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Inception Report

Regional R&D Strategy for Innovation
in the Western Balkan Countries

Key Issues and Implications for Technical Assistance

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# Executive Summary

Building on existing collaboration in the area of research and development (R&D) and innovation between the European Union (EU) and the Western Balkan countries, the World Bank and the EU signed an agreement to implement a technical assistance program for the development of a Regional Research and Development Strategy for Innovation in the Western Balkans.

The strategy will identify priorities in terms of legal requirements, infrastructure, education and training, policies, and programs to be implemented by the beneficiary entities. The technical assistance is financed by the European Commission (DG-Enlargement) through a Multi-Country Instrument for Pre-Accession Assistance Project.

The value added of the proposed technical assistance is twofold. First, the focus would be on how to increase the economic impact of R&D in the Western Balkans. Second, the approach to technical assistance would be comprehensive, integrating the three axes of the knowledge triangle, namely, education, research, and innovation.

This Inception Report aims to identify key issues related to the development of a regional R&D strategy in the Western Balkans and is expected to be presented to the beneficiary entities as a contribution to the implementation of the technical assistance in Zagreb July 2011. The report is composed of three main sections.

**Section 2** summarizes the recent history of cooperation in R&D among Western Balkans countries and between the Western Balkans and the EU. It highlights the importance of focusing the strategy not only on strengthening the science base in the Western Balkans but also on increasing the contribution of R&D to innovation, regional competitiveness, and growth, following the 2009 Declaration of Sarajevo.

**Section 3** reviews key obstacles to ahigher contribution of R&D to innovation, competitiveness, and economic growth. In recent decades, talent migrated, infrastructure deteriorated, R&D expenditures fell, and scientific output declined, threatening the regional science base. Most R&D continues to be performed by the public sector. Yet, little is commercialized through licensing, spinoff companies, or contract research, leaving research results idle from an economic standpoint. Innovative startups and business R&D expenditures—the demand side of the innovation process—are scarce.

**Section 4** discusses some preliminary ideas on how to help build consensus among the different stakeholders as well areas where additional analytical work may be needed to support a fact-based consensus-building effort.

Of the 24 months planned to be devoted to the technical assistance, a first phase of roughly 12 months will focus on knowledge sharing and preparation of the draft strategy as well as country action plans by the beneficiary entities. The remaining 12 months will be devoted to consultation and dissemination of the draft strategy among the different stakeholders in the region and preparation of the final draft strategy and action plans.

* Roundtables with a small number of participants are the primary instrument for knowledge sharing, and professional facilitators are expected to be involved in the process.
* A broader foresight exercise, mini-courses, public seminars, and communication campaigns are some of the events expected to be used for consultation and dissemination of the draft strategy.

With respect to additional analytical work, we propose to focus on issues related to four intermediate objectives, which, when taken altogether, are expected to contribute to the overarching goal of increasing the contribution of R&D to innovation, competitiveness, and economic growth in the Western Balkans. The four objectives are:

1. **Improving policy making, implementation, monitoring, evaluation, and governance of national innovation systems*.*** The technical assistance will include a review of the institutional framework of national innovation systems. It will identify, among others, the existence of high-level oversight of the system to promote coherence; the participation of relevant stakeholders in policy making; and the degree of transparency and accountability of policies, including the adoption of monitoring and evaluation mechanisms.
2. **Strengthening the science base***.* The technical assistance will focus on the cause of the inadequate management of available R&D resources and ways to improve it, specifically, by (a) avoiding fragmentation of budgetary and physical resources (including identifying centers of excellence); (b) emphasizing integration into the international scientific community (especially the European Research Area); (c) properly managing human resources, including career development based on academic results; and (d) implementing results-based management of financial resources, through programmatic agreements and external evaluations (as opposed to per headcount).
3. **Accelerating commercialization and deepening collaboration with the business sector.** Sustainable impact of public R&D expenditures on economic development depends on the way that research results financed by public investment are commercialized. The problem is not so much the existence of commercialization activity but whether the conditions for a massive and systemic (as oppose to rare and occasional) process of research commercialization are in place. We propose to (i) assess whether the institutional framework for R&D incentivizes economic agents (researchers, research organization, and the business sector) to engage in commercialization efforts; and (ii) appraise the role of existing infrastructure for research commercialization (technology transfer offices and science parks).
4. **Increasing business R&D and facilitating innovative startup companies**. The following elements may be examined during the technical assistance program: access to external financing; mitigation of financial constraints through a combination of tax breaks and direct support to smaller firms and innovative startup companies; provision of “nurturing” services for R&D in small enterprises and innovative startups; and attraction of R&D-intensive FDI.

The report is accompanied by more detailed, preliminary overviews of the R&D policy frameworks in Albania, Bosnia and Herzegovina, UNMIK/Kosovo[[1]](#footnote-1), Former Yugoslav Republic (FYR) of Macedonia and Montenegro. These overviews will be further developed in close consultation with beneficiaries.

# Introduction

1. **In June 2011, the World Bank signed an agreement with the European Commission to implement a technical assistance program for the development of a Regional Research and Development (R&D) Strategy in the Western Balkans** (Albania, Bosnia Herzegovina, Croatia, UNMIK/Kosovo, FYR Macedonia, Montenegro, and Serbia). The agreement was a response to a request made by Western Balkan governments during a ministerial conference in Sarajevo in April 2009, which marked the launch of the initiative to develop a Regional Strategy on Research and Development for the Western Balkans to foster regional cooperation within the “knowledge triangle” (research, education, and innovation).
2. **The technical assistance is being financed by the European Commission (DG-Enlargement) through a Multi-Country Instrument for Pre-Accession Assistance Project** (“Project”), to be implemented in coordination with the European Commission, the Regional Cooperation Council (RCC)[[2]](#footnote-2) and one representative of each of the beneficiary entities over a two-year period starting in July 2011. The technical assistance is also envisaged as a continuation of an existing cooperation agreement in the area of R&D in the region. It is a follow-up to the Thessaloniki "EU-Balkan Countries Cooperation in Science and Technology," and to a large extent relies on initiatives that emerged from it, namely, the results of SEE-ERA.NET and WBC-INCO.NET projects funded under Framework Programs, as well as the UNESCO-ROSTE (BRESCE) activities. As the mechanism for coordinating collaboration in the region, the RCC will continue to play a leading role in R&D in the Western Balkans.
3. **This Inception Report aims to identify key issues related to the development of a regional R&D strategy in the Western Balkans. It is expected to be presented to the beneficiary entities as a contribution to the discussions on the action plan** to be adopted for the implementation of the technical assistance program in Zagreb in July 2011. The Report is composed of five sections. Following the introduction, the second section provides background on, and the rationale behind, a regional innovation strategy in the Western Balkans. In the third section, the current status of research, development and innovation in the region is presented. Next, the main implications for the design of a technical assistance program are drawn. Section five summarizes the key findings and describes next steps. The Report is accompanied by more detailed preliminary overviews of the R&D policy frameworks in Albania, Bosnia and Herzegovina, UNMIK/Kosovo, the Former Yugoslav Republic (FYR) of Macedonia, and Montenegro, which will be further developed in close consultation with beneficiaries (see Country Reports of beneficiary countries).[[3]](#footnote-3)

# Background and Context

1. **The European Union and the Western Balkans have a fairly long history of bilateral cooperation in R&D**. Early on, research cooperation took place between the EU and what was then the Republic of Yugoslavia on two occasions (1986 and 1991), when a number of projects were selected for funding. Cooperation in the R&D area has also been part of the Stabilization and Association Agreements (SAA) negotiated by the EU and the Western Balkan countries within the framework of the Stabilization and Association Process that followed the peace process in the region.[[4]](#footnote-4) The first bi-regional ministerial meeting on science and technology took place in Thessaloniki, Greece, in 2003.[[5]](#footnote-5) Three years later, under the auspices of the Austrian EU Presidency, a Steering Platform on Research for the Western Balkans was created, with the ultimate goal of monitoring the implementation of their integration into the European Research Area (ERA).
2. **Cooperation between the EU and the Western Balkan countries has achieved many important results.** Stabilization and Association Agreements have been concluded with all the Western Balkan countries, and their implementation provides a natural framework for the progressive compliance with the EU *Acquis Communautaire* in the field of R&D (Chapter 25 – “Science and Research”). All Western Balkan countries are currently associated with the Seventh Framework Program (FP7) and are actively involved in the European Research in COST and Eureka programs. The association status also entitles the country to nominate representatives as observers in the corresponding FP7 Committees as well as to the Scientific and Technical Research Committee (CREST) and other ERA governing bodies. Upon association to the FP7, Western Balkan countries gained access to the EU’s Joint Research Center (JRC) and to the provision of capacity building and training on EU-related policies.
3. **In recent years, cooperation between the Western Balkans and the EU has paid increasing attention to the role of R&D in promoting economic development**. Research at the EU level has become much more important, evolving into a full-fledged EU policy. The prominence of R&D and innovation in the Lisbon Agenda and the Europe 2020 Strategy has changed the way that research cooperation with third countries is addressed. While the Thessaloniki Action Plan on Science and Technology remains valid, this new approach to international cooperation under the FP7 has prompted the Western Balkan countries to change their approach as well. As a result, all of the Western Balkan countries have now started designing integrated research policies to support economic reform, while at the same time contributing to overall ERA objectives.
4. **The experience of regional cooperation on R&D within the Western Balkans is comparatively more limited.** Between 2005 and 2010, Western Balkan governments have been supported by EU funds (predominantly through Framework Program coordination and support actions) in their intentions to integrate into the ERA and rebuild the once-strong cooperation in R&D. Two examples are the *FP6 Southern European Research Area (SEE-ERA.NET)* project, a networking project aimed at integrating EU member states and Southeast European countries into the ERA by linking research activities to existing national, bilateral, and regional RTD programs, and the *FP7 WBC-INCO.NET,* a project aimed at coordinating research policies within the Western Balkans.[[6]](#footnote-6) Bilateral exchange of policy experiences has intensified in recent years, especially between Croatia and Serbia.
5. **The Joint Statement of Sarajevo, issued on April 24, 2009, gave new impetus to regional cooperation within the Western Balkan region**. In this joint statement, Ministers from the Western Balkan countries responsible for science and research, the EU Commissioner for Science and Research, and the Czech Republic Presidency of the Council of the European Union, under the auspices of the Regional Cooperation Council Secretary General, launched a coordinated effort to develop a Regional Strategy on Research and Development for the Western Balkans. Building a knowledge-based society leading to increased competitiveness and sustainable development was confirmed as a priority for the Western Balkans on their path toward EU accession.
6. **According to the Sarajevo declaration, the ultimate goal is to build a political coalition to help mainstream innovation policy in the region.** Long-lasting regional research cooperation will contribute to making R&D a priority on national political agendas. Mainstreaming R&D and innovation policies is a complex task, as illustrated by the reductions in the science and technology budgets in the Western Balkan and other Southern European countries during the global financial crisis. Public funding for R&D was also reduced in EU-10 economies such as Spain and the United Kingdom, in the form of broader fiscal adjustments imposed by tighter global financial markets. The expectation is that mutual international commitments, coupled with financial and political support from the European Commission and multilateral organizations, including the World Bank, will help these countries advance the process.
7. **Another objective is to improve the effectiveness and the efficiency of public expenditure**. While stressing the need for short-term measures, such as preventing reductions in public and private funding of R&D during the global crisis, the Ministers also recognized the importance of reforming their research, development, and innovation systems to increase the impact of public expenditures on the competitiveness of the economy. In particular, they recognized the need to focus on the added value of the regional dimension, including:
* Considering education, research, and innovation in a comprehensive manner, moving from a fragmented to an integrated approach in the region;
* Encouraging cooperation between the science and research community and the business sector, particularly small and medium-sized enterprises (SMEs);
* Supporting the development of cross-border regional clusters in sectors that have a competitive advantage based on knowledge and innovation;
* Promoting the establishment of competitive regional centers of excellence in fields of strategic interest to the region;
* Promoting the development of regional research infrastructure and open access to pan-European research facilities of common interest;
* Enhancing the potential of young scientists by supporting their career development and creating favorable conditions to sustain their research endeavors and facilitate their training, mobility, and cooperation within the region; and
* Strengthening the potential and the capacity of the Western Balkans to participate fully in FP7, CIP, and other European programs and initiatives, such as EUREKA and COST, particularly the increased involvement of the business sector, mainly SMEs.
1. **The World Bank signed an agreement with the European Commission to implement a technical assistance program** **for the regional strategy.** In recognition of the need to foster synergy in the field of research and development in a strategic manner, the Ministers responsible for science and research from the Western Balkans, the RCC Secretary General, and all stakeholders agreed that a roadmap for the development of a Regional Strategy on R&D should be established. The EU’s support to this endeavor was requested and granted through a Multi-Beneficiary Instrument of Pre-Accession Assistance (IPA) – Project Fiche N.13 **“**Western Balkans Regional Strategy on Research and Development for Innovation,” CRIS Number: 2010/022-028) in the amount of EUR1.5 million. The technical assistance will be implemented in 24 months through a Trust Fund Agreement signed with the World Bank in June 2011. The beneficiary entities are Albania, Bosnia Herzegovina, Croatia, UNMIK/Kosovo, FYR Macedonia, Montenegro, and Serbia).

# Research, Development, and Innovation in the Western Balkans

1. **Measuring and evaluating the R&D activity and performance in the Western Balkans can reveal much about the potential for reaping further benefits** in terms of productivity at the firm level as well as international competitiveness of the economy as a whole. Several important studies on R&D and innovation in the Western Balkans have contributed to the discussions on R&D performance, innovation infrastructure, and R&D financing.[[7]](#footnote-7) Building on this existing body of work, this section presents an overview of the current status of R&D and innovation in the region.
2. **Although there are significant discrepancies among the region’s economies, they all seem to share the problems of low R&D demand, brain drain, weak business R&D investments, and limitations in ICT services.** Available data show that, although the regional economies are different in terms of performance and stage of research, development and innovation, collectively they still have significant room for improvement. For instance, scientific inputs in terms of availability and efficiency in the use of researchers, is a problem in most Western Balkan countries, resulting in a weakening science base. Innovative performance, in terms of patents and citations, lags significantly behind EU averages, while availability of adequate ICT infrastructures is also a serious problem in the region. There is a general legacy of unfinished reforms in the area of research, development and innovation. This area has suffered from neglect, as policies instead have focused more broadly on post-war and, more recently, post-financial and economic crisis restructuring. Only recently have governments made real efforts to formulate strategies on R&D and science and technology, and to further integrate into the ERA.[[8]](#footnote-8)

***Review of Innovation Performance in the Western Balkans***

1. **Gross expenditures on research and development (GERD) in the Western Balkans are limited** (0.34 percent in Serbia and 0.03 percent in Bosnia and Herzegovina), and are relatively inconsistent with the countries’ national incomes, as can be seen in Figure 1 and Figure 2. Expenditure in the region is significantly below the EU-27 or even ECA averages (1.85 and 0.83 percent, respectively). Moreover, spending in the Western Balkan countries is heavily tilted toward basic, as opposed to applied, research. Croatia, the innovation leader of the Western Balkan countries in 2007, spent 35 percent of GERD on basic research. In comparison, the United States and Japan spent 18 and 12 percent, respectively.
2. **Western Balkan governments, together with universities, continue to be major contributors to overall R&D expenditure, while private investments remain very low.** In general, the vast majority of R&D spending in the Western Balkan countries is financed by governments (Serbia, FYR Macedonia) and universities (Bosnia and Herzegovina, Montenegro). In Croatia, the innovation leader in the region, only 40 percent of R&D in 2009 was conducted by the private sector. In other countries, this indicator was much lower: only 5 percent in Montenegro (). In Albania, higher education institutions and the government together account for over 90 percent of R&D expenditures. Moreover, given the low value of business R&D expenditures relative to income levels in the region (Figure 4), the countries continue to be characterized by low levels of innovation efficiency. By contrast, in economies with high rates of R&D expenditure, such as Japan, the United States, and Finland, the share of industry-related R&D spending ranges from 70 to 80 percent, while government spending accounts for 20-30 percent.

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| Figure 1: R&D Intensity in Selected Western Balkan countries, 1998-08 | Figure 2: GERD and GDP per Capita, 2008 (or nearest year) |
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| *Note:* (\*2003-2007) (\*\*2003-2005) *Sources:* UNESCO, National Statistical Offices; Data for UNMIK/Kosovo not available. |

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| Figure 3: R&D Expenditure by Performing Sector | Figure 4: Business R&D Expenditures and GDP per Capita, Selected Economies, 2008 (or nearest year) |
|  |  |
| *\*partial data; Sources:* UNESCO; OECD STI; National Stat. Offices | *Sources:* UNESCO & OECD STI (including provisional data for BERD) |

***Scientific Output: Publications and Patents in the Western Balkans***

1. **Although the number of scientific publications has been increasing in recent years, they are still rarely cited.** Scientific publications in a country are a good indicator of innovation activity in an economy, and the number of times that they are cited can provide an idea of the quality of innovation. In the Western Balkans, the number of publications as a share of the total population has been increasing in recent years (Figure 5), particularly in Serbia and Croatia. These two countries also noted the highest citation rate (). This rate, however, does not compare well with citation rates in new EU member countries. Publications in Hungary, the Czech Republic, and Slovenia, for example, have an average of 1.5, 1.3 and 1.2 citations per document, respectively (not shown in graph).

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| Figure 5: Publications per mln. Population | Figure 6: Citations per Document, Regional Comparison, 2010 |
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| *Source*: SJR – SCImago Journal & Country Rank, *www.scimagojr.com*; data for UNMIK/Kosovo not available. |

1. **Patent applications by Western Balkan scientists are not only notably behind applications in developed economies, but seem also to be stagnating, or even decreasing.** The countries in the Western Balkans are characterized by very low numbers of patent applications (Table 1), with applications per capita even decreasing in many of them. The most active country in this field is Croatia, with 56 patents per million population filed by residents in 2009. FYR Macedonia and Bosnia and Herzegovina only filed 16 and 17 patents per million inhabitants, respectively, in 2008. Comparatively, the Western Balkan countries lag significantly behind top performers, such as Israel and Finland, in number of patent applications per capita.

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| Table 1: Patent Applications by Residents in Selected Western Balkan countries and Comparators, per Mln Population |
|  | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Bosnia and Herzegovina | 13.2 | 17.5 | 14.5 | NA | 15.6 | NA |
| Croatia | 86.7 | 81.7 | 71.4 | 77.5 | 74.4 | 56.4 |
| UNMIK/Kosovo | NA | NA | NA | NA | NA | NA |
| FYR Macedonia | 18.2 | NA | NA | NA | 16.7 | NA |
| Serbia | 63.4 | 50.0 | 58.3 | 53.5 | 52.5 | 43.6 |
| Israel | 226.8 | 45.6 | 36.4 | 224.9 | 209.1 | 186.4 |
| Finland | 384.7 | 348.8 | 344.8 | 341.1 | 338.6 | 338.3 |
|  |  |  |  |  |  |  |
| *Source:* WDI. |

***Scientific Input in the Western Balkans: Are There Enough Scientists and Engineers?***

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| --- | --- |
| Figure 7: Total Full-time Researchers per Thousand  | Figure 8: Share of all New University Degrees Awarded in Science or Engineering, 2009 (%) |
|  |  |
| *Source:* UNESCO, EUROSTAT \*2006 \*\*2007 \*\*\*2008. | *Source:* UNESCO, EUROSTAT \*Graduates in science, mathematics and computing. |

1. **Despite some increases in their research bases, the countries in the region still lag behind, indicating a weak demand for R&D**. Research and development personnel play an important role in creating new knowledge in the Western Balkan countries, and although the number of researchers has been increasing in the past decade, the countries still lag behind European averages (Figure 7). As international cooperation and further integration with the ERA increases, demand for skilled workers is expected to increase. A breakdown of the data on graduation from higher education shows that a relatively high percentage of new university degrees in selected Western Balkan countries are granted in engineering and, to some extent, science (Figure 8). This can be seen as a positive legacy from these countries’ earlier socialist education systems. Fourteen and 15 percent of university graduates in Croatia and Serbia, respectively, receive degrees in engineering, compared to 13 percent in the EU-27.
2. **However, due to political instability, the Western Balkan economies have been experiencing massive brain drain from the region.** Brain drain is an extensive problem among all Western Balkan countries. For example, more than 60 percent of skilled scientists, researchers, and university personnel have left Bosnia and Herzegovina in the past 10 years. Some countries have tried to address the issue: Croatia launched the Unity through Knowledge Fund (UKF) program, which supports joint projects between the Croatian diaspora and local Croatian companies and research institutes, while Albania developed the 2008-09 plan for the Brain Gain Program, co-financed by the UNDP.

***Information and Communications Technology in the Western Balkans***

1. **The majority of the Western Balkan states recognize missing innovation infrastructure as a serious obstacle to the development of science and innovation**. Only Croatia, FYR Macedonia, and Serbia have developed some innovation facilities. Nonetheless, infrastructure in Bosnia and Herzegovina remains poor, and there are no facilities for innovation in Albania and Montenegro. For instance, as of 2008 there were still no local or regional research centers in Albania, or any new technologies or innovation parks. Technology and technical research equipment has improved in recent years but is still insufficient. In Bosnia and Herzegovina, on the other hand, the government has made it a priority to develop and sustain the capacity of science and technology parks and has been establishing centers across the country. Croatia continues to be the leading performer in the region in innovation and technology centers and cooperation, with a good policy framework in place and adequate budgetary resources.[[9]](#footnote-9)

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| Figure 9: ICT Usage in the Western Balkans and Comparator Economies, 2009 |
|  |
| *Note:* Simple average of normalized scores of Telephones per 1,000 people; Computers per 1,000 people; Internet Users per 10,000 people. *Source*: World Bank Knowledge Assessment Methodology 2009. |

1. **There is significant disparity in usage of information and communications technologies (ICT) among the countries in the region.** Croatia compares relatively well with Western European economies in terms of ICT usage, with Serbia and FYR Macedonia not far behind (Figure 9). The existing research infrastructure in UNMIK/Kosovo, Albania, and Bosnia and Herzegovina, on the other hand, is inadequate and does not facilitate participation by these countries’ research institutions in international research projects. Collectively, the Western Balkan countries benefit from EU support, specifically within the framework of the EU project “Strengthening Strategic Cooperation between the EU and the Western Balkan Region in the field of ICT Research” (SCORE).

## Implications for Technical Assistance

1. **The final product of the technical assistance will be a pragmatic regional R&D strategy for innovation, with corresponding national action plans**. The strategy will identify clear priorities in terms of legal requirements, infrastructure, education and training, policies, and programs to be implemented by the beneficiary entities in national action plans. The regional strategy is expected to be endorsed at the highest political level by the Western Balkan countries and become the basis for future (donor) funded activities in this area. In short, the main expected results can be summarized as follows:
* Regional priorities in R&D defined, including: (i) policy on structural and institutional transformation of R&D systems outlined; (ii) prerequisites for development of cooperation on R&D between higher education and the business sector defined; and (iii) regional centers of excellence in R&D mapped;
* Conditions for stronger relationship with the EU in the R&D area identified, including: (i) measures to improve the capacity to absorb resources from available European funds; and (ii) improved conditions for integration into the European Research Area.
* Framework for monitoring and evaluation established, including: (i) action plans defining further steps to strengthen cooperation at the national and regional levels clearly established; and (ii) a system for monitoring the development of cooperation and criteria for assessing the results of cooperation outlined.
1. **We propose to implement the technical assistance in two phases**. The first phase, which is expected to last roughly a year, would be devoted to knowledge sharing among the beneficiary entities and preparation of the draft strategy and action plans. The second phase, also about a year long, would be devoted to consultation and dissemination of the draft strategy among the different stakeholders in the region and preparation of the final draft and action plans. Additional analytical work will be undertaken to facilitate fact-based consensus building among the beneficiary entities. Roundtables will be the primary instrument for knowledge sharing, and professional facilitators are expected to be involved to help with the process. A broader foresight exercise, mini-courses, public seminars, and communication campaigns are part of the events expected to be used for consultation and dissemination of the strategy.
* **Briefing notes.** A briefing note for each beneficiary entity on the status of research and innovation will be prepared. These will include, among other, analysis of human resources in R&D sectors; and the quality of the existing R&D and ICT infrastructure.
* **Reports on best practices**. Reports on successful innovation and research and development policies (best practices), as well as reports on Western Balkan regional innovation and research policy challenges, will be prepared.
1. **Identifying common ground for regional collaboration should be the immediate goal**. This means identifying not only the problems that are common to the countries in the region but also those that are worth addressing at the regional level and could benefit from a regional approach. A more comprehensive review of the status of R&D and innovation policy in the Western Balkans will be the first step in the implementation of the technical assistance. Country Reports of R&D policy in the beneficiary countries will be developed based on close consultation with representatives of the beneficiaries. A complete review of similar studies will also be undertaken. For example, a white paper on the overlaps, gaps, and opportunities for bilateral and multilateral cooperation in the field of R&D among Southern European countries (Rost et al.) was undertaken in 2007. The European Investment Fund completed a report on venture capital financing in the Western Balkans in 2010 in the context of the WBC-INCO, and a report on the infrastructure in Western Balkans is being prepared.
2. **A common regional strategy on R&D will bring a number of benefits.** In principle, different economic, social, and political development phases imply different roles for research, development, and innovation. Despite its common political and cultural heritage, from a development standpoint, the Western Balkan region is fairly diverse. For example, the per capita income of Croatia is more than five times that of UNMIK/Kosovo. Yet, the definition of common reform agendas at a multilateral level may help advance the implementation of the national strategies. Another area of potential benefit relates to rationalization of the use of resources by (i) sharing common infrastructure facilities and programs with countries specializing in selected research areas, and (ii) achieving economies of scale by pooling resources and achieving a minimum critical mass (and adequate size) in selected programs. At a more basic level, countries benefit from an enhanced exchange of experiences and a clearer understanding of common problems.
3. **The ultimate goal is to help countries mainstream R&D and innovation policies in their development processes.** Given the scope of existing collaboration between the EU and the Western Balkans, the value added of the proposed technical assistance is twofold. First, we propose to focus on how to increase the economic impact of R&D and innovation in the Western Balkans. This corresponds to the renewed emphasis on R&D seen in the EU’s growth strategy and expressed in the flagship *Innovation Union* and the *Strategy for Smart Growth,* among others. Second, we plan to adopt a comprehensive approach, integrating the three axes of the knowledge triangle, namely education, research, and innovation. The idea is to focus on intermediate objectives that contribute to the overarching goal of improving the contribution of R&D and innovation to economic development: (i) improving policy-making, implementation, monitoring and evaluation, and governance of national innovation systems; (ii) strengthening the regional science base; (iii) strengthening commercialization and collaboration with the business sector; and (iv) enabling higher levels of business R&D and the startup of innovative companies.

***Strengthening the Regional Science Base***

1. **Western Balkan countries need to significantly raise the quality of their research.** Despite some important improvements in recent years—particularly in Croatia and Serbia—indicators such as publications, citations, and patenting are unnecessarily low. While this situation is partly a function of the level of economic development, it is also the result of a combination of a limited supply of human capital and the poor quality of tertiary education, particularly in the hard sciences and engineering, along with inadequate management of human, financial, and physical resources. While reforms in the context of the Bologna process have been addressing the first problem to some extent, most of the proposed technical assistance should focus primarily on the causes of the inadequate management of existing R&D resources and ways to address them, namely, (i) avoiding fragmentation of budgetary resources, and (ii) improving the management of research organizations, particularly human resources.
2. **Avoiding fragmentation of budgetary resources.** Governments often adopt a horizontal approach in distributing research funding, following the principles of equity and to some extent fairness. Yet, as budgetary resources become scarcer, R&D authorities will inevitably need to look for ways to prioritize research investments. Prioritizing research investments is also a way to provide selected research sectors with the minimum critical mass or pool of resources necessary to create world-class resources. The importance of specialization of research in narrow fields of expertise for achieving global standards is illustrated by the cases of research organizations in the Western Balkans that mastered the transition to a market economy, such as Galapagos in Croatia. There are different, often complementary, approaches to achieving this goal.
3. **One approach is to concentrate budget allocation in fields of “revealed scientific comparative advantage.”**[[10]](#footnote-10)Revealed Scientific Advantage (RSA) indicators,measures of the efficiency of research in a given sector, are estimated for the Western Balkans in Table 2, with indicators showing RSA shadowed. It is interesting to see that cases of overlap among the countries are limited to “agriculture and biology” (fields in which all six countries seem to present RSA); and “physics and astronomy” (all but Bosnia). Rather, in most research fields, the most frequent result is up to three countries showing RSA. While countries need to take into account equity, fairness, and other societal goals, emphasis on fields in which research seems more likely to generate scientific outcomes may be a good way to improve the cost effectiveness of public investments. From a regional perspective, it may be an indication of the potential gains from specialization in research.

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|  | Table 2: Revealed Scientific Advantage in the Western Balkan Countries, 2005-09 |
|  | **Albania** | **BiH** | **Croatia** | **UNMIK/Kosovo** | **FYR Macedonia** | **Montenegro** | **Serbia** |
| **Agriculture & Biology** | 2.0 | 1.2 | 1.7 | NA | 1.1 | 2.1 | 1.5 |
| **Arts & Humanities** | 2.2 | 0.2 | 0.6 | NA | 0.1 | 0.5 | 0.2 |
| **Biochemistry, Genetics & Molecular Biology** | 0.5 | 0.7 | 0.8 | NA | 1.2 | 0.4 | 0.9 |
| **Business, Management & Accounting** | 0.4 | 0.7 | 0.9 | NA | 0.5 | 0.2 | 0.6 |
| **Chemical Engineering** | 0.2 | 0.6 | 0.8 | NA | 1.3 | 0.8 | 1.2 |
| **Chemistry** | 0.4 | 0.6 | 1.2 | NA | 2.4 | 0.5 | 1.9 |
| **Computer Science** | 0.2 | 0.7 | 0.6 | NA | 1.1 | 2.2 | 0.8 |
| **Decision Sciences** | 0.0 | 0.5 | 0.3 | NA | 0.8 | 0.0 | 1.4 |
| **Dentistry** | 0.0 | 0.7 | 0.7 | NA | 0.5 | 1.0 | 1.1 |
| **Earth & Planetary Sciences** | 3.3 | 0.9 | 1.4 | NA | 0.9 | 1.1 | 0.5 |
| **Economics, Econometrics & Finance** | 0.9 | 0.4 | 0.6 | NA | 0.5 | 0.4 | 0.4 |
| **Energy** | 0.7 | 0.8 | 0.5 | NA | 0.6 | 3.1 | 1.0 |
| **Engineering** | 0.4 | 0.8 | 0.6 | NA | 1.0 | 1.5 | 0.9 |
| **Environmental Science** | 2.8 | 0.7 | 1.3 | NA | 0.8 | 0.9 | 0.8 |
| **Health Professions** | 0.0 | 0.7 | 0.5 | NA | 0.0 | 1.2 | 0.5 |
| **Immunology & Microbiology** | 2.5 | 0.5 | 0.6 | NA | 0.4 | 0.4 | 0.6 |
| **Materials Science** | 0.8 | 0.6 | 0.8 | NA | 0.9 | 0.8 | 1.5 |
| **Mathematics** | 0.8 | 1.1 | 1.2 | NA | 1.4 | 1.0 | 2.0 |
| **Medicine** | 1.1 | 1.7 | 1.0 | NA | 0.9 | 0.8 | 0.8 |
| **Multidisciplinary** | 0.0 | 0.5 | 0.3 | NA | 0.5 | 0.0 | 0.3 |
| **Neuroscience** | 0.3 | 0.4 | 0.5 | NA | 0.4 | 0.0 | 0.6 |
| **Nursing** | 0.6 | 0.1 | 0.1 | NA | 0.2 | 0.0 | 0.1 |
| **Pharmacology, Toxicology & Pharmaceutics** | 0.7 | 0.6 | 1.3 | NA | 1.0 | 0.3 | 0.8 |
| **Physics & Astronomy** | 1.1 | 0.8 | 1.0 | NA | 1.2 | 2.5 | 1.6 |
| **Psychology** | 0.6 | 0.5 | 0.5 | NA | 0.2 | 0.0 | 0.6 |
| **Social Sciences** | 1.1 | 2.2 | 2.3 | NA | 0.4 | 0.3 | 0.4 |
| **Veterinary** | 1.3 | 1.4 | 2.0 | NA | 0.4 | 0.0 | 1.5 |
|  | *Source*: *Authors’ elaboration based on SJR — SCImago Journal & Country Rank.* |

1. **Countries will also need to rationalize their research infrastructures according to scientific specialization and available resources.** Research infrastructure and research laboratories are important assets, and their existence should be a clear public policy priority. Specific provisions should be made in the public budget to guarantee adequate maintenance and periodic investment in upgrading technology. Building and maintaining state-of-the-art research infrastructure, however, takes a large share of the R&D budget in the Western Balkans, reducing the amount of funding for research projects. The lack of investment in modernization in recent decades has aggravated the problem. In the context of increasingly limited fiscal resources, countries should explore the possibility of sharing existing facilities and building supra-national infrastructure as dictated by the fields of research specialization. Building on existing work, the technical assistance will carefully assess the modernization needs of the region’s research infrastructure.
2. **Specialization should be combined with an added emphasis on integration into the international scientific community (particularly the ERA) and research mobility.** International integration is essential for excellence in research. An analogy with international trade seems relevant. Western Balkan countries need to break free of the remaining autarkic elements of their scientific work to fully integrate with the ERA. Publications in international journals should be emphasized, joint participation on international calls should be prioritized, and instruments supporting those achievements should be mobilized. There is clearly a “chicken and egg” problem, as demonstrated by the low performance of Southern European countries in FP7 (Romania’s acceptance rate in 2009 was about 15 percent as compared to 25 percent in Slovakia and almost 30 percent in Denmark). Yet, some countries are managing to break this vicious cycle by mobilizing knowledge from abroad, as illustrated by Croatia’s Unity through Knowledge Fund. The fund has been financing research projects between Croatian scientists living abroad and those residing in Croatia as a means to mobilize knowledge and strengthen local research. The results look promising: the rate of acceptance of these projects in the FP7 is almost twice as high as the country’s rate.
3. **A complementary approach is to re-balance the allocation of funds between basic and applied research.** There is no generally accepted rule about the “right” allocation between basic and applied research (and the boundaries between them are not completely clear). In the last 15 years, leading economies, such as Israel, Korea, Japan, the United States, and Denmark, have kept their allocation levels around or below 15 percent. This amount may be difficult to achieve when overall expenditures are low, as some spending on basic research is allocated to cover fixed costs in the overall system. Yet, neighboring countries, such as Romania, were allocating more than 40 percent of total public investments in R&D by 2009. Data for the Western Balkans are not readily available, but this is a point worth examining by the technical assistance. Applied research is less risky, likely to bring fewer results (less spillover). But in the shorter term, while basic research is riskier, it is more likely to yield results (spillovers) in the long run. In developing economies, discount rates tend to be higher, placing a higher value on short-term results. Additionally, as capital is expensive, emphasis on activities that are less risky is recommended.
4. **Concentrating efforts in fields related to the economic needs and potential of the region could also bring development dividends in the short term.** Global scarcity of food and livestock is a serious problem. The Western Balkan region is not well suited for land-intensive crops but has an edge in typical Mediterranean products, including wine. The presence of large lakes and coastal areas also raises the prospects for the fishing industry. Comparisons to the Chilean experience are inevitable: technological solutions for both the wine and salmon industries resulted from the combination of existing available knowledge (imported from the United States) and local R&D to enable appropriate adaptation. Strengthening the capacity of agricultural and maritime research to address the specific needs of those industries will raise productivity and bring important short-term economic impacts, including poverty alleviation (given the rural profile of poverty and the low levels of productivity in the agriculture and fishing industries).
5. **The fields of low carbon emission and energy-smart R&D represent global challenges but also important economic opportunities.** The countries of the Western Balkan region are carbon and energy intensive. The level of emissions per capita of Croatia and Serbia are high and above the world average.[[11]](#footnote-11) The scope for reducing emissions through actions in key technology areas is broad*.* For instance, the Western Balkan region has been identified as one of the areas in the world with potential for carbon capture and storage (CCS).[[12]](#footnote-12) The existence of CCS capacity in the Western Balkan countries offers them a comparative advantage (for instance, sites can offer CCS services through pipelines to carbon-intensive neighboring countries, or allow them to use cheaper fuels under a carbon-constrained regime). Yet, innovation in these key technology areas has been poor across the region (see Box 1).[[13]](#footnote-13)

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| Box 1: R&D Policy and Climate Change in the Western Balkans: Challenges and Opportunities**Climate change is a serious global threat that demands an immediate global response.** Action is required across all countries, and it need not cap the aspirations for growth of rich or poor countries. A sustainable growth path will require both innovation and green growth (*growth* can and should go hand in hand with *green*). And to achieve strong green growth (new green industries, businesses, and jobs), countries will have to introduce a broad and integrated set of policies, including instruments to foster innovation.Greenhouse gas (GHG) emissions can be drastically reduced by accelerating the deployment of existing mitigation technologies in high-emitting countries. But achieving the more ambitious medium-term emission reduction objectives will require breakthrough low-carbon technologies and practices. Middle-income countries can ensure that their investments take them in the direction of low-carbon growth and that their firms reap the benefits of existing technologies to compete globally. At the same time, low-income countries can ensure that they have the technological capacity to adapt to climate change, by identifying, assessing, adopting, and improving existing technologies and practices with local knowledge and know-how.**The countries of the Western Balkan region are carbon and energy intensive.** The level of emissions per capita of Serbia and Croatia are high and above the world average. Macedonia, Bosnia and Herzegovina, Montenegro, and Albania exhibit per capita carbon emissions lower than the world’s average, but similar to those of large, emerging economies, such as India and Brazil. Carbon emissions per unit of GDP are as high as those exhibited in China, India, and Russia, especially in Bosnia and Herzegovina, Croatia, and Macedonia. According to the most recent national communications to the UNFCCC, carbon emissions are projected to increase across all countries of the region (except in Montenegro). The energy intensity of most Western Balkan countries is also above the world average and is in some cases comparable to India or South Africa (e.g., Bosnia and Herzegovina, Macedonia, and Serbia).**The scope for reducing GHG emissions through actions in key technology areas is broad***.* For instance, the potential for energy savings in the public sector across the region has been estimated in the range of 35-40 percent. In the residential, commercial, and industrial sectors, the potential for energy savings is also high (10-35, 10-30, and 5-25 percent respectively).However, the most recent assessment of the status of energy efficiency practices in the Western Balkan countries indicates that the lack of reliable data on energy consumption—and reliable energy balances—is a huge constraint for establishing priorities and preparing sound action plans or strategies.Renewable energy—other than hydro—is largely undeveloped in the region. At the end of 2008, only a few small-scale landfill, wind, and solar-based generating facilities had been installed in Croatia. The general lack of basic data on resource potential, especially in Montenegro, Serbia, and UNMIK/Kosovo, has been considered a critical constraint. For example, data on solar and wind atlases and historical data on wind velocities are lacking, and there are no data on geothermal potential.The Western Balkan region has been identified as one of the areas in the world with potential for carbon capture and storage (CCS). Preliminary studies have confirmed the existence of high-capacity depleted hydrocarbon fields in Croatia and Albania, and suggest the possibility of CCS capacity in the Pannonian Basin. CCS is a critical option in the portfolio of solutions available to combat climate change, because it allows for significant reductions in CO2 emissions from fossil-based systems, enabling it to be used as a bridge to a sustainable energy future. The existence of CCS capacity in the Western Balkan countries offers them a comparative advantage (e.g., sites can offer CCS services, through pipelines, to carbon-intensive neighboring countries, or allow them to use cheaper fuels under a carbon-constrained regime).Innovation in these key technology areas has been poor across the region. In the period 2000-07, only two patents on renewable energy were issued, in Bosnia and Herzegovina, and no patents were registered in the area of energy efficiency.**At the same time, the Western Balkan countries will have to adapt to the effects of climate change***.* Climate change adaptation needs vary by country; thus, responses and strategies should be country-driven. In their most recent national communications to the UNFCCC, the Western Balkan countries have identified some of the potential local impacts of climate change (for example, impacts on hydrology, forestry, agriculture, infrastructure, and others). Indeed, this is one area where intensive research activities will be necessary (for example, for identifying specific regional and local risks, integrating climate risks into development planning, and adjusting or creating new industries, businesses, or practices).In particular, data collection and systematic observations at the country and local levels will be extremely important. This would require the set up of local observation and monitoring systems.**The Western Balkan countries have yet to develop comprehensive green growth or low-carbon development and adaptation strategies.** A low carbon development strategy is based on detailed assessments of available options and associated costs (and basic data on energy consumption, renewable energy resource potential and other, is necessary to assess costs per unit of emissions reduced).These strategies, and the policies that emerge and evolve from them, have triggered entrepreneurial activity and new green industries, businesses, and jobs across many developed and emerging economies.A long-term low-carbon development strategy should also provide technology paths or measures that help outline a low-carbon innovation policy at the country and regional levels.**The Western Balkan countries are already investing in knowledge institutions and research programs focused on key low-carbon technology areas. However, these efforts need to be strengthened.** Innovation policies focused on energy efficiency and renewable energy have been introduced in Croatia, Serbia, Macedonia, and Montenegro. These countries have already established several frameworks, policies, and funds targeting different low-carbon technological options. Universities and research centers are actively conducting research on low-carbon development areas, including clean energy technology absorption and development and policy design. These efforts, however, need to be strengthened with additional funding and streamlined with other regional initiatives to exploit synergies and leverage available funds.**Regional collaboration on low-carbon and climate-smart RD&D will be necessary to exploit synergies and leverage available funds.** The Western Balkan countries need to design and introduce a comprehensive regional platform that targets low-carbon (mitigation) and climate-smart (adaptation) RD&D. This platform can promote the following actions:* Redefine knowledge-based institutions and programs, especially universities as centers that investigate and foster green growth, the diffusion of low-carbon practices (technological and non-technological innovation), and measures for adapting to climate change impacts.
* Increase funding to regional research programs (or institutions) for research, development, adaptation, diffusion of clean or low-carbon technological options and climate-smart measures and practices.
* Increase links between academic and research institutions, the private sector, and public planning agencies (this would be especially important for CCS).
* Promote legislative and regulatory harmonization, knowledge sharing and coordination, cost sharing, and technology transfer along the innovation chain to create large investor pools and markets for climate-smart innovation.
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1. **Regardless of the area to be prioritized, one underlying difficulty is how resources are allocated.** Often, the basis for allocation is the number of researchers, which means that most of the budget is allocated to salaries without any direct link to results. Allocating resources on a per headcount basis is not only cost ineffective, but it generates a perverse incentive to increase the number of researchers and reduce research productivity. Several countries have begun to introduce external evaluations and to link the allocation of funding to the achievement of minimum levels of excellence. Others are further advanced in the attempt to introduce more stringent performance-based contracts. The option for increasing the competition-based allocation of research funding is certainly positive.
2. **A related problem is the ability to properly manage human resources**. Incentives for performance are severely constrained (as in the rest of the public administration) due to rigid pay, job classification, and promotion rules. Anecdotal evidence suggests that between 20 and 40 percent of research staff is often underperforming, and dismissing such staff is so complicated and time-consuming that managers are often deterred from commencing the process. This is a government-wide problem that clearly inhibits any efforts to create and sustain the professional excellence of research institutes. Managers should be provided with all legally possible means to use monetary and non-monetary rewards to incentivize performance, support for disciplinary actions, and assistance as needed to reorder activities to include collaboration with the private sector and efforts to increase useful patenting and other commercialization of outputs.
3. **Additional challenges include strengthening research development institutes (RDIs) and university career prospects and improving work environments to retain or repatriate human capital.** Of particular relevance are the difficulties in attracting and maintaining young, qualified researchers working in the region. It may be that many countries have inverted staffing structures resulting from efforts to reward time in the job and/or unregulated salary grade creep. Discussions with directors of institutes suggest that their primary concern is to prevent the emigration of scientists in the first place. Greater attention should be paid to maintaining a base of mid-level researchers who have established themselves through publications, but are seeking the challenges and rewards of more market-related work which will be more actively promoted in the future. Such a work environment may help retain talent as well as attract the repatriation of Western Balkan researchers, or at least engage them through cross-border collaboration.
4. **In a nutshell, in order to improve management of financial and human resources by public research organizations, several key aspects need to be addressed. These include**: the financing of public institutes through programmatic agreements and external evaluations (as opposed to per headcount), career development based on academic results, emphasis on attracting and nurturing young researchers, and enhanced managerial autonomy for public research organizations. Creating junior temporary positions, promoting mentoring, setting minimum qualifications, facilitating some research mobility, and setting up time-limited and benchmarked funding arrangements are also useful instruments.

***Commercialization of Public Research and Collaboration with the Business Sector***

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| Figure 10. The Commercialization of Public Research – a Schematic View |
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| *Source: Authors’ elaboration*. |

1. **Commercialization of public research and collaboration between public research organizations and the business sector are pivotal.** In the absence of commercialization—through technology licensing and spinoff companies, for instance—research results remain unused and R&D generates negligible economic effects. An efficient collaboration between public research organizations and the business sector promotes transfer of research capacity (knowledge) to the business sector. For example, more than one-third of innovative companies collaborate with higher education institutions in Finland. Yet commercialization and collaboration do not evolve naturally from the research activity (see Figure 10).
2. **Transferring ideas from the laboratory to the market is an intricate process**. One of the challenges for the commercialization of publicly funded R&D is establishing fiduciary responsibility over the research output. Contrary to privately funded R&D, public sector sponsors of R&D often lack the capacity and incentive to monitor research results. One additional difficulty is that research results often lack immediate applicability and require further development to reach a stage in which patenting is possible or their market potential can be evaluated. Another obstacle is that researchers, who are best positioned to engage in further development efforts, will prefer to allocate their time to purely academic activities if the structure of academic incentives is conducive to academic achievement but not to commercialization efforts. Finally, finding the appropriate user/investor for the existing idea is a complex searching exercise. Developed countries have found a number of institutional solutions to deal with such complexity.
3. **Unsatisfactory commercialization of intellectual property (IP) by research universities in the United States motivated the adoption of the Bayh-Dole Act in 1980**. The Act transferred to the universities the IP rights resulting from publicly funded research (previously belonging to the funding agency), encouraged universities to issue exclusive licenses to private firms (non-exclusivity basis was mandatory before), established a minimum amount of royalties to be shared with the researcher, and simplified substantially the process of IP management (subject before to more than 20 different laws).[[14]](#footnote-14) After the Act was passed, patent commercialization increased by a factor of ten and contract research by a factor of seven (see Box 2 ).

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| Box 2: Commercialization, Collaboration, and the Bayh-Dole Act**Prior to World War II, industry was the primary source of funding for basic research in American universities.** Several American universities currently at the cutting edge of scientific research and which have the highest returns from research commercialization, such as the Massachusetts Institute of Technology and Stanford University, were set up with large contributions from the business sector with the clear mandate to provide educated professionals (e.g., engineers) to an industrial sector that was becoming internationally competitive but was still a technological laggard. This financial support helped shape priorities and build relationships between the business and the university sectors in the United States. **After the war, the federal government supplanted the private sector as the major financial contributor** **to university research**. For several decades after World War II, most R&D in the United States was financed by the federal government, specifically through the National Science Foundation, the National Institutes of Health, and the Department of Defense. Consequently, the principal determinant of the type and direction of the research performed by academic institutions during this period were the priorities set by these public agencies, resulting in a reduction in the collaborations and linkages between higher education and private sector. **In the view of U.S. policy makers, this reduction in collaboration between the private and university sector also reduced the contribution of publicly funded R&D to economic growth and thus higher living standards**. Moving an invention or technology from the research stage to a marketable product or process typically requires the participation of the private sector. With priorities of business and scientific communities diverging, this involvement depended on the occasional coincidence of interests or the tradition of cooperation that had existed since the beginning of the century. In the late 1970s, U.S. research universities were often criticized for being more adept at developing new ideas than facilitating the commercialization of existing ones.**The 1980 Bayh-DoleAct aimed to reverse this trend by accelerating the commercialization of new technologies, thereby promoting entrepreneurial activity and economic development.** The intent of the law was to encourage research universities (i) to acquire patents on inventions resulting from federally funded research, and (ii) to issue exclusive licenses to private firms under the presumption that exclusive licensing creates incentives to commercialize these inventions. The Act also introduced a single, uniform national policy designed to cut down on bureaucracy related to the management of intellectual property and provided for the increased participation of small firms in the national R&D enterprise. **The centralized control of ownership and management of intellectual property by the federal government that existed prior to the Act hindered technology transfer for at least two reasons**. First, with ownership belonging to the federal government and a highly complex patent policy in place—26 different agency policies regulated the use of the results of federally funded R&D—universities had limited incentives to monitor, patent, and commercialize research results. Second, the centralized monitoring of research implemented in thousands of universities did not provide an adequate mechanism for the full use of all potentially patentable discoveries. In such a context, discoveries remained unused and tax-payers did not fully benefit from the results of publicly funded R&D.**Prior to the Bayh-Dole Act, licenses to use government patents were generally negotiated with firms on a non-exclusive basis.** Early-stage technologies require additional research and development before they can be brought to market. The lack of exclusive rights under the IP regime prior to the Bayh-Dole Act reduced the ability of private firms to appropriate potential returns on their investments in developing and commercializing promising early-stage technologies. By limiting the appropriability of the returns to such investments, the regime significantly reduced the number of projects that were profitable for the private sector. As a consequence, only 5 percent of government-owned patents before 1980 were used by the private sector. **The regulatory regime may also have hampered research commercialization by reducing the amount of time that scientists allocated to applied research and product development**. On the one hand, expected returns from engaging in commercialization-related activities were comparatively low: potential rents to be derived from discoveries were unknown to the researcher, and the probability of commercialization of the research itself was small. On the other, scientists had to bear the related opportunity costs, namely, allocating less time to generating new ideas and advancing their academic careers. In such a context, the incentive regime faced by scientists seems to have been biased against the commercialization of research.**The amount of research conducted by universities and funded by industry accelerated in real terms after the passage of the Bayh-Dole Act.**  The figure below depicts the evolution of industry-funded R&D performed by research universities in the United States between 1953 and 2004. Data show that the growth of private funding to R&D conducted by universities did not start with the Act but accelerated significantly after its enactment: annual business funding for R&D at research universities after Bayh-Dole increased on average by sevenfold. Academic patenting has also increased substantially: 3,622 patents were awarded to research universities in 2006 as compared to 390 in 1980. Possibly the most significant impact accrued to universities that were not actively engaged in patenting, as shown by the large contribution of middle-tier universities to the acceleration in patenting activity during the 1980s and early 1990s.

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| Industry Funding of R&D at Colleges and Universities, 1953-2004 |
| *Source: National Science Foundation, 2006*. |

**The Bayh-Dole Act had a strong positive impact on commercialization by simplifying the patenting process and aligning incentives of researchers and universities in favor of commercialization of research.** By simplifying the patenting process and assigning the ownership and management of the intellectual property created by publicly funded R&D to research universities, the Bayh-Dole Act seems to have better aligned the incentives of research institutions and scientists to pursue applied research, develop intellectual property, and commercialize it, thereby contributing to economic development in the United States, as indicated by the licensing activity and the number of startups. According a 2007 survey of the Association of University Technology Managers (AUTM), approximately 5,505 new licenses/options were granted, corresponding to approximately US$1.25 billion in 2006. Roughly 555 new companies were created to commercialize university research in that year, while 686 new products marketed in 2007 were based on academic R&D. **It is important, however, not to overestimate the achievements of the Bayh-Dole Act beyond accelerating the commercialization of publicly funded research by universities**. For instance, the U.S. government remains the main source of financing for R&D at universities, despite the significant growth in private financing enabled by the Act. Moreover, most of the financial gains from commercialization are concentrated in a small number of U.S. universities, which raises equity concerns. Interestingly, recent studies show that the Act seems not have encouraged an excessive allocation of scientists to applied research, a concern expressed at the time the Act was passed. |

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| Figure 11: Addressing the Loopholes in the Process of Research Commercialization – the Denmark Example |
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1. **By 2002, similar versions of the Bayh-Dole Act had been adopted in roughly 20 OECD countries**. illustrates how Denmark’s legislation has addressed the problems discussed above. Note that ownership belongs to the university rather than to the researcher or funding agency; employees *must* disclose their inventions to the universities and assist in the commercialization process as needed. For their part, universities *must* actively try to commercialize the invention, and researchers are entitled to one-third of the net income generated by the commercialization. By assigning clear responsibilities to the various agents involved in the commercialization process, the law better aligns the interests of those agents with the overall objective of research commercialization. Aligning the public interest (commercialization of research outputs) with private interests (of universities and researchers) has been shown to be a pivotal step toward the commercialization of research.
* Germany abolished the “professor’s privilege” in 2001, transferring rights from researchers to their employers. Austria followed suit in 2002.
* In Italy, IP legislation adopted in 2001 transferred IPR ownership from universities to individual researchers based on the opposite assumption, but this was reversed in 2004 following opposition from universities, research development institutes, and industry.
* A Japanese version of the Bayh-Dole Act, adopted in 1998, established invention committees that award ownership of patent rights to publicly funded research between the university and the government.
1. **In addition to the allocation of IP rights, other initiatives favoring technology transfer have been introduced as well**. Countries have gradually considered commercialization results, such as patenting, as achievements that count toward academic advancement. For example, establishing equivalency for career development between patenting and scientific publications. Another increasingly used practice is the extension of sabbatical years for academic entrepreneurship: university regulations often provide for a defined period during which researchers may be fully dedicated to the commercialization of their research. At a more macro level, countries have also tried to establish and simplify the rules for collaboration between public research organizations and the business sector. In Chile, for example, pre-announced decline in budgetary support incentivized public research centers to look for collaborators in the private sector. International experience shows that additional funding is the primary motivation for researchers to engage in collaboration with the business sector.
2. **Once the incentives are right, technology transfer offices** **(TTOs)** **may play an important role in accelerating the commercialization of public research.** The role of TTOs is essentially to match the “supply” of potentially commercial ideas with business sector “demand” or needs. TTOs are responsible for managing the intellectual property (IP) that emerges from public research—evaluating its commercial potential, identifying potential users in the business community, and determining the best way to commercialize the research (spinoff, licensing, etc). Several factors influence the success of TTOs, including finding a manager with the appropriate scientific and business skills, designing a remuneration package that rewards results, implementing an effective informatics system that allows effective monitoring, and others. While providing a public good —the commercialization effort— TTOs commonly require public financing for a period of 5 to 10 years, before which sustainability is not expected to be achieved. Adequate management of IP also requires public research organizations to have sufficient autonomy to own, manage, and sell financial assets (patents, spinoffs, and others). Few public sector organizations have such autonomy.
3. **The availability of science parks is often considered another important factor that facilitates cooperation between the public and private sectors.** The importance of physical infrastructure for creating spinoff companies has often been overemphasized, as compared to the importance of IP management and incubation services for the success of academic entrepreneurship and research commercialization. In Turkey, for example, a survey on the impact of technology development zones (TDZ) conducted by the World Bank in 2008 showed that a negligible share of the tenant firms collaborating with universities (4 percent) would not have done so if they had not been located in a TDZ. In addition, one-fourth of the tenant firms found the incubation services provided to be unattractive or very unattractive. Yet there were 7.3 zones in Turkey for every 10,000 researchers in 2007, compared to 1.2 in the United States, where the clustering of firms around universities is used as a point of comparison.

***Increasing Business R&D and Innovative Startup Companies***

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| Figure 12: Business R&D and Patenting |
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| *Sources: OECD STI, WDI.* |

1. **Promoting business R&D and innovation should be one of the intermediate goals to increase the impact of R&D on export competitiveness and economic growth**. shows a positive relationship between industry-financed R&D expenditures and patenting in the United States, the EU, and Japan (the triadic patent countries). The same relationship is weaker when total R&D is taken into account, and no clear pattern emerges when only publicly financed R&D is considered. There are a number of reasons why industry-financed R&D is more likely to generate patents, including better management of research and results orientation. On the downside, such R&D is less likely to support basic research, due to higher externalities. Patenting is neither a necessary nor a sufficient condition for innovation, but it is commonly seen as a good proxy for the innovative potential of a country, the main advantage being its clear definition and proper measurability. In turn, patenting in the triadic country is commonly perceived as indirect evidence of the commercial potential to be protected when compared to patenting in the original country.
2. **The overall business R&D activity in a country is affected by a number of factors, including economic specialization and competition**. Economic specialization is a relevant factor because sectors such as biotechnology and IT may be more likely to invest in R&D than, for example, the textile or footwear industry. Requirements to adjust to environmental regulation, however, have raised R&D activities in non-conventional sectors (e.g., the cement industry) contributing to an increase in R&D activity across sectors of economic activity. The relationship between competition and innovation has long been a source of debate, with more recent theories of industrial organization predicting that innovation should decline, while competition and empirical studies find the opposite. More competition could foster R&D and innovation when it reduces pre-innovation profits by more than it reduces post-innovation profits. With structural reforms still underway, this differential may be relevant, and promoting competition (i.e., reducing pre-innovation rents) may play an important role in transition economies. Moreover, international experience shows that countries that succeed in promoting business R&D often have a governance regime in which the expected net returns on unproductive activities (e.g., corruption and crime) are much lower than those associated with productive ones, such as the creation of innovative startups and R&D investment.

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| Figure 13. Change in Government R&D Budgets, 2002 |
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1. **Access to external financing is another important factor in the expansion of business R&D**. Access to credit for routine activities, such as acquisition of new equipment and working capital, frees up internal resources to be invested in riskier activities, such as R&D and innovation. Asymmetric information, leading to standard moral hazard and adverse selection problems, often makes external capital too costly, or simply unavailable, to firms to finance innovation. Innovative startup companies, a key source of market dynamism, are particularly financially constrained and often struggle to escape the so-called Death Valley. The term refers to that period lasting potentially years between the proof of a product’s technical concept to the successful launch of that product in the market—after which it becomes a bankable asset which would then attract normal collateralized bank financing (or venture financing, when available). In that period, asymmetric information is particularly acute, and its consequences are hard to overcome by traditional investors. Angel investors try to address the problem by having some sort of direct control over the enterprise, but the supply of angel and venture investors (early-stage financing) is scarce even in developed economies.
2. **Governments have tried to mitigate those financial constraints through a combination of tax breaks and direct support to smaller firms and innovative startup companies**. Tax breaks often benefit large firms already engaged in R&D activity. Direct subsidies in the form of grants, matching grants, and soft loans (conditional loans at subsidized interest rates) are more likely to benefit innovative startups — small, young companies entering the R&D business. The preference between these two types of instruments varies significantly. Figure 13 shows that Canada, for instance, spent about 0.24 percent of GDP between 2002 and 2007 in direct support to business R&D, mainly through tax breaks. At the other extreme, the United States spent about the same amount (0.22 percent of GDP) mainly through direct subsidies. France and Spain combined relatively high tax breaks with high direct subsidies. In 2008, France granted the highest tax breaks, about 0.42 per dollar spent on R&D (0.35 cents in Spain).
3. **Beyond financing, governments have also focused on nurturing R&D projects in small enterprises, and innovative startup companies are also important.** Business angels are one natural option, but they do not often exist on a sufficiently large scale in developing countries. Increasing their presence may not be feasible in the short term given the limited supply of “serial entrepreneurs,” the main input for the efficient provision of business angel services. Importing such services from advanced economies may not be a feasible solution either, given the local dimension of such networks and the importance of geographic proximity. Yet nurturing services is extremely important for R&D projects in small companies and innovative startups for the successful transition of ideas to the market, a process in which a number of non-financial obstacles tend to emerge.[[15]](#footnote-15) One example of such a nurturing service is facilitating access to potential clients and investors: the feedback received from those agents is often critical to help focus research activities on market needs, reducing the time and costs of product development. A slim and specialized agency would not enable access to a scattered and informal supply of business and technological consultants available at local and international levels, helping firms to address coordination and informational failures. The Finnish TEKES is one example of such an agency.
4. **Governments have tried to increase the levels of business R&D investments also by attracting R&D-intensive foreign direct investment.** R&D-intensive foreign direct investment (FDI) increased significantly during the 1990s. Yet the fast internationalization of corporate R&D seems to be shifting toward a period of stagnation, given the maturation of corporate R&D networks and the effects of the 2007-2010 economic crisis that forced some consolidation of R&D activities within multinational corporations. Moreover, emerging countries are becoming more important both as destinations and as sources of R&D-intensive FDI. The number of R&D centers owned by foreign multinational corporations (MNCs) rose tenfold in China and India from 2001 to 2008: from only 100 in each of the two countries in 2001 to 1100 in China and 780 in India by the end of 2008. Between 2004 and 2007, 83 percent of all new R&D sites opened by the largest MNCs by R&D expenditure were located in China or India.

## Summary and Next Steps

1. **The EU and the Western Balkans already have significant experience collaborating on R&D.** The World Bank signed an agreement with the EU to provide technical assistance aimed at developing a Regional R&D Strategy for Innovation (and corresponding country-level action plans). The final product of the technical assistance is a pragmatic regional R&D strategy for innovation with corresponding national action plans. The ultimate goal is to help countries mainstream R&D and innovation policies in their development processes.
2. The value added of the proposed technical assistance is twofold. First, we propose to focus on **how to increase the economic impact of R&D and innovation in the Western Balkans**. This corresponds to the renewed emphasis on R&D seen in the EU’s growth strategy and expressed among others by the flagship *Innovation Union* and the *Strategy for Smart Growth*. Second, we plan to **adopt a comprehensive approach integrating the three axes of the knowledge triangle**, namely education, research, and innovation.
3. The idea is to focus on intermediate objectives that contribute to the overarching goal of improving the contribution of R&D and innovation for economic development. The issues within each of the subject topics were discussed in detail in Section 4:
	* improving policy-making, implementation, monitoring and evaluation, and governance of national innovation systems;
	* strengthening the regional science base;
	* accelerating commercialization and deepening collaboration with the business sector; and
	* facilitating higher levels of business R&D and startups of innovative companies.
4. We propose to implement the technical assistance in two phases. A first phase, of roughly one year, will be devoted essentially to learning, knowledge sharing, and preparation of the draft strategy and action plans by the beneficiary entities. A second phase would be dedicated to the consultation and dissemination of the draft strategy among the different stakeholders in the region and preparation of the final draft and action plans.
5. This inception report is expected to be discussed by the Coordinating Body of the Regional Strategy for Research and Development for Innovation for the Western Balkans in Zagreb on July 11, 2011. This meeting, organized by the RCC Secretariat, will be the first opportunity for substantial discussion on the scope of future activities and the optimal module for implementing the technical assistance, including the definition of a tentative schedule.
1. The United Nations, through the United Nations Interim Administrative Mission in Kosovo (UNMIK/Kosovo, hereinafter referred to as Kosovo) has administrative oversight under United Nations Security Council Resolution 1244 (1999). Kosovo became a member of the World Bank Group in June 2009. [↑](#footnote-ref-1)
2. The Regional Cooperation Council (RCC) was officially launched on February 27, 2008, as the successor of the Stability Pact for South Eastern Europe. RCC consists of 46 member countries, organizations and international financial institutions. [↑](#footnote-ref-2)
3. Croatia and Serbia are being extensively covered by different Bank activities and were not particularly reviewed in this Inception Report. [↑](#footnote-ref-3)
4. Another milestone in developing regional cooperation in the field of R&D was the International Venice Conference of Experts co-organized, in 2001, by UNESCO, the Academia Europea, and the European Science Foundation. The Venice Conference advocated the adoption of a series of activities and projects, which are vital for the recognition and integration of national S&T into the pan-European research area, as well as for up-grading existing cooperative agreements and promoting new ones. [↑](#footnote-ref-4)
5. The “EU-Balkan Countries Action Plan in Science and Technology” was part of the overall Thessaloniki Agenda for the Western Balkans: Moving towards European Integration, envisaged as support to strengthen relation between EU and the Western Balkans. [↑](#footnote-ref-5)
6. The objectives of the FP7 WBC-INCO.NET are: 1) support to bi-regional dialogue on science and technology by benefiting from and interacting with the Steering Platform on Research for Western Balkan countries, 2) identification of RTD potential and priorities for take-up in FP7 and other European programs in a transparent and methodologically sound way, and 3) enhancement of participation of researchers from the region in European projects of mutual interest and benefit by implementing capacity building measures and accompanying networking activities. [↑](#footnote-ref-6)
7. - Center for Social Innovation, see-science.eu. 2007. *Innovation* *Infrastructure in the Western Balkan Countries;*

- Dall, E. (ed.) 2008. *Science and Technology in the Western Balkans,* Reports of the Information Office of the Steering Platform on Research for Western Balkan Countries*.* Vienna;

- European Investment Fund. 2010. *Western Balkans Venture Capital Market Assessment*. Draft, November 2010;

- UNESCO. 2010. *UNESCO Science Report 2010: The Current Status of Science around the World*. Paris [↑](#footnote-ref-7)
8. Country Reports of beneficiary countries was developed in connection with the Inception Report and provides more detailed overviews of the individual countries’ R&D policy frameworks and the international cooperation efforts in the areas of R&D and innovation. [↑](#footnote-ref-8)
9. More detailed information on innovation infrastructure in the Western Balkans can be found in the Country Reports on R&D policy as well as the report “Innovation Infrastructures in the western Balkan Countries” (2007) see.science.eu. (http://www.wbc-inco.net/attach/InnovationInfrastructuresinWBC\_see-science.euReport\_version2.pdf). [↑](#footnote-ref-9)
10. Revealed scientific advantage (RSA) is defined as the publications of a given country in a given subject area, divided by the country‘s share of the world’s publications in that area. [↑](#footnote-ref-10)
11. Per capita carbon emissions in Albania, Bosnia and Herzegovina, Macedonia, and Montenegro are lower than the world average but similar to those of large emerging economies, such as India and Brazil. Carbon emissions per unit of GDP are as high as in China, India, and Russia, especially in Bosnia and Herzegovina, Croatia, and Macedonia. [↑](#footnote-ref-11)
12. Preliminary studies have confirmed the existence of high-capacity depleted hydrocarbon fields in Croatia and Albania, and suggests the possibility of CCS capacity in the Pannonian Basin. CCS is a critical option in the portfolio of solutions available to combat climate change, because it allows for significant reductions in CO2 emissions from fossil-based systems, enabling it to be used as a bridge to a sustainable energy future. [↑](#footnote-ref-12)
13. In the period 2000-07, only two patents on renewable energy were issued, in Bosnia and Herzegovina, and no patents were registered in the area of energy efficiency. At the same time, the Western Balkan countries will have to adapt to the effects of climate change. [↑](#footnote-ref-13)
14. The Act also introduced a single, uniform national policy designed to cut down on bureaucracy related to the management of intellectual property and provided for the increased participation of small firms in the national R&D enterprise. [↑](#footnote-ref-14)
15. For instance, contact with potential clients is of critical importance because their feedback helps to make product development more cost-effective. Such obstacles are not present at the level of purely scientific research, and researchers are fully trained and equipped to perform “pure” research tasks. [↑](#footnote-ref-15)