Dimitar Nikoloski and Ljupcho Pechijareski

Research and development in post-transition: a case study of western Balkans countries

Abstract

Research and development (R&D) represents a crucial input to the innovation process, while R&D expenditure significantly determines the innovation capacity of a given country. The issue of the sub-optimal allocation of resources to R&D has been widely elaborated. The low innovation potential of post-transition countries, including western Balkan countries, may inter alia stem from insufficient capacity to provide the conditions for efficient R&D. Namely, the long transition has had tremendous economic, political and social impacts. In consequence, the western Balkans have experienced an erosion of their R&D potential while their national innovation systems remain under-developed. This article seeks to explore the scope and nature of R&D in the western Balkans as determinants of their innovation capacity and to assess the impact of R&D on economic development. In the process, it seeks to come up with policy recommendations that will contribute to better R&D performance and which will assist the transformation of western Balkans countries into 'innovation learners'.

***Keywords**: R&D, innovation, post-transition, western Balkans*

Introduction

The long period of transition has undoubtedly had tremendous consequences for the economic development of western Balkan countries.[1] All of the western Balkans decisively believe that their future lies in the European Union (EU) and have already undertaken measures for meeting the conditions for EU accession. However, there remain a number of challenges for the future socio-political and economic development of the western Balkans region.[2] This is particularly relevant with respect to intensifying regional co-operation, strengthening good governance and increasing prosperity via sustainable economic growth.

The sustainable economic growth of western Balkans countries will only be possible via open markets and by attracting foreign investment. Thus, a positive investment climate, including legal certainty and a zero tolerance policy on corruption, are indispensable to the development of small- and medium-sized enterprises. Furthermore, economic reforms should account for overcoming the current account deficits of countries in the region, increasing competitiveness via regional value chains, improving the region's logistical connections to European markets and developing ef-

1 These are: Albania; Bosnia and Herzegovina; Kosovo, Macedonia, Montenegro and Serbia.
2 Final Declaration by the Chair of the Conference on the Western Balkans, 28 August 2014.

fective academic and vocational training as a precondition for reducing youth unemployment. In this context, investment by companies in R&D is fundamental to enhancing the region's 'absorptive capacity', i.e. its ability to adopt and adapt foreign technology, benefit from spill-over effects from foreign direct investment (FDI), and gain from other sources of knowledge transfer.

Historically, the funding of R&D was shared between two domestic sources: the government and private business (Greenhalgh and Rogers, 2010). Governments exert a strong influence on the process of innovation through the financing and steering of public organisations that are directly involved in knowledge generation and diffusion, as well as through the provision of financial and regulatory incentives to all actors in the system of innovation. In addition, R&D investment increases the possibility of achieving a higher standard of technology in firms and regions, which would allow them to introduce new and superior products and/or processes, resulting in higher levels of income and growth (Bilbao-Osorio and Rodríguez-Pose, 2004).

Economic reforms across the western Balkans during the period of transition have put science, technology and innovation policies as a second priority, which has led to a deterioration in their research capacities. Given that the Balkan region lags behind the rest of the EU in technology accumulation and innovation capacities, the outline described above calls for the application of new growth models which would emphasise the role of innovation and research (Švarc, 2014a). The consequence of a renewed emphasis on research and innovation is that it might be expected that the region will gradually converge with the R&D and policy targets set by the EU (World Bank, 2013a).

The aim of this paper is two-fold. Firstly, to explore the scope and nature of R&D in western Balkans countries as determinants of their innovation capacity; and, secondly, to assess the impact of R&D on economic development in the region. For this purpose, we apply panel data analysis in order to relate R&D indicators to those of economic growth in the western Balkans. In the process, we expect to come up with policy recommendations that will contribute to improved R&D performance and which will assist the transformation of western Balkans countries into 'innovation learners'.

Hence, this article is structured as follows. Firstly, we provide a brief introduction followed by an elaboration of the theoretical framework regarding R&D and its impact on economic growth. In the third section, we provide an empirical assessment of the impact of R&D on economic growth in western Balkans countries. Finally, the concluding section encompasses some closing remarks and sets out some policy recommendations.

Theoretical background

R&D, as a specific group of activities, is mainly focused on increasing the productivity level of companies which, in turn, would lead to higher levels of economic growth. In general, R&D activities are conducted by specialist units or centres belonging to a company; or otherwise they can be outsourced to a contract research organisation, universities or state agencies. Different in nature and funded by various sources, R&D nevertheless significantly determines the capacity for innovation of a

given country. The issue of the sub-optimal allocation of resources to R&D in a free market economy, due to the appropriability problem, the high amount of fixed costs and related uncertainty, has been widely elaborated in the literature (Greenhalgh and Rogers, 2010). In this context, there are various policy measures that can be undertaken to correct market failure and solve the problem of R&D under-provision. Moreover, R&D represents an important component of a country's National Innovation System (NIS), viewed as a complex inter-related system which consists of three sectors: industry; universities; and the government. This concept of NIS is also known as a triple helix model, defined as a set of components, relationships and functions that generate and promote innovation (Švarc, 2014b).

The impact of R&D through innovation on economic growth has, for a long time, been in the focus of research and policy-making debates. The neo-classical model of economic growth, also called the 'Solow model', was among the first to account the role of new technology alongside capital and labour as a determinant of an economy's output. In addition, many models demonstrate, from a theoretical point of view, the role of R&D as an engine for growth and point out the reason why government must intervene in order to achieve an optimal level of R&D (Snowdon and Vane, 2005; Pessoa, 2010).

During the mid-1980s, several economists, most notably Paul Romer and Robert Lucas, sought to construct alternative models of growth in which the long-run growth of income per capita depends on investment decisions rather than unexplained technological progress. However, the term 'investment' in the context of these new models refers to a broader concept than the level of physical capital accumulation reported in national accounts, such as research and development expenditures and human capital formation. A further implication of Romer's research is that, for a given country to maintain its leadership position, government policies must continue to support a high level of R&D activities in both private and public institutions. Given the well-documented large divergence between social and private rates of return from R&D expenditures, the government has a vital role to play in preventing under-investment in this activity (Snowdon and Vane, 2005).

In addition, R&D spill-overs have particular importance for developing countries, such as those in the western Balkans, which have experienced a prolonged process of transition from a centrally-planned to a market economy. Given that the majority of R&D activities are carried out in developed countries, there are clearly opportunities for developing countries to benefit from knowledge spill-overs. In this context, empirical evidence shows that the total factor productivity of developing countries is positively and significantly related to the level of R&D among their trade partners in industrialised countries as well as to their imports of machinery and equipment from industrialised countries.

However, the empirical evidence is not decisive as to whether there is a strong association between R&D efforts and the growth rate in a given economy. For instance, Jones concludes that total factor productivity does not increase, even with an increase in the resources (from both domestic and foreign sources) devoted to R&D activities (Jones, 1995). Possible explanations for this are diminishing returns to R&D and that total factor productivity growth would anyway have declined unless

there had been a large increase in the R&D workforce. Similarly, Sylwester (2001) did not find an association between R&D and economic growth in twenty OECD countries. However, when considering G7 countries, he reports a positive association between industry R&D expenditure and economic growth. Furthermore, Bilbao-Osorio and Rodríguez-Pose (2004) disaggregate the relationship between R&D and economic growth by assuming that the transmission mechanism occurs through innovation. They apply an empirical analysis for EU countries and show that the link between innovation and economic growth is less forthcoming than that between R&D investment and innovation. On the other hand, taking into account that, in OECD countries, the composition of R&D has shifted from low to high-tech areas, there is evidence that R&D investment in the high-tech sector has strong positive effects on GDP per capita in the long-term (Falk, 2007).

One of the important issues related to R&D investment and economic growth is the problem of simultaneity between these variables. Pessoa (2010) points out that, even though there is a positive relationship between GDP per capita and R&D intensity, there are many factors which are omitted in typical regressions which simultaneously affect total factor productivity growth and incentives to invest in R&D. If such factors have a clear effect on total factor productivity and, at the same time, induce firms to invest in R&D, R&D intensity seems to be rather a proxy of the level of development than a cause of it. The result of this is that, when we search for the actual relationship between R&D intensity and GDP growth, the picture is not particularly confirmative of the positive effects of the former on the latter.

Bearing in mind these arguments, we look more closely at R&D data in western Balkans countries and make an attempt to assess the possible impact of R&D on economic growth.

Empirical analysis

In this section, we provide an empirical analysis aiming to examine the relationship between R&D and economic growth in the western Balkans. For this purpose, we use aggregate data at national level for five countries in the region: Albania; Bosnia and Herzegovina; Macedonia; Montenegro; and Serbia.[3] Research systems in western Balkans countries differ in their research intensity, manpower, institutional complexity and performance abilities, but their common feature is a low level of R&D investment compared to the EU average.

For the purpose of our analysis in this article, we have used standard R&D indicators defined by the OECD. According to OECD (2013), the standard expenditure measure for R&D is Gross Domestic Expenditure on Research and Development (GERD), which covers all R&D carried out on a national territory in a particular year. Furthermore, GERD can be disaggregated by performance sectors: business enterprise (BERD); higher education (HERD); government (GVRD); and private nonprofit (PNPRD).

The dynamics of Gross Domestic Expenditure on Research and Development in the western Balkans during the 2002-2012 period is presented in Figure 1.

3 Kosovo does not form part of our consideration here as a result of a lack of data.

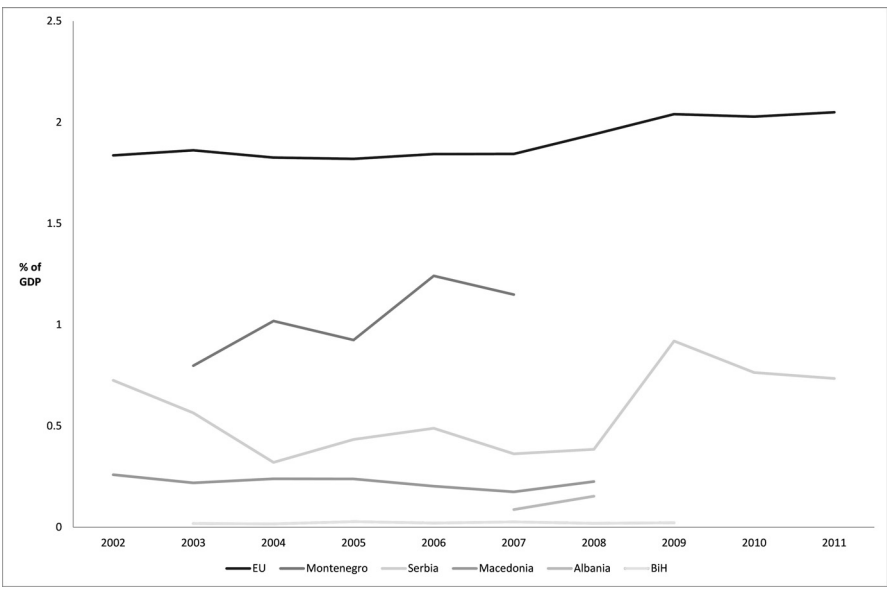
From this, it is obvious that GERD in all of Macedonia, Albania and Bosnia and Herzegovina is below 0.5% of GDP; the share in Serbia stands at about 0.75%; and in Montenegro is about 1%. In sum, these amounts of expenditures are much lower than the EU average, which stands above 2%.

In addition, the business enterprise sector in western Balkans countries' Gross Domestic Expenditure on R&D represents only a modest share compared to the EU average. For instance, according to the Erawatch platform on research and innovation policies and systems, the share of the private sector in western Balkans R&D expenditure are, on average, between 15 and 20 per cent, which is much lower compared to the 2012 EU average of 63 per cent in 2012.

Other common problems that the western Balkans share with respect to the research sector are as follows (Švarc, 2014a):

- a lack of manpower and the 'brain drain'
- low international and sectoral mobility of researchers
- low participation in Framework Programmes
- obsolete scientific equipment
- weak abilities for university-industry collaboration
- the commercialisation of research results.

Figure 1 – R&D expenditures in EU and south-east European countries



Source: World Bank World Development Indicators

In order to position the R&D capacities of the western Balkans in a global context, we can examine countries' Global Innovation Index (GII) ranking. Namely, the last sub-pillar, on R&D, measures the level and quality of R&D activities with indi-

cators on researchers (headcounts), expenditure and the quality of scientific and research institutions as measured by the average score of the top three universities in the QS World University Ranking. By design, this indicator aims at capturing the availability of at least three higher education institutions of quality within each economy (i.e. included in the global top 700) and is not aimed at assessing the average level of all institutions within a particular economy.[4]

The country percentage ranks in 2013 are presented in Table 1.

Table 1 – WBC percentage ranks, 2014 (Global Innovation index)

Country	GII ranks	R&D ranks	R&D components		
			Researchers	Gross expenditure on R&D	QS university ranking average score of top 3 universities
Albania	0.35	0.33	0.42	0.19	0.00
BiH	0.44	0.30	0.50	0.01	0.00
Macedonia	0.58	0.39	0.51	0.28	0.00
Montenegro	0.59	0.54	0.69	0.41	0.00
Serbia	0.54	0.56	0.59	0.65	0.52

Source: Global Innovation Index (2013) The Local Dynamics of Innovation.

From Table 1 we can notice that, among the R&D components, western Balkan countries have the best scores on the number of researchers, followed by gross expenditures on R&D and, finally, the worst performance is marked with respect to university ranking average score of the top three universities. Compared to the general GII ranks, it is obvious that, in general, western Balkans countries are under-performing regarding their R&D capacities.

Furthermore, we can implement econometric analysis in order to determine the impact of R&D on economic growth during the 1996-2012 period. For this purpose, we have used the World Development Indicators database as well as SCImago Journal and Country Rank for five western Balkans countries: Albania; Bosnia and Herzegovina; Macedonia; Montenegro; and Serbia. The World Development Indicators are the World Bank's collection of development indicators compiled from officially-recognised international sources. This presents the most current and accurate global development data available and includes national, regional and global estimates. The SCImago Journal and Country Rank is a portal that includes journals and country scientific indicators, developed from the information contained in the Scopus database. These indicators can be used to assess and analyse scientific domains.

4 This indicator replaces a survey question from the World Economic Forum's *Executive Opinion Survey* that was used in the last two editions of the GII on the quality of scientific and research institutions.

In order to assess the impact of R&D on economic development, we have estimated two separate regression models based on panel data with random effects and one year lagged explanatory variables. The rationale for including lagged explanatory variables is because of the assumed time delay of the effects of R&D upon economic development and growth. In the first model, the dependent variable is GDP growth; whereas, in the second, we assess the impact of R&D on the export of goods and services in terms of percentages of GDP. Bearing in mind that the number of observations per time period varies for different western Balkans countries, in our case the panel is unbalanced. We take into consideration the following R&D indicators as explanatory variables: research and development expenditure (as a percentage of GDP); the number of patent applications; the number of researchers engaged in R&D (per million people); the number of citable documents; and international collaboration.

The results from the estimation of R&D impact on GDP growth are presented in Table 2.

Table 2 – Estimated regression model (the impact of R&D on GDP growth)

Explanatory variables	Coefficient	Standard error	p>|z|
■ Constant	-3.523451	6.22954	0.572
■ Research and development expenditures	1.846506	7.535802	0.806
■ Number of patent applications	0.0086327	0.0088102	0.327
■ Researchers in R&D (per million people)	-0.0049936	0.0053815	0.353
■ Number of citable documents	-0.0000346	0.0007546	0.963
■ International collaboration	0.1547074	0.0904411	0.087*

Note: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels respectively.

From Table 2, we note that, with the exception of international co-operation, none of the estimated coefficients are statistically significant. In this case, an increase in international collaboration of ten percentage points would lead to an increase in the growth rate of GDP by 1.5 percentage points. In addition, the overall R-squared is about 0.53, which means that about 53 per cent of the variation in GDP growth is explained by R&D indicators.

Hence, based on this panel data analysis, we can conclude that, in general, there is no positive association between R&D and GDP growth in the western Balkans.

Next, we assessed the impact of R&D on the export of goods and services as a percentage of GDP. The theoretical assumption for this model is that improved R&D capacities might increase exports through a heightened competitiveness of domestic firms on global markets.

The results of the estimated regression model are presented in Table 3.

From Table 3, it is obvious that the number of researchers and international collaboration have a positive and statistically significant impact on the export of goods and services in the western Balkans. On the other hand, the impact of the number of patent applications on exports is negative and statistically significant; whereas expenditure on R&D and the number of citable documents do not have a statistically significant impact. The overall R-squared in this case is 0.59, which means that 59 per cent of the variation in exports may be explained by R&D indicators.

Table 3 – Estimated regression model (the impact of R&D on the export of goods and services)

Explanatory variables	Coefficient	Standard error	p>|z|
■ Constant	16.19472	10.83516	0.135
■ Research and development expenditures	4.394223	13.10717	0.737
■ Number of patent applications	-0.0343169	0.0153237	0.025**
■ Researchers in R&D (per million people)	0.0220368	0.0093602	0.019**
■ Number of citable documents	-0.0019122	0.0013126	0.145
■ International collaboration	0.3243065	0.157306	0.039**

Note: *, ** and *** represent statistical significance at the 10%, 5% and 1% levels respectively.

Conclusions and policy recommendations

In this article, we have sought to assess the R&D capacities in the western Balkans and the possible impact of these on economic development and growth. Bearing in mind the development goals of western Balkans countries, as well as their perspective towards EU accession, we assume that R&D represents a substantive element in the accomplishment of the development agenda of the western Balkans. Moreover, the Balkan region lags behind the rest of the EU in technology accumulation and innovation capacities, which calls for the application of new growth models which would appropriately emphasise the role of R&D in the region.

The theoretical models clearly suggest that R&D activities increase the productivity level of companies which, in turn, leads to higher levels of economic growth. One of the main issues related to R&D investment in a free market economy is a sub-optimal allocation of resources due to the appropriability problem, the high amount of fixed costs and related uncertainty. Hence, an appropriate design of policy measures, including the National Innovation System, is important in correcting market failure and resolving the problem of R&D under-provision. In addition, technology spill-overs are crucial in increasing the R&D capacities of developing countries since most R&D activities are carried out in developed countries.

However, most of the empirical work does not show clear-cut evidence that R&D does have a significant impact on economic development and growth. Furthermore,

the problem of simultaneity in assessing the relationship between R&D indicators and those of economic growth is an additional issue that hampers an appropriate application of econometric modelling. Taking into account these considerations, our empirical analysis points to the low level of R&D capacities in the western Balkans, which holds for most R&D indicators. In addition, the estimated econometric models indicate that only international collaboration exerts a positive and statistically significant impact on the GDP growth rate, although international collaboration and the number of researchers do have positive and statistically significant impacts on the export of goods and services from the western Balkans.

Taking into account these results, as well as the common strategic goals of countries in the region of the western Balkans, we can differentiate several policy recommendations which aim to improve R&D capacities in the region.

Firstly, in order to improve the research base, western Balkans countries need to slow down the 'brain drain' and provide support for investment in human capital. In addition, improving access to modern research facilities and the availability of research funding are of crucial significance. The region needs to invest in the qualifications of its researchers and expand participation in tertiary education. Reforms should also be advanced which promote the mobility of researchers, within the region and between the region and other countries, both in Europe and elsewhere. These might include the adoption of common PhD programmes, diploma equivalence and lower visa requirements for scientists.

Secondly, western Balkans countries need to promote research-industry collaboration and technology transfer. For this purpose, they have to improve the incentive regime for collaboration between research institutes and the private sector. To exploit the economic impact of publicly-funded research, the countries of the region need to take steps to simplify the legal requirements governing the interaction between public research organisations and the enterprise sector. Legislation regulating the management of the intellectual property generated from publicly-funded research is crucial, since uncertainty about the ownership of research results can limit the incentives of public research organisations, individual researchers and businesses to generate and use research for commercial purposes.

Finally, universities throughout the western Balkans need to continue their process of integration into the European Higher Education Area. Broader reform of the education sector would further strengthen the research and innovation system. For instance, the introduction of performance-based contracts and greater autonomy in managing resource allocation and research results would enhance the quantity and quality of research outputs and their relevance to the economy. In addition, a better balance between basic and applied research would also increase the impact of research on the economy.

On a related issue, the allocation of resources could be defined according to a 'smart specialisation strategy' which favours fields where scientific excellence meets the region's economic potential.

References

Bilbao-Osorio, B and A. Rodríguez-Pose (2004) 'From R&D to Innovation and Economic Growth' *Growth and Challenge* 35(4): 434-455.

Dynamising National Innovation Systems (2002) OECD.

Falk, M (2007) 'R&D spending in the high-tech sector and economic growth' *Research in Economics* 61: 140-147.

Global Innovation Index (2013) *The Local Dynamics of Innovation* WIPO.

Greenhalgh, C and M. Rogers (2010) *Innovation, Intellectual Property and Economic Growth* Princeton University Press.

Innovation and Growth, Chasing a Moving Frontier (2009) OECD and IBRD/World Bank.

Jones, C (1995) 'R&D-Based Models of Economic Growth' *Journal of Political Economy* 103(4).

Marinković, I and D. Elke (2014) *R&D and Innovation in Western Balkans, Moving Toward 2020* WBC-INCO.NET c/o ZSI – Centre for Social Innovation.

National Innovation Strategy of the Republic of Macedonia 2012-2020.

OECD (2013) *Main Science and Technology Indicators* Volume 2013/1, June.

Oslo Manual (2005) *Guidelines for collecting and interpreting innovation data* OECD, 3rd Ed.

Pessoa, A (2010) 'R&D and Economic Growth: How Strong is the Link?' *Economic Letters* 107: 152-154.

Snowdon, B and H. Vane (2005) *Modern Macroeconomics* Edward Elgar Publishing.

Sylwester, K (2001) 'R&D and Economic Growth' *Knowledge, Technology & Policy* 13(4): 71-84, Winter.

Švarc, J (2014a) 'Comparative Analysis of the Innovation Capacities in the WBC with Emphasis on Joint Cooperation Needs in the Field of Innovation' published in *R&D and Innovation in Western Balkans, Moving Toward 2020* WBC-INCO.NET c/o ZSI – Centre for Social Innovation.

Švarc, J (2014b) 'Is the Triple Helix model relevant for innovations in WBC?' published in *R&D and Innovation in Western Balkans, Moving Toward 2020* WBC-INCO.NET c/o ZSI – Centre for Social Innovation.

UNESCO (2010) *Measuring R&D: Challenges Faced by Developing Countries* UNESCO Institute for Statistics, Technical Paper No. 5.

World Bank (2013a) *Western Balkans Regional R&D Strategy for Innovation* World Bank Technical Assistance Project (P123211).

World Bank (2013b) *Western Balkans Regional R&D Strategy for Innovation* Country Paper Series Former Yugoslav Republic of Macedonia, World Bank Technical Assistance Project (P123211).