was owed to a large (32.2 percent) rebound of manufacturing production in 2001 and a 24.9 percent hike in non-manufacturing (mainly energy) production in 2002, both reflecting the removal of trade and financial restrictions. In subsequent years, growth rates gradually increased from 2.9 percent in 2003 to 10.4 percent in 2007 (Figure 1), driven mainly by tourism and related services. As other sectors started to make positive contribution to growth, the economy grew by 8.73 percent during the 2006-2008 period.

Figure 1: Montenegro – Sources of GDP Growth 2001-2011



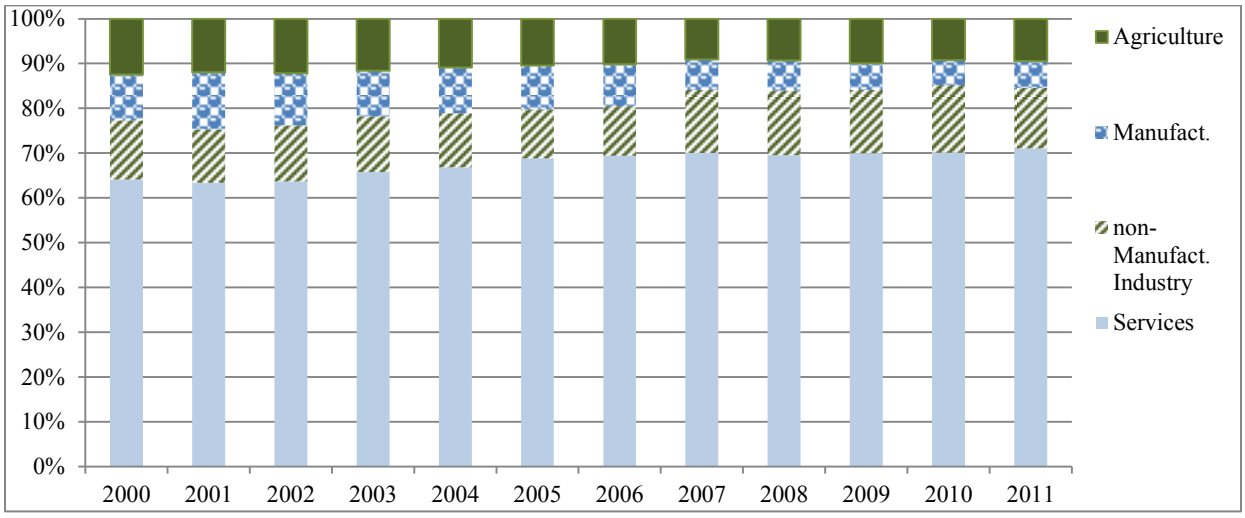
Source: MONSTAT, World Bank WDI database, staff calculations.

20. The economy of Montenegro was hit hard by the global crisis. Predictably, the tourism industry suffered from lower demand. In addition, both the price and demand for metals, the main export of Montenegro, collapsed during the crisis and have remained weak. Workers' remittances declined and external sources of financing almost dried up due to global credit crunch and the sudden withdrawal of private investors engaged in the real estate market. As a result, the economy contracted by about 5.7 percent in 2009 and has been on a slow recovery path ever since.

21. Montenegro is a small (pop. est. 623,000), upper middle-income country ($10,468 GDP per capita in 2011, in constant 2005 purchasing power parity (PPP) dollars), with a services-based economy led by tourism. Seven years after obtaining formal independence, 15 years after de facto independence, and more than two decades after the breakup of former Yugoslavia, the country is still in the process of transitioning to a market economy. In the past, the Montenegrin economy relied on metals (iron and steel, and aluminum) and associated industries, which provided the bulk of employment and value added. Designed to substitute imports for a much larger Yugoslav market, these industries suffered from outdated technology, high energy intensity, and overemployment, and simply could not stand the test of competition, even when privatized.[7]

[7] After three failed privatizations, the Niksic steel mill was recently acquired by a large Turkish metal conglomerate, which may find a viable market solution for the company. By contrast, the privatized Podgorica aluminum plant stalled due to excessive electricity debt as the government (expectedly) failed to deliver on heavily subsidized energy.

Figure 2: Montenegro - Sector Composition of GDP



Source: MONSTAT, World Bank WDI database, staff calculations.

22. The transition towards a market economy has seen a shift away from traditional industries towards high-growth sectors such as tourism and related services. Services now account for more than 70 percent of GDP, followed by non-manufacturing industry (mainly energy) with 13-14 percent, and agriculture 9-10 percent. The share of manufacturing has substantially declined over the past two decades and now stands at mere 6 percent of GDP. Despite strong privatization efforts, state-led mid-size industrial enterprises still comprise a substantial portion of the economy, especially in terms of employment, fixed assets, and the use of scarce energy and natural resources, as well as public funds (through subsidies and tax exemptions). The last decade has also seen an increase in the share of small and medium-sized enterprises (SMEs) in economic output. These firms primarily serve the domestic market even when they produce tradable goods and business services.

23. Before the global crisis, investment and interest in coastal tourism had been increasing steadily. The large capital inflow financed huge current account deficits ranging between 16.6 percent of GDP in 2005 and 49.8 percent in 2008, and fueled an unsustainable real estate boom. Despite the significant adjustment brought about by the crisis, the external deficit still stands at around 20 percent of GDP, which is not sustainable in the longer run. Montenegro thus urgently needs to increase the competitiveness and export orientation of its key industries, tourism and business services, by leveraging innovation and human capital. Greater emphasis on higher education and R&D could create a mix of human talent and innovation required to expand to new markets in the Western Balkans and beyond.

R&D and Innovation Trends

R&D Spending

24. As of 2011, the Gross domestic Expenditure on Research and Development (GERD) was 13.2 million euros, or 0.41 percent of GDP.[8] This is marginally higher than the average for the Western Balkans (0.33 percent of GDP) but considerably below the EU average of 2.03 percent of GDP.[9]

25. About three-fifths of the 1.62 percent gap in R&D financing (GERD) between Montenegro and the EU can be traced to exceptionally low private sector spending, while the remaining 40 percent is due to inadequate public sector performance. The private sector in Montenegro contributes 27 percent of the GERD, almost the same as the average (27.6 percent) for the WBC region and significantly below the EU average (53.8 percent).

26. Although the Montenegrin public sector contributes a larger share of GERD (58 percent) than the comparable balance for the EU, it still falls significantly short of the EU in terms of R&D expenditures expressed as a percent of GDP (0.24 percent compared to 0.94 percent). Yet government budget outlays on R&D as a share of total general government expenditure have increased from 0.20 percent in 2008 to 0.27 percent in 2010.

27. Commercialization of research and private sector spending on R&D are hampered by weak technological capacity. Montenegro is still catching up with the developed world in terms of the technological capacity of its business sector. Despite subsidies that increase incentives for private sector research, it will take some time for the country to achieve the critical mass of research resources (human, knowledge, and physical) that would spur an increase in private sector spending on R&D. For now, it seems that the perceived risks and costs of investment in R&D for most firms in Montenegro are too high.

28. The small size of the economy reduces the capacity to invest in research equipment. Modern equipment for advanced labs requires high capital investment, which is often beyond the capacity of small countries like Montenegro. This severely limits the scope for research specialization and makes regional research initiatives with other Western Balkan countries much more important. Unlike large economies, investment in specialized labs makes up a larger proportion of the economic output for small countries like Montenegro. This makes it harder for such countries to invest heavily in technically advanced research.

[8] MONSTAT (2013).

[9] Official statistical data for R&D in Montenegro may be biased downwards due to incomplete coverage and partial reporting. The statistical survey did not cover private research institutions and R&D activities conducted within private businesses. The voluntary reporting of R&D expenditures was partial, as it reflected only the budget resources allocated for research, and did not cover the associated salaries and other expenditures (such as the use of buildings, equipment and infrastructure provided by higher education institutions). The initial improvements in the statistical methodology implemented last year produced a substantially higher GERD figure with similar level of budget expenditures on R&D: i.e., GERD for 2011 was estimated at 0.41 percent of GDP compared to 0.13 percent in 2010. Further improvements expected in the coming years are likely to generate a higher true GERD figure and, thus, lower the present R&D expenditure gap with the EU.

Human Resources and Brain Drain

29. The scientific research community is rather small in comparison with others in the EU, despite the notable increase in the number of licensed scientific research institutions and researchers during the last few years. According to 2011 Census data, the total number of workers in Montenegro was 175,171. R&D Survey results for 2011 show that 2,303 personnel were engaged in R&D jobs that year, of which 1,699 were researchers which makes researchers 0.97 percent of the country's total number of workers.[10]

30. There are fewer researchers and employees with tertiary education in Montenegro compared to the EU norms, and they are concentrated in a few institutions. For every 1,000 employees, the EU has 2.5 times the number of people with tertiary education and 4 times the number of researchers compared to Montenegro. In addition, approximately 65 percent of those employed in R&D institutions work at the University of Montenegro, indicating a high degree of concentration of human resources.

Table 1: Scientific research and development organizations, and scientific works

	Number of R&D institutions	Employees	Scientific and technical workers		Completed research works		
			Researchers	Contributors	Basic	Applied	Developmental
2000	23	1,217	642	255			
2001	22	1,223	626	234			
2002	21	1,185	605	236			
2003	21	1,227	602	312			
2004	22	1,200	597	259	7	13	27
2005	23	1,246	633	290	18	17	27
2006	24	1,233	602	282	4	7	33
2007	32	1,344	671	276	12	24	23
2008	34	1,462	766	306	14	32	26
2009	36	1,512	781	326	7	13	27
2010	42	1,346	752	238	14	25	19

Source: MONSTAT, Department of Education statistics, research and development, culture, justice and administration.

Table 2: Relative structure of Researchers by scientific fields

Natural sciences and Mathematics	**7.50%**
Agriculture	6.60%
Engineering and Technology	**20.30%**
Medicine	27.00%
Social sciences	**18.70%**
Humanities	**19.90%**

Source: MONSTAT (2011).

31. The Ministry of Science has created an Action Plan to close this gap. These initiatives aim to improve enrollment and quality for higher education by providing additional funds through various channels, bilateral/international programs, and cooperation with the diaspora. The Ministry has also

[10] MONSTAT (2011).

increased funding to university research laboratories to improve research infrastructure. However, given the lags in realizing returns from education, it would be some time before these investments lead to an actual change in the numbers. In addition, academic standards and quality of instruction in Montenegro need to be raised further to meet Bologna agreements.[11]

32. Like other small countries, brain drain is a significant threat to R&D in Montenegro. The political instability in the 1990s led to an exodus of technically trained personnel seeking employment and career opportunities in other countries, and Montenegro has been struggling to bridge the talent gap ever since. The government of Montenegro does not collect information on emigrants abroad, but past censuses indicate that around 9 percent of Montenegrins live outside the country.[12] In 2012, in collaboration with the Millennium Project, the Ministry of Science launched a new initiative called Tele-Montenegro, which aims to use the Internet to match skilled Montenegrins based outside the country with the needs in the country. Such efforts, however, need to be supplemented with measures to prevent further drain of talent from the country.

Public Research Institutions and R&D Infrastructure

33. With the exception of a few research areas, R&D infrastructure in Montenegro is generally weak and out of date. Montenegro has research infrastructure potential in the areas of: (a) biomedical and life sciences (especially agriculture, public health, hydrographical and seismological research, water and marine chemistry, and microbiology research, as well as marine biology infrastructure); (b) Information and Communication Technologies (ICT) (especially in the field of energy, telecommunications, electronics, computer engineering, and related technologies); and (c) materials science (in the area of mechanical engineering and metallurgy with research and testing labs).

34. Insufficient financial resources and the detrimental impact of erstwhile international sanctions and regional instability have hampered investment in technological progress and imposed a significant constraint on Montenegro's ability to innovate and produce quality research. In addition, the current university-funding model does not provide the right incentives to balance teaching and research, or stimulate collaboration with the business sector.[13]

35. Despite the gap in technological capacity and policy constraints, Montenegro can build institutional capacity for innovation given sufficient time and capital investment. The overall research output, however, is still low compared to other Western Balkan countries and the European Union. See Box 1, below.

36. The government has also made a concerted effort to improve research infrastructure and encourage private sector spending on R&D. There has been particular emphasis on increasing the institutional capacity for collaboration between research institutes and private sector firms. In 2011, the Ministry of Science commissioned feasibility studies for centers of excellence and technology parks. These initiatives are focused on speeding innovation and commercialization of research by increasing collaboration between the private sector and academic institutions. The low demand for technical research from private sector firms is, however, a matter of concern.

[11] World Bank (2011).
[12] Presentation by Sekulovic (2012).
[13] World Bank (2011).

The Business Sector and Industry-Science Linkages

37. The private sector comprises about 12,000 active companies. The majority of private companies are small and medium enterprises (SMEs) that perform simple production and services and have neither interest in nor funds for R&D. The links between science, research, education, and industry in Montenegro are weak. Another problem is the lack of adequate financing and the unwillingness of companies to take on high-risk R&D projects.

38. Industry-science linkages in Montenegro are negligible. While the private sector is represented in research-related policy-making bodies such as the Council for Scientific Research, there is very little actual collaboration between businesses and academic institutions. Most research in Montenegro continues to be funded publicly and conducted by academic institutions.

39. Lack of linkages could be caused by insufficient private-sector demand for research or inadequate institutional and physical space for collaboration. The government is taking steps to correct the latter problem by setting up Centers of Excellence and technology parks, but it remains to be seen if this will also lead to increased private sector demand for research products.

S&T Outputs and Innovation Performance

40. Montenegro lags behind the Western Balkans and the EU in terms of technological output and innovation. The number of patents administered in Montenegro, as reported by the Federal Institute for Patents, has been relatively low in recent years.[14] As for international patent applications, the country filed only 3.17 patents per million people to the Patent Cooperation Treaty (PCT) in 2011. This compares very poorly with the numbers of 18.5 and 99.8 for the Western Balkans and the EU, respectively.

41. The figures for number of journal articles are similarly poor.[15] In terms of scientific outputs, according to a study based on bibliometric data from SCOPUS,[16] Montenegro is at the bottom of the Western Balkans region and Eastern European countries in terms of total publications, with only 485 publications between 2005 and 2010. Publications per thousand inhabitants decreased from 69 to 4 in the same period. Further details of scientific performance of Montenegro are provided in Box 1, below.

42. In terms of quality, according to the same study aforementioned, the quality of Montenegrin science ranks among the lowest of European countries. On average, Montenegro has a normalized citation index of 0.66, which is 4th in the WBC region but among the bottom 10 in Eastern Europe. [17] The country is far below the EU-27 average (1.30). The average citation per publication was 3.25 between 2003 and 2010, one of the lowest among the WBCs. According to this indicator, Montenegro is far behind the average of the WBCs, Eastern Europe, and the EU-27.

[14] Four patents were granted in 2002 and one in 2003. Uvalic (2006).
[15] See Annex, Table A1 for a list of indicators on innovation and technology.
[16] SCIMAGO Research Group (2012).
[17] Normalized Impact scores indicate the scientific impact that institutions/countries/regions have over the scientific community. Normalized Impact values show the ratio between the average scientific impact of an institution/country/region and the world average impact of publications of the same time frame, document type, and subject area. The values are expressed in decimal numbers and show the relationship of the institution's average impact to the world average, which is 1. For example a score of 0.8 means the institution is cited at 20 percent below the world average, and 1.3 means the institution is cited as 30 percent above world average. Normalized Impact is computed using the methodology established by the Karolinska Institutet in Sweden, where it is called the "Item oriented field normalized citation score average."

43. In terms of research specialization, the activity index (also called the "Relative Specialization Index"[18]) per area for the WBC shows that Montenegro has no well-established specialization (see table 3). In fact, there is no scientific field in which there is a specialty index above 1, indicating a lack of specialization. The only two areas where the country approaches a specialization index of even half of the world average is computer science, and physics and astronomy (see table 1 below). In terms of publication production, Montenegro concentrates its output in engineering, with 164 documents, very closely followed by physics and astronomy (154), which also coincides with being the area with the highest citations per publication average (6.42).[19]

Box 1: The State of Scientific Performance in Montenegro

- In Montenegro, 80 percent of the publications are produced by higher education institutions, which also have an exceptionally high percentage of the citations (almost 95 percent). This pattern is more extreme than in other countries in the region and the EU-27 averages.
- A single institution is responsible for most publications in the country: the University of Montenegro, with 634 documents in the period, is the only institution with an output exceeding 16 publications.
- Montenegro shows the highest rate of international collaboration in publications within the WBCs. The average of collaborations from 2006 to 2010 is 73.10 percent, far above EU-27 and WBC averages. Half of the collaborations are with Serbia, and less than 5 percent are with Croatia.
- The country has high rates of collaborations between private and higher education institutions; however, there is no collaboration between private and government institutions.

Source: SCIMAGO Research Group (2013).

44. In terms of firm quality certification, the numbers of certificates are relatively low compared to Serbia and Croatia (see table 4). The number of ISO-9001 certificates remains around 140 (over the period 2007-2011) while certificates for ISO 14001 remain below 30.

Table 3: Research Specialization Areas in the WBCs: Activity Index of the total volume of publications over the period 2003-2010.

		Albania	Bosnia & Herzegovina	Croatia	FYR of Macedonia	Montenegro	Serbia
Most Specialized	1	Earth and Planetary Sciences 3,3	Medicine 2,8	Social Sciences 2,5	Chemistry 2,2	Computer Science 0,6	Mathematics 3,6
	2	Environmental Science 2,9	Social Sciences 2,7	Veterinary 1,8	Mathematics 1,4	Physics and Astronomy 0,5	Chemistry 3,2
	3	Immunology and Microbiology 2,3	Agricultural and Biological Sciences 1,1	Agricultural and Biological Sciences 1,7	Physics and Astronomy 1,3	Agricultural and Biological Sciences 0,3	Decision Sciences 3,1

[18] The activity index highlights the relative research efforts of a country to a given field. The concept was suggested by Frame (1977) to compare any country's performance with the world's performance. The activity index (also called "Relative Scientific Specialization" or RSS) is a measure of the degree of specialization of a country in a particular field. It is calculated by dividing the percent of all papers in a field from Country X by the same proportion calculated at the world level. Thus a RSS between 0 and 1 indicates that a country is relatively unspecialized in that field, while any RSS above 1 represents a relative specialization in that field; the higher the RSS above 1, the greater the degree of specialization in that field. SCIMAGO Research Group (2012).

[19] SCIMAGO Research Group (2012).

Least Specialized	24	Engineering 0,4	Arts and Humanities 0,3	Neuroscience 0,4	Arts and Humanities 0,2	Pharmacology, Toxicology and Pharmaceutics 0,03	Economics, Econometrics and Finance 0,6
	25	Health Professions 0,2	Neuroscience 0,3	Decision Sciences 0,3	Nursing 0,2	Veterinary 0,03	Arts and Humanities 0,3
	26	Chemical Engineering 0,2	Nursing 0,04	Nursing 0,1	Health Professions 0,1	Nursing 0,03	Nursing 0,2

Source: SCIMAGO Research Group (2013).

Table 4: Number of Quality Certificates

ISO 9001						ISO 14001				
	2007	2008	2009	2010	2011		2008	2009	2010	2011
Albania	23	43	155	52	164	Albania	…	1	…	11
BiH	652	811	909	944	1119	BiH	60	87	100	148
Croatia	2073	2302	2567	2102	2117	Croatia	343	469	451	488
FYR Macedonia	255	271	…	…	…	FYR Macedonia	26	…	…	…
Montenegro	136	160	157	85	146	Montenegro	17	18	15	25
Serbia	1987	2091	2733	1790	2868	Serbia	176	298	318	520

Source: The ISO Survey of Certifications (2011).

ICT Infrastructure and Diffusion

45. Research institutions in Montenegro are now connected to the European Academic Network (GÉANT). This is a significant step in fostering a greater exchange of information between researchers in Montenegro and the rest of the world. Through this network, researchers in Montenegro can access information from other universities and institutes in Europe over a high-speed network.

46. The ICT infrastructure has been growing at a fast pace in Montenegro. The main ICT indicators, such as PC and Internet penetration and information technology (IT) consumption per capita, are increasing, although they are below the EU average. Internet penetration for households has increased to 51.4 percent in 2011, from 2.6 percent in 2001. According to Monstat, 43.5 percent of households had a personal computer in 2009. There are 40 Internet users per 100 people, which is comparable to the Western Balkan average of 54 but much lower that the EU average of 72. The most recent numbers indicate a personal computer penetration of 72.6 percent for households. In addition, there are 185 mobile phone subscriptions per 100 people in Montenegro; this number is much higher than the averages for both Western Balkans and the EU.

47. The Ministry of Science represents the official body in charge of research activities in ICT. A strategy for the development of an information society for the period 2009-2013 was created with the aim to strengthen ICT infrastructure, promote access to modern technologies, and facilitate the use of ICT. Another key promoter of ICT is the Ministry for Information Society and Telecommunications.

Intellectual Property Rights (IPR)

48. Montenegro has made progress in establishing institutions and laws to protect intellectual property rights (IPRs), which safeguard innovation. Montenegro has been modernizing its intellectual property law since independence in 2006 and established the Intellectual Property Office of Montenegro (IPOM) in May 2008. In intellectual property protection, Montenegro ranks 70th globally, higher than the average Western Balkan country (95) but lower than the EU average ranking of 40.[20]

49. In December, 2006, Montenegro became a member of the World Intellectual Property Rights Organization (WIPO). Since then, Montenegro has enforced all of the IP conventions and protocols to which it was a signatory. In addition, a regulation on the recognition of IPRs, as adopted by the Patent Office of the State Union, has been adopted. This regulation referred to the status of applications and approved IPR given by the Belgrade office before the national IP Office became operational.[21]

50. Montenegro, in collaboration with WIPO, has framed a National Intellectual Property Strategy to reform and modernize its IPR systems. However, the IPOM recognizes several constraints that hamper the implementation of reforms, which include a weak IT infrastructure, limited awareness of IPR, a weak enforcement system, and lack of cooperation between different entities in the IPR space in the country.[22]

2. THE RESEARCH, DEVELOPMENT, AND INNOVATION SYSTEM, AND ITS CHALLENGES

51. Despite many initiatives, new legislation, and adoption of strategies, it is evident that there has been little tangible progress in the area of R&D capacity, technology transfer, and innovation in Montenegro. Undoubtedly, limited funding is a serious factor. However, reforms can still proceed in an environment of resource scarcity if there is a clearer understanding of the systemic nature of R&D and innovation and a comprehensive program to address key binding constraints.

52. The following section explores the nature of Montenegro's R&D and innovation system—stakeholders, governance, stated strategy, funding, and dynamics—with the aim of identifying possible weaknesses and options for reform.

Need for a Systemic View

53. Montenegro's R&D and innovation efforts should be seen by policy-makers and the broader public as a system of many stakeholders within the public and private sectors, spending on R&D and interacting as parts of a value chain that should move ideas to market.

54. When properly functioning, R&D transforms into innovation and leads to products and services that strengthen the country's business investment, technological sophistication, comparative advantage, and economic performance. Performance of national innovation systems depends on both the capabilities

[20] Global Competitiveness Report (2012).
[21] Knezevic (2008).
[22] Presentation by Sekulović (2012).

of the actors –including the science sector, private sector, policymaking institutions, financial institutions and market intermediaries, society – and well-articulated and strong linkages among them. Different stakeholders act at different stages in the innovation process.

55. In the context of developing countries, a well-functioning innovation system facilitates incremental private sector technological improvements through various means, including employment of highly qualified science and technology personnel, collaboration with researchers, training, extension services (R&D and engineering services; quality certification and standards), and the ability to access and utilize global technological developments.

56. Improving knowledge capacity (R&D) and innovation is not a simple or quick task, and it requires the active participation of all stakeholders. The multiplicity of players, difficulty in aligning incentives and establishing modern legal frameworks and government policies, and encouraging private sector actions poses challenges. Overcoming ingrained cultural differences, if not distrust, between entrepreneurs and researchers; reducing business fear of government dictates, revenue demands, or red tape requirements; or stimulating the private sector to take a more proactive interest in R&D to gain global market share all require concerted and well-conceived initiatives. As a chain, the weakest link can determine overall success, so ignoring key links can be costly.

Need for Good Governance

57. In the path toward research excellence, it is essential to have research systems that are competitive and transparent, with competitive recruitment and efficient administrative procedures. Appropriate governance mechanisms and sufficient performance-driven incentives help to enable the conditions needed to improve both the amount and quality of scientific research.

58. In Montenegro, increasing funding for research and ensuring its continuity over time remains a great challenge. In parallel, governance of research institutions and universities needs to be improved in line with the aim of research excellence. Better governance of universities and public laboratories can be achieved through the use of new mechanisms, such as greater use of project funding (typically contracts and grants awarded through competition), and selective increases in funding for research fields that are linked to social and economic need.[23] Incentives that focus on excellence and relevance can help strengthen the contribution of public investment to scientific progress and innovation. In particular:

- **Merit-driven research funding** means competitive granting, subject to a peer-review system and international criteria in which projects are selected on the basis of the quality of proposals and expected results.
- **Good governance in research funding** implies meritocracy and transparency in grant funding, along with accountability, evaluation and monitoring practices, transparency, and performance evaluation gauging contributions to knowledge, local economic and social needs, and growth.[24]

59. In research institutions, appropriate governance mechanisms mean performance-driven career development, clear and transparent recruitment policies, and clear rules regarding ownership and commercialization of intellectual outcomes – revenue participation by researchers – resulting from

[23] OECD (2011a) and OECD (2011b).
[24] OECD (2011a).

research. This also implies that results of publicly funded research are protected and published in a way that encourages their exploitation. The European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers provide examples of governance principles to make research careers more attractive, a key element in improving governance for research excellence, and consistent with the goal of a better integration to ERA.

60. Good governance of universities requires enhanced autonomy to organize their activities in the areas of education and training; research and innovation; open transparent and merit-driven recruitment methods;[25] institutional accountability; quality assurance systems; and, the ability to access alternative sources of funding and engage in interactions with industry (e.g., collaboration, curricula development and doctoral training).[26]

61. Some of these policy areas are covered by the Bologna Declaration within the framework of the European Higher Education Area, signed in 2007 by 46 governments. Countries agreed on 10 action lines aimed at making higher education in Europe more compatible and comparable, as well as more competitive and attractive for students and researchers in Europe and worldwide.[27]

62. Most of the WBCs have entered the Bologna process and are currently implementing reforms in that direction. Yet implementation of reforms is difficult, and it is proceeding at different rates across the countries, particularly the reforms that require changes in culture, and additional resources and skills (e.g. managerial competencies, internationalization, in addition to other requirements related to integration and governance).

Key Stakeholders

63. Policy-making agencies have control over legislation and implementation of an R&D strategy. This affects the day-to-day activities of research institutions and agencies with the aim of enhancing public-private cooperation in research. Policy-makers are advised through a set of expert councils that draw expertise from relevant sectors of the economy and society. The private sector informs the advisory agencies through representatives and collaborates with research institutions through agencies that promote collaboration.

Policy-Making Agencies

64. The policy-making agencies for research in Montenegro are responsible for framing laws, funding RDI projects, defining research priorities, assessing and implementing quality standards and governance incentives, and investing in research and innovation infrastructure.

The Parliament of Montenegro is the highest legislative body in charge of preparation and adoption of legislative acts dedicated to research activities.

[25] Merit-based recruitment implies not only scientific productivity but also a wider range of evaluation criteria, such as teaching, supervision, teamwork, knowledge transfer; management and public awareness activities (see Innovation Union and the Code of Conduct for Recruitment of Researchers, EC).
[26] OECD (2011b).
[27] This entails comparability in degrees –countries are setting up national qualifications frameworks that are compatible with the overarching framework; adoption of quality assurance mechanisms in accordance with the Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG); and fair recognition of foreign degrees and other higher education qualifications in accordance with the Council of Europe/UNESCO Recognition Convention.

65. The Ministry of Science (MoS), created in 2010 to improve governance of the science and R&D system, is responsible for science and R&D on the operational level. It funds R&D projects, develops research infrastructure, and acts on strategy documents prepared by advisory bodies. It also coordinates with different ministries to develop national R&D projects. The Ministry of Education and Sports controls not only quality assurance and accreditation of higher education, but also bilateral intergovernmental cooperation of universities.

66. Other ministries are also involved in R&D policy. The Ministry of Economy supervises the Directorate for Small and Medium Sized Enterprises (SMEDD), which is responsible for promoting innovation and modernization of SMEs. Several other ministries work with the MoS to promote research projects relevant to their areas of interest. Strong inter-ministerial cooperation has been established, as reflected by the announcement of a call for proposal co-funded by seven ministries to finance national research projects for the period 2012-2014, with a budget of €5 million.[28] Other actors involved in policy-making and implementation are: the Chamber of Economy of Montenegro, Directorate for Development of SMEs, NGOs, and the Ministry for Information Society and Telecommunication. The Agency for Electronic Communications and Postal Services (for the ICT area) and the Environmental Protection Agency (for environmental protection) are involved as implementing agencies.

Advisory Agencies

67. Advisory agencies provide expertise and guidance to different ministries and recommendations on prospective research projects and appropriate R&D strategies. They include:

- The Council for Scientific Research Activities, with members from various spheres of the economy and academia. It has the mandate to provide opinions, recommendations, and conclusions that are public. The Council also offers advice on whether to assign the statute of a Center of Excellence to a research organization and/or group of individuals.
- The Higher Education Council, appointed by the Minister of Education, advises on accreditation of new curricula.

Research Institutions and Universities

68. Currently, there are 51 institutions with a license to perform scientific research activities in Montenegro. Besides the Montenegrin Academy of Science and Arts (MASA), the country has around 50 licensed research institutions, including three universities, public and private independent research institutions, and R&D companies.

69. *University of Montenegro* - Founded in 1974, UoM (Univerzitet Crne Gore) is the only public university and the largest higher education and research institution in Montenegro. In addition, Montenegro also has two private universities that complement the R&D system.

70. The Montenegrin Academy of Sciences and Arts (MASA) is the other premier research institution in the country. Along with conducting research, it plays a significant role in improving the technical capacity of scientists, assessing and disseminating research, and improving academic standards.

[28] Ministry of Science, Ministry of Agriculture and Rural Development, Ministry of Health, Ministry for Information Society and Telecommunications, Ministry of Sustainable Development and Tourism, Ministry of Education and Sports, and Ministry of Culture.

Its members conduct research within the departments of natural sciences, social sciences, and arts. The Academy is independent of the government, industry, and other organizations, and operates under separate law. The main activities include the promotion of science, research, and artistic work; organization, realization, and coordination of scientific-research projects important for preservation and promotion of the natural and cultural heritage; playing an advisory role in adoption of various decisions at the state level; elaboration and implementation of R&D state programs; and, providing expertise for and enhancing international cooperation.

Agencies for Research Commercialization and Private-Public Collaboration

- Montenegro has two technology/innovation centers (European Information and Innovation Centre Montenegro (EIICM), and the R&D Service Center at the University of Montenegro) and two business incubators that are focused on innovative technologies.
- The Investment and Development Fund (IDF) of Montenegro is a joint stock company that controls a portfolio of companies valued at 100 million euros. It provides incentives, loans, and guarantees to companies, with the goal of accelerating economic development.
- Other actors include the Agency for Electronic Communications and Postal Services (for ICT), the Business Alliance, and the Chamber of Economy of Montenegro.
- The Ministry of Science is also planning to develop technology parks and Centers of Excellence to increase public-private collaboration in research.

3. POLICY DEVELOPMENT

71. Despite the progress on the institutional front, significant structural deficiencies of research and innovation system remain. They include lack of infrastructure for research and innovation; lack of incentives and funding support; lack of cross-discipline collaboration in research; and, lack of information on possible funding initiatives and partnerships.

72. These challenges have been addressed in recent policy programs. The two main strategy documents that guide research policy in Montenegro are: the Strategy for Scientific and Research Activity 2008-2016, and the Strategy for the Development and Financing of Higher Education.

73. The key goals outlined in the different strategy documents relevant to research (R&D) and innovation are as follows:

- Increase research activity
    - Increase the emphasis on research at universities (relative to teaching)[29]
    - Encourage student involvement in science through changes in curricula
    - Remove restrictions on who can conduct research
- Increase regional collaboration
    - Improve quality standards
    - Increase researcher mobility

[29] As documented in the UoM research strategy, which was a result of the EVOLUNIMONT Project (Evaluation of Research Activities and Strategic Planning of Research at the UoM), financed under FP7.

    - Promote regional research initiatives to increase economies of scale and specialization at the country level
- Improve research infrastructure:
    - Invest in R&D infrastructure to modernize equipment
    - Increase private sector investment in R&D through technology parks and Centers of Excellence
- Stimulate private sector interest in research:
    - Increase collaboration and sharing of information between the private sector and research institutions

National Strategy

74. Governance capability is crucial for the success of any public policy. Good governance for research and innovation policy means having an integrated and coherent policy-making process in place, with stable institutions and deploying policy agencies performing according to policy objectives and well-defined implementing procedures. Elements of good governance are: formulation mechanisms (consultation and priority identification); target setting and programming (medium and long run); monitoring and accountability; and, information dissemination mechanisms.[30]

75. Definition of policy priority and targets, action lines, and corresponding resource planning are made possible through national strategies for research and innovation. National strategies articulate countries' vision regarding the contribution of research and innovation to national economic development, and are therefore helpful to organize efforts and policy reforms into a specific direction. In some cases, national strategies outline the specific policy instruments to be used to meet a set of goals or objectives.[31]

76. In Montenegro, the Strategy for Scientific and Research Activity is prepared by the Council for Scientific Research Activities, which is the highest advisory body for scientific research policy and strategic planning. Particularly, the Strategy determines: (i) priorities in scientific research activities; (ii) a plan for developing and promoting young postgraduate researchers in priority development areas; (iii) a framework for financing programs with public interest; (iv) a plan for investment of annual financial resources for scientific research activity; (v) necessary scientific research infrastructure; and, (vi) research information systems.

77. The most recent Strategy was adopted in 2008 for a period of 8 years (2008-2016). Following evolving market challenges and the establishment of an independent Ministry of Science, the government, at the suggestion of the Ministry of Science, revised the Strategy in December 2012.

78. The Council has 11 members nominated by the government. Four members of the Council are nominated from the representatives of the bodies of public administration in charge of science, higher education, economy, and finances. Seven members are nominated as distinguished experts that contribute

[30] European Commission's White Paper on Governance (2001) has set out five principles that underpin good governance. They are: openness, participation, accountability, effectiveness, and coherence. These are required for the sound management of public resources and essential in creating environment conducive to business, as well as a productive partnership between public and private sectors.
[31] OECD (2012b).

to the development and application of scientific research activity, from scientific research institutions, higher education institutions, the Montenegrin Academy of Sciences and Arts, and the business sector. It is important that the principle of equal representation of all scientific fields be respected. After the Strategy Draft is prepared, it is open to public discussion, and public debate is organized. The final step is approval by the government.

79. The strategy, however, does not always inform changes in policies, resource allocation and institutions. There are no direct links between strategy targets and public budget decisions. The available budget has not followed defined strategy objectives. Besides resource constraints, the three most binding constraints on the implementation of the strategy are: networking problems between different market actors; limited access to information; and, the lack of an available statistical database on innovation activities. Interviews and surveys conducted by the World Bank indicate that the strategy does not have sufficient impact on government policy or spending. Moreover, collaboration between private and academic institutions in Montenegro remains a major obstacle to innovation despite several interventions. The private sector still has inadequate access to information on innovation activities in the country, and there seems to be a coordination problem that prevents different market entities from coming together to use research to innovate and create new products.

Legal Framework

80. The most important laws that regulate Science and Research in Montenegro are: the *Law on Scientific and Research Activity of Montenegro* and *the Law on Higher Education.* The Law on Scientific Research and Research Activity (promulgated in 2005 and updated in 2011) "regulates the organization, conditions and modes of financing of scientific research activity and other issues relevant for the performance of this activity." Pursuant to the 2005 Law, the government adopted the Strategy for Scientific and Research Activity, which determines the priorities of scientific and research activities, funding, and the need for research infrastructure for the period 2008-2016. The Law on the Montenegrin Academy of Sciences and Arts regulates the activities of the Montenegrin Academy of Science and Arts.[32]

81. The Law on Scientific and Research Activity of Montenegro was amended in 2010 and 2011, taking into account that the research environment has changed significantly and that there is a need for introducing and defining quality in research, parameters for funding on a competitive basis, quality assurance and promotion, and recognition of quality in research. Reforms therefore focused on establishing international quality standards and greater integration with the ERA. The amendments also relaxed restrictions on who could perform research in the country, and established the Council for Scientific Research Activity, which controls the allocation of Centers of Excellence status in compliance with the newly amended requirements. In addition, the amendment recognized 14 priority areas for programs of public interest.

[32] Official Gazette of the Republic of Montenegro 24/93, 30/94.

Policy Reforms

82. According to the World Bank Policy Questionnaire, Montenegro has undertaken major initiatives to reform the organization and governance of universities and public research organizations in order to improve quality of research and conditions for innovation. These measures include: stronger evaluation of scientific performance (e.g., publication and citation criteria, participation in international conferences, etc.); broadening of funding structures; and, changes in the organizational structures for performing R&D. There are also plans to improve research synergies by pooling expertise and resources through the creation of centers of excellence.

83. More specifically, Montenegro has instituted a process of external evaluation of researcher performance and scientific projects when applying for research funds. The Law stipulates that the Ministry stimulate the quality of scientific research work by: (i) awarding prizes for scientific achievements to researchers; (ii) realizing programs of public interest in which scientific productivity is promoted in the form of publication of scientific works in refereed journals and other forms; and, (iii) awarding the status of the Centre of Excellence to a scientific research institution or group of researchers in an institution that has, by the originality or significance of achieved results in research, realized the highest level of achievement and produced internationally recognized outputs in its area of science.

84. Amendments to the Law on Higher Education were adopted in Parliament on July 27, 2010. Major updates of the new Law include: an integrated university system; introduction of a three-cycle education system; and, the ability to transfer credits from other European universities via the adoption of the European Credit Transfer and Accumulation (ECTS) system. It also instituted a new council for assuring the quality of higher education in Montenegro. These amendments will have an effect on improving the quality of education and greater integration with the EU. In addition, the law has taken measures to increase the autonomy of universities. Since 2006, Montenegro has also been reforming laws that govern intellectual property to ensure that they match laws in other European countries. In 2005, Montenegro adopted its own "Law on the Enforcement of Intellectual Property Rights."[33] Subsequently, several new acts have been adopted.[34]

85. With respect to universities, a number of steps have been taken to improve governance:

- Autonomy in recruitment has been enhanced, together with the ability to establish internal governing bodies. Financial resources related to salaries at the public University of Montenegro depend, however, on the Ministry of Finance.
- Access to other sources of funding and procedures to collaborate with industry has been eased. Yet, there are no strong links between industry and academia.
- Universities have taken steps to adopt quality monitoring procedures and conduct self-evaluations to assess quality, which involve stakeholders from the management, students, and staff. However, they still need to improve accountability and flexibility to allocate resources internally.

[33] Official Gazette of Montenegro No.45/2005.

[34] New policies and laws introduced in the domain of IPRs include: (i) Decree on Declaration of the Patent Act; (ii) Law on Trademarks; (iii) Decree on Declaration of the Law on the legal protection of designs; (iv) Decree on Declaration of the Law on Geographical origin; (v) Decree on Declaration of the Law on Protection of semiconductor topographies; and, (vi) Decree on Declaration of the Law on Copyrights and Related Rights.

86. No reforms have been undertaken concerning policy or the legal framework on IPR ownership and commercialization rights enabling research institutions and higher education institutions to own and commercialize technology derived from publicly-funded research. To date, ownership of IPR resulting from publicly-funded research is defined by the IPR Law. In fact, the contract between the Ministry and the research institutions stipulates that the results of research are considered as joint ownership. Additionally, at the end of the project, the funded institution has to organize public presentation of research findings (except for research that would imply presentation of secret data). Rules concerning spinoff creation and incentives to researchers to participate in technology transfer activities (e.g., recognition in curricula; researchers' rights to participate in licensing revenues; and, equity participation in new firms) are lacking.

87. Other policy actions have emerged at the institutional level.

The University of Montenegro (UoM) initiated several measures aimed at supporting and promoting research and scientific work, including creation of a university research strategy. These measures include:[35]

- Provide financial incentives to researchers who publish papers in international journals and participate in scientific meetings.[36]
- Establish a Research, Technology, and Development (RTD) service center under the project sponsored by the TEMPUS program.[37][38]

Monitoring Policy Evaluation and Statistics

88. Montenegro has established an external evaluation system to improve the quality of its research. Through this system, experts from the Western Balkan region evaluate all national research proposals before approval. The panel of experts also monitors the projects annually and evaluates them at the end. While external evaluation imposes extra costs, responses to the World Bank questionnaire indicate that it has improved research quality.

89. At the institutional level, the Ministry of Science uses independent evaluators to monitor and evaluate its research funding programs, in order to ascertain whether resources are being used efficiently and quality is being maintained. In addition, the ministry is also making an effort to increase dissemination of data, by summarizing outcomes from research and presenting information to the public.

[35] As a result of the Evolunimont Project, financed under FP7, the university research strategy for 2010-2013 was adopted. The strategy aims to strengthen research culture, build research capacity and capabilities, adapt infrastructure and design training opportunities, increase the involvement of undergraduates, graduate students, and postdoctoral fellows in research undertakings, increase research funding and promote interdisciplinary and international research, strengthen and expand research partnerships, and establish a fully operational research administration and research priorities.
[36] The 2011 budget for the University of Montenegro totals 12.5 million euros.
[37] The services offered include management of existing projects, support in the development and contracting of new projects, consultancy and support in writing new project proposals and fundraising, the coordination of bigger multidisciplinary groups inside UoM for new project ideas, the dissemination of information about available funds and open calls, the organization of trainings, events and workshops and assistance in the partner search for new projects. In the future, the center plans to offer a broader set of services, including the consultancy on legal ownership of start-ups and issues on intellectual property rights.
[38] Tempus is the European Union program that supports the modernization of higher education in the Partner Countries of Eastern Europe, Central Asia, the Western Balkans and the Mediterranean region, mainly through university cooperation projects.

It also encourages researchers to present findings to the public. Increased dissemination of information is useful, since it would likely impose an additional layer of monitoring from the public.

4. FUNDING AND INSTRUMENTS

Human Resources in Science and Technology

90. According to the World Bank Policy Questionnaire, efforts undertaken to improve the development of human resources in science and technology (S&T) include: raising interest in and awareness of science among youth; revising academic curricula to make S&T more attractive; improving teaching in mathematics and science, including through the use of ICT in teaching content and delivery; enhancing financing opportunities for PhD study and post-doctorate training; and, improving infrastructure for university research. Improving industry involvement in PhD programs and training as well as demand-side policies to increase the attractiveness of employment in PROs or make public sector employment more flexible are not part of the current policy agenda.

91. The Action Plan by the Ministry of Science foresees different instruments to increase the number of researchers, as well as measures for promoting science among youth, especially in natural and technical sciences (STEM disciplines - science, technology, engineering, and mathematics). These comprise funding of scholarships, the creation of special positions at universities and research centers, and promotion of collaboration with the scientific diaspora. There is a significant number of programs created by the Ministry of Science related to the improvement of PhD and postdoctoral training, such as project funding for PhDs, bilateral cooperation, international programs and grants, co-financing of PhD studies, conference fees, stimulation of publishing in journals with impact factors, etc. Similarly, the Ministry has funded improvement of university research laboratories and infrastructure of research institutions.

92. With regard to mobility, national and bilateral cooperation programs have been set up to expand opportunities for the mobility of researchers and high-skilled personnel within the WBC. In January, 2010, Montenegro joined the “Euraxess – Researchers in Motion” initiative that promotes the mobility of researchers throughout the EU. The UoM was appointed as the service center for incoming researchers, thus becoming part of a network of more than 200 centers in 35 European countries. The Ministry of Science is also co-financing participation at regional conferences. Universities in Montenegro have created the position of visiting professor, which offers the opportunity to invite international professors. Additionally, the Ministry of Science has created instruments for the stimulation of cooperation with the diaspora, to increase the mobility of researchers.

93. Currently, no reforms have been considered in immigration legislation (e.g., special visas for researchers) either at the regional level (intra-WBC) or with European countries, to ease mobility of scientists. There are currently no programs to promote return of expatriate students, scientists, and engineers.

Public Sector Research and Universities

94. The Ministry of Science is the dominant funding mechanism in Montenegro. The financing of R&D is executed via annual national calls for research proposals published by the Ministry of Education and Science. During 2007-2009, the Ministry financed 74 projects. Most of the projects were financed for 2 years. Applied research is financed up to 70 percent, while fundamental/basic research up to 100 percent.

95. According to data for 2009 and 2010, total public R&D funding was 3.68 million euros and 3,82 million euros. Approximately 0.13 percent of GDP was devoted to R&D funding at public research organizations. In 2010, 2.19 million euros were allocated through institutional funding (block grants) and 1.63 million euros through project funding (contracts and grants) to public research institutions. Another 1.79 million euros went to funding research in higher education institutions. No funding was dedicated to collaborative platforms, networks, or centers of excellence.

96. Recently, the Ministry of Science adopted new rules for the financing of research activities, the selection process, and licensing of research organizations. Since 2007, the Ministry has been inviting international reviewers for project selection.

97. The call for co-financing research activities is announced on yearly basis. It encourages participation in FP7, scientific output, mobility of researchers, science promotion, and cooperation with the diaspora.

98. Table 3, below, summarizes research funding in Montenegro. In 2012, there was a call for proposals made by the Ministry of Science in partnership with six other ministries. This process resulted in 104 research projects being selected, with a total budget outlay of 5 million euros. In addition, the government also seeks external funds from agencies such as the World Bank to develop technology parks and Centers of Excellence to supplement internal funding sources.

Table 5: Broad Share of Available Budgets by Main Categories of Research and Innovation Measures

Broad category of research and innovation policy measure	Approximate total annual budget for 2010 (in euros)	Commentary
Governance & horizontal research and innovation policies	• Measure for scientific and research projects • Last call was in 2008: allocated budget was €1.15m per year	• Only public resources are committed to this measure. • The Ministry of Science in cooperation with the Ministry of Agriculture and Rural Development, Ministry of Health, Ministry for Information Society and Telecommunications, Ministry of Sustainable Development and Tourism, Ministry of Education and Sport, as well as the Ministry of Culture, will launch new measures for scientific and research projects in 2012 for period 2012-2014 with the total budget of €5m.
Research and Technologies	• No such program exists	• The Ministry of Science and Ministry for Information Society and Telecommunications will provide budget of €600,000 for period 2012-2014 for technology projects.
Human Resources (education and skills)	• Last call was in 2008: allocated budget was €0.28m	• Only public resources are committed to this measure. • New measure envisaged as outlined above.

Promote and sustain the creation and growth of innovative enterprises	• No such program exists	
Markets and innovation culture	• Last call was in 2011: allocated budget was €15,000	• Call for competitive grants "Support to inventors and innovative solutions." This is a new call launched in 2011.

Source: Pro Inno Europe/ Inno Policy Trendchart (2011) Mini Country Report/ Montenegro.

99. According to the World Bank Policy Questionnaire, policy initiatives to promote stronger industry-science collaboration are still under-developed. Currently – and until December 2013 - no policies are in place targeting professional mobility between the public and private sectors, and collaborative research between public research organizations and businesses. No policy instruments are available to promote public-private partnerships for research and innovation targeting specific technology areas or firms. However, there is awareness of the need to strengthen public-private partnerships between firms and R&D institutions. The Strategy for the Development of SMEs 2011-2015 recommends collaboration between SMEs, universities, and science-research institutes, especially in the field of applied research. Future plans for centers of excellence, along with science and technology parks, are aimed at addressing these shortcomings.

100. In spite of the awareness of the importance of technology transfer, mechanisms and public support for the formation of technology transfer capabilities (TTOs) are yet to be deployed. There are no policies currently in place that would give greater visibility to research findings – e.g., funding of proof of concept and prototype – from publicly funded research. The Ministry has, however, demanded that research institutions improve promotion and valorization of their findings through workshops, open tables, poster sessions, etc.

Globalization of Research and Innovation Systems

101. Measures to support the internationalization of domestic public research institutions include: (i) facilitation of the integration of scientific research institutions and researchers into the ERA and international scientific programs; (ii) S&T collaboration; (iii) stimulation of career development and mobility of Montenegrin researchers, including cooperation with the diaspora; (iv) national and bilateral research projects; and, (v) participation in international conferences, seminars and workshops, etc. The involvement of internationally recognized foreign scientists in research programs and projects in Montenegro is also supported. Foreign research institutions may cooperate in bilateral and multilateral research projects with Montenegrin institutions.

102. Bilateral cooperation has been established with Albania, Bosnia and Herzegovina, Croatia, FYR of Macedonia, and Serbia. In addition, Montenegrin researchers are regularly involved in regional conferences, workshops and roundtables, scientific visits, mentoring, and guest lecturing. To improve R&D collaboration globally, it is important to underline that private networking is one of the crucial factors for improving global R&D collaboration. Montenegrin researchers have significant networks, which are helpful for further improvement in the R&D field.

Private Sector Research and Innovation

103. In addition to third-party research, private sector innovation requires an increase in the capacity to do in-house research. The private sector, however, only accounts for 27 percent of the GERD in Montenegro. The Law on Scientific and Research Activity encourages private institutions and other legal entities to apply for public funds for conducting R&D in accordance with the Strategy. However, the private sector has not expressed much interest in applying for calls announced by the Ministry.

104. Remissions of VAT and import duties on research equipment are among the indirect financial incentives for R&D and innovation investment. In terms of direct public funding of business R&D and innovation, the Ministry of Science and the Intellectual Property office of Montenegro jointly provide grants (up to 15,000 euros per year) to encourage patent applications.

105. According to the World Bank Policy Questionnaire, public support and private mechanisms for technology based startups are scarce. There is a current program of vouchers from the Directorate for Development of SMEs, and a loan program from the Investment and Development Fund of Montenegro (grants/vouchers can be funded up to 3,000 euros; loans can be funded up to 50,000 euros.) In addition, the Directorate for SME Development and two business incubators continuously provide information and consulting services, seminars, and training to domestic SMEs through the Enterprise Europe Network (EEN). There are currently no venture capital programs or any form of second-stage financing for the support of new technology startups or spin-offs from public research organizations. There is no R&D funding program targeting SMEs. The Ministry of Science is planning to provide training on IPR issues dedicated to innovation in SMEs and academia.

106. While collaborating with academic institutions within the country can help drive innovation, a small country like Montenegro also needs to leverage international research to spur private sector innovation. However, private sector firms, particularly SMEs, currently lack access to international research. There are two ways to increase access to international research: dissemination of research through conferences, workshops, publications, and databases, or leveraging of international partners with existing R&D infrastructure. The Ministry of Science is attempting to stimulate the latter avenue by establishing a network of national contact points that SMEs in Montenegro can leverage to find international partners.

107. Inadequate transfer of trained researchers to the private sector, and insufficient incentives to invest in R&D, are among the factors behind the low propensity of companies, especially SMEs, to undertake innovation. Recent steps aimed at addressing these shortcomings including amendments to the Law for Scientific Research Activities introducing tax breaks for companies looking to import scientific equipment. In addition, the Directorate for Development of SMEs and the Investment Development Fund of Montenegro have adopted several schemes to encourage patent filing and promote technology start-ups. The effects of these programs on private sector investment in R&D will have to be studied in the future.

5. INTEGRATION WITH ERA AND INTERNATIONAL COLLABORATION

108. The Montenegrin government is using several of the EU framework programs such as TEMPUS, COST (European Cooperation in Science and Technology), EUREKA, and Central European Exchange Program for University Studies (CEEPUS) to improve the quality of research, invest in research projects and equipment, and improve the mobility of researchers. These efforts will, however, take time to bear fruit due to the lags in returns from investment in R&D. The Montenegrin Research and Education Network (MREN) has been connected with the European Academic Network (GÉANT). This network, which is reserved specifically for research and education, has opened up channels for greater exchange of information between researchers, lecturers, and students in Montenegro and the world. The Ministry of Science has also adopted several initiatives to increase the mobility of researchers. In addition, the new evaluation system that relies on external experts allows for greater quality assurance and standardization.

6. CONCLUSIONS

109. Since independence, Montenegro has made significant progress in aligning institutional incentives and improving governance of research and education systems. Increased integration with the EU has also led to positive effects in standardizing incentives for research excellence and expanded possibilities for funding. However, research and innovation capabilities are still insufficient to have an impact on economic development. The small size of the economy, a technologically weak business sector, and a lack of collaboration between the private sector and research institutes continue to hamper the ability to invest in research and drive innovation.

110. Several policy challenges remain. Science careers need to be further leveraged, and research excellence boosted through enhanced linkages with the scientific diaspora and the international scientific community (ERA). At the same time, research needs to be more relevant, of higher quality, and with tangible outcomes for the national economy.

111. Collaboration between public research institutions and the private sector is currently lacking, and the country does not have the institutional and physical infrastructure it needs for collaboration between academic institutions and businesses. The Ministry of Science has, however, taken steps to provide this space. In undertaking this comprehensive process, a more coherent and articulated innovation system is needed with stronger linkages among actors.

112. Based on the analysis, the top priorities for Montenegro, in line with its different strategy documents for coordinating research and innovation, include:

- ***Strengthening of the technological (and research) capacity of the private sector*** through:
    - Collaboration with international partners and research agencies;
    - Collaboration with local research agencies through technology parks and Centers of Excellence;
    - Increased dissemination of research to the private sector;

  - Better linkages between academically well-trained students and the private sector; and,
  - Further embedding individuals from the private sector into the decision-making process in government and in research institutions.
- ***Improving the quality and commercialization potential of research***:
  - Continue to improve the flow of knowledge and human capital between Montenegro and the rest of Europe;
  - Link project funding to research quality and potential for commercialization;
  - Further pursue joint research initiatives to achieve economies of scale; and,
  - Invest in lab equipment for applied science and product development.

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ANNEX

Table A 1: Innovation Measures

Innovation Measures	Montenegro	Western Balkans	European Union
Number of Patents Filed to PCT[i] per Million Population (2011)	3.17	18.5[ii]	99.8
Scientific & Technical Journal Articles per Million Population (2009)	16.8	125[iii]	500
Global Innovation Index Rank 2012 (of 125 countries)	72	60[iv]	24[v]
Trademark Applications per Million Population[vi] (2010)	5,459	1,832[vii]	130[viii]

Table A 2: R&D Funding and Allocation

Currency and unit: €	2008	2009	2010	2011
Funding Sources				
Total public R&D funding	2.94 M€	3.68 M€	3.82 M€	13.21M€
Institutional funding (block grants)	1.30 M€	2.03 M€	2.19 M€	n/a
Project funding (contracts and grants)	1.64 M€	1.65 M€	1.63 M€	1.63 M€
Funding for platforms, networks, centers of excellence, etc.	0 €	0 €	0 €	0 €
Private sector funding	n/a	n/a	n/a	2.95m€
Government budget outlays on R&D as share of total general government expenditure (%)[39]	0.20 %	0.24 %	0.27 %	7.7M€
Allocation of Funds				
Funding allocated to public research institutions	2.94 M€	3.68 M€	3.82 M€	n/a6.56m€
Funding allocated to HEIs	2.55 M€	1.68 M€	1.79 M€	n/a3.46m€

Source: Project's documentation

[i] Patent Cooperation Treaty – an international patent law treaty with 146 countries as signatories and provides a unified procedure for filing patent applications.
[ii] Patent filings per million population in Bosnia, Croatia, Montenegro, and Serbia.
[iii] Average of World Development Indicators data on Albania, Bosnia, Croatia, Kosovo, Macedonia, Montenegro, and Serbia.
[iv] Average of ranks of 6 Western Balkan countries – Albania, Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, and Serbia.
[v] Average of ranks of the EU 27
[vi] World Intellectual Property Organization
[vii] Average of World Development Indicators data on Albania, Bosnia, Croatia, Macedonia, Montenegro, and Serbia.
[viii] Total trademark applications per million population in the EU-27 from World Development Indicators.

[39] Government Budget Appropriations or Outlays on Research and Development (GBAORD) refers to budget provisions, not to actual expenditure, i.e., GBAORD measures government support for R&D using data collected from budgets. The GBAORD indicator should be seen as a complement to indicators based on surveys of R&D performers, which are considered to be a more accurate but less timely way of measuring R&D activities. Total GBAORD is here expressed as a percentage of total general government expenditure. For more details, see http://epp.eurostat.ec.europa.eu/portal/page/portal/science_technology_innovation/data/main_tables