Theoretical and Applied Economics
Volume XX (2013), No. 5(582), pp. 15-26

Innovation: a path to competitiveness and economic growth. The case of CEE countries

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Abstract. *Innovation is often considered to be a typical activity of the developed countries. If we put behind the leading excellence research institutions and the high educated specialists we can tell that innovation is, in the end, the attempt to create new or improved products or processes.*

The aim of this study is to show the empirical evidence on the link between innovation and economic growth in the Central and Eastern European countries (CEE). Even if this part of Europe was highly affected by the economic crises, we consider that innovation can be the most important component of long-term economic growth. Our study considers a number of different proxies to measure innovation, such as R&D spending, patenting or the number of researchers as well as firms characteristics and mergers and acquisitions. Our findings are consistent with the existing literature that innovation makes significant contribution to national competitiveness and economic growth and the gap between the Western and Eastern economies can be reduced by investing in innovation.

Keywords: innovation; economic growth; competitiveness; CEE countries.

JEL Codes: O11, O30.
REL Codes: 8A, 8E, 16E.

1. Introduction

The current article aims to identify the right balance between resource allocation for developing innovation capacity and revenue generated by selling new products and services. Experience proved that new products and services on the market are those that generate the biggest revenue which encourages companies to invest in innovation. This explains the close relationship between the competitiveness and the need for innovation. Improving business model can be the formula that helps identify the equilibrium point. In some cases changing the business model can lead to a completely new one that succeeds to meet the needs of its customers, to conquer new market segments and thus to stand out from competitors. So, innovation is a key feature in the world from high developed economies to developing ones. Economic growth is directly influenced by companies' ability to innovate, and especially by the process result rather than its triggering.

The relationship between innovation and economic growth has been highlighted in numerous theoretical (Solow, 1956, pp. 65-94, Romer, 1986, pp. 1002-1037) and empirical studies (Mansfield, 1972, Nadir, 1993). A large part of these studies were conducted in developed economies (USA, Japan, Western Europe). This is because of the lack of data for developing economies or less developed, such as CEE states until 1989, but due to the political situation that put them in the category of countries with centrally planned economy. Once with the transition to the market economy, these countries have experienced large capital inflows from the developed countries.

In terms of innovation, for CEE countries, there were attempts to catch-up by importing capital and technology. However, the situation in CEE states differs from the one in developed countries and therefore the importance of innovation and technology must be adapted to the economy and culture of the concerned states.

Article includes in section II a summary of studies in this area, followed by an overview of the database and research methodology used in this study, section IV presents the achieved results, and the last part is devoted to conclusions.

2. Literature review

The literature review highlights how important is the innovation for competitiveness and the economic development. However, it is not easy to outline the direct link between innovation and firm sales. Difficulty of quantifying the effects of innovation occurs due to long time to convert

knowledge into economic value, substantial costs and uncertainty that characterize each stage of the innovation process (Coad, Rao, 2008, pp. 633-648).

Since 1939, Schumpeter identifies a link between innovation and economic cycles. The question arises how are they correlated? The two possible options are: reducing innovation activities in periods of recession, or otherwise, reverse evolving economic cycle - during periods of recession can be observed an innovation growth in firms (Filippetti and Achibugi, 2011, pp. 179-192). Firms can be influenced also by their strategy, by their development stage, by new technology rise on the market, but can we identify such a link in the case of countries? At the country level, this link is greatly influenced by the National Innovation System (NIS), which is composed of institutions and structures that influence the rate and direction of change process, such as the education system, research institutions, the financial system, the specialization of labor and the degree of industrialization (Filippetti, Achibugi, 2011, pp. 179-192). Although recession is characterized by a major decline in demand, which implies a low rate of success for an innovative product, NIS can be both a source of constraints or can generate opportunities for business innovation. Thus, it is unlikely that firms with access to public funding sources to interrupt investment in the innovation projects. This underlines the important role that NIS plays in stabilizing investments in innovation during recession periods (Paunovic, 2012, pp. 24-35). Countries less affected by economic shocks are those with a strong NIS, as the Western European countries, which had strong political cooperation and innovation at European level not only in good times but also in times of crisis. Technology has a natural development that occurs as a result of an experience and knowledge accumulation, and some jump points called radical evolution, or breakthrough, when it manage to change an old technology on the market. Another opinion about the optimal period is that an investment in the innovation process should be located at the zero moment, immediately before or after a revolutionary technological breakthrough, is (Hritonenkoand, Yatsenko, 2010, pp. 1064-1078).

More than 70% of companies in the Eastern Europe countries mentioned that the first impact of the crisis was a decline in demand for their products (Ramalho et al., 2009). In adverse economic situations, reducing investment is due to the low profit while in periods of economic expansion increases the chances of new products or technologies to appear on the market (Freeman et al., 1982). A different perspective is that a reduced income is both signal and stimulus for companies to introduce new products or processes regardless of the economic cycle (Filippetti, Achibugi, 2011, pp. 179-192).

The importance of innovation activities for companies varies according to their size, so it proved that the level of sales of medium firms are not as influenced by innovation while for the developed firms innovation activities are

more important on sales volume (Coad, Rao, 2008, pp. 633-648). Also, innovation contributes to the rapid development especially for small and relatively new ones on the market that are more active in product or process innovation than the long ones on the market (Mansfield, 1962, pp. 1023-1051, Cassia et al., 2009, pp. 211-220, Paunovic, 2012, pp. 24-35).

In Europe the percentage of firms that have increased their innovation expenses decreased significantly by approximately 30% during 2008-2009 period in comparison with 2006-2008. The most affected countries were those among the new members of the European Union, especially the countries from Central and Eastern Europe (Filippetti and Achibugi, 2011, pp. 179-192). During the crisis period 2008-2009, it was put more emphasis on process innovation than product innovation; this indicates that firms have focused on efficiency of the production process in order to deal with the global crisis (Paunovic, 2012, pp. 24-35). Private investments in innovation are cyclical and significantly lower during periods of economic recession (OECD, 2009).

Investments in innovation are different from other types of investments because they are characterized by a higher uncertainty rate of results, significant initial costs which cannot be easily recovered, often turns into knowledge of staff involved in research projects that can be lost with persons who hold them (Paunovic, 2012, pp. 24-35).

There were identified two methods of economic growth through innovation: technological competitiveness, which focuses on improving performance through new products and new markets access, and a second engine of growth generated by cost competitiveness based on innovation replacing human labour process and industrial technology, which presumes a more flexible and reduced costs production (Bogliacino, Pianta, 2011, pp. 41-53). Thinking that the CEE countries have a market economy with major investments during the recent years, national investment in innovation and the European funds had an effect on economic growth?

The neoclassical growth theory, as it was founded by Solow (1956, pp. 65-94) and Swan (1956, pp. 334-361), contains models that assume the existence of perfect competition, no externalities, constant returns to scale, positive and smooth elasticity of substitution between labour and capital (which can always be substituted) to produce the expected results. Given these assumptions, models predict an increase in productivity as amount of capital each worker brought in an economy. In these circumstances, additional investments can be an attractive option leading to economic development. Romer (1986, pp. 1002-1037) and Lucas (1988) have shown the need to introduce technology as endogenous factor affecting growth. From this perspective, endogenous growth theorists assume a macroeconomic growth as investments which lead to improvements in technology. Other studies show a

direct dependency relationship between innovation and economic growth (Jones, 1995, Howells, 2005, pp. 1220-1234). Most studies are based on the American economy and on the countries from Western Europe. Under these conditions the first hypothesis tested in this study is:

H1: Innovation has a direct and positive impact on economic growth in CEE.

Major changes have occurred in CEE in the period after 1989, once with the transition to a market economy, the shock was felt long after this time. Local investors, but also the foreign ones, felt the opportunity to invest in these economies, which became in time more and more efficient. The opportunity for some countries to join the European Union, but also the existence cohesion founded by the Maastricht treaty in 1992 and Amsterdam in 1996, led to the so-called economic and monetary union which raised the level of resources allocated for the development of these areas by introducing structural funds.

Rodríguez-Pose (1999, pp. 1002-1037) supports the existence of social factors in individual states or regions that affect their ability to assimilate and transform their own or foreign funds dedicated to innovation in a value-added economic activity. Considering this phenomenon, we take account of the developed model to quantify the effect of the economy on innovation and the fact that there are specific states differences that emphasize or may restrict this hypothesis.

The economic structure of the region may also have a significant effect on the assimilation process innovation (Rodríguez-Pose, 1999, pp. 1002-1037). A state where agriculture is the main activity is less likely to generate a large number of patents, these industry being characterized by a low degree of innovation. States based on technology sectors will report a large number of patents, innovation being an important factor in their economic development.

The literature shows the relationship between economic growth and innovation, the later being the driver. Few studies aimed at analyzing the dependence between the level of investment in research and development (R&D) (the economic development of a state) and the innovation level as the independent variable. Through this study we show that there is an inverse relationship between economic growth and how financial resources are allocated, which significantly influences innovation. Considering these elements, the second hypothesis will be:

H2: The state of the economy and the resources allocation affect innovation.

Next it will be presented the database particularities and some aspects regarding the research methodology.

3. Database and methodology

The aim of this paper is to show the existence of a circular dependency between the level of innovation and economic growth (and, implicitly, competitiveness). Analysis was performed in the countries of Central and Eastern Europe. This region was less analyzed, most studies being conducted in a state or a group of states from a developed region. A major concern was to find a complete database, for a long period of time so the findings can express the real economic situation. The main source was the database provided by the World Bank. We had the possibility that for the EU countries to take the database provided by the European Statistical Office, EUROSTAT, but because of the existence of CEE countries that are not part of the EU, especially for data consistency, the only source used was World Bank. For most countries the data provided for the last 20 years was complete. There were some exceptions, so we decided to exclude them from our study. These are: Albania, Bosnia Herzegovina, Kosovo and Montenegro. In addition we have included in the study the Republic of Moldova.

The study was conducted in 15 states (Estonia, Latvia, Lithuania, Poland, Germany, Czech Republic, Slovakia, Hungary, Romania, Moldova, Bulgaria, Croatia, Macedonia and Serbia), the data for each country covering the period 1996-2010. The year 2011 was not included in the analysis, because of the lack of data.

Investing in R&D can be seen as an effort by a state to create knowledge or to improve the existing one. R&D activities are considered the main driver of innovation and therefore required an analysis of how investments in R&D can affect innovation in CEE states. The variables analyzed in this study are presented in Table 1.

Table 1

The variables used in the models

Indicator	Explanation
GDPgrowth	GDP growth from year to year for each of the CEE states
Education	The percent of education expenditure in GDP for each of CEE states
Research	The percent of research and development expenditure in GDP for each of CEE states
FDIongdp	The percent of Foreign Direct Investments in GDP F for each of CEE states
Unemployment	Unemployment for each CEE state
HDI	Human Development Index
GDPhab	The GDP per capita for each of the CEE state ($)
Researchers	Number of researchers to 1,000,000 people
Patents	Number of patents for each of CEE states

To highlight the relation between economic growth and innovation we have conducted two models, where the dependent variable is first the number of patents and second the economic growth. The others variables were included in the analysis as independent variables.

GDP growth is the real growth rate of Gross Domestic Product from year to year. This is a good proxy for a state's economy at a given time. The amount of GDP per capita is a proxy for amount of financial resources of a state, and in many studies is seen as a proxy to quantify country's knowledge stock. Moreover, Stern, Porter and Furman (2000) say that GDP per capita is an estimate of the size of the technological development of a country. The same attribute can be agreed for the human development index. GDP per capita is a proxy for national competitiveness, as well.

The number of patent represents the number of applications registered by the national patent office for exclusive rights for an invention – a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years.

The size of R&D expenditure as a percentage of GDP is a proxy for the intensity of the R&D. A higher value of this indicator shows greater concern to state regarding the technological development. This indicator, in both cases should be significant and positive, as it is "an engine" of economic and innovation growth. Another indicator used in studies to quantify the degree of development and innovation of a state is the education expenditure. From the theoretical perspective, a higher level indicates that a larger capacity exists to transform R&D activities in innovation. Expectations are reserved for this indicator, because it is well known that CEE states, with some exceptions (Germany, Czech Republic, Poland) do not focus on this, education is often regarded not a priority in developing economies.

Unemployment is considered a control variable in this model, assumed to be significantly and inversely correlated with both economic growth and innovation. The level of the foreign direct investment in GDP is a proxy for the interest of foreign investors of a state. A high value indicates a stable economy that can provide a favourable business environment. We assume that this indicator is also significantly and directly correlated with the two dependent variables.

The number of researchers can be another proxy for the level of innovation, along with the number of patents. The number of persons employed working in research is considered to be the absolute number to 1,000,000 people.

The descriptive statistics of these variables for all the CEE countries for the period 1996-2010 can be founded in Table 2. The values are between the normal limits, highs were recorded mainly in Germany and lows in Moldova.

This table shows the descriptive statistics of the variables used in the models which show the relationship between economic growth and innovation. Statistics were performed on a sample of 15 countries of CEE over the period 1996-2010. Explicit description of each variable is presented in Section 3.

Table 2

Variables descriptive statistics

	Mean	Median	Standard deviation	Max	Min
GDPgrowth ()	3.31	4.17	4.58	12.23	-17.95
Unemployment ()	12.35	10.00	7.28	37.30	3.90
Education (GDP)	4.79	4.64	1.09	9.90	2.40
R&D (GDP)	0.85	0.67	0.56	2.82	0.17
FDI (GDP)	5.21	3.99	6.33	52.05	-29.23
HDI	0.750	0.749	0.072	0.903	0.559
Researchers (/1.000.000)	1661.97	1499.61	799.04	3807.09	471.61
Patents	3655.55	297.00	11858.10	51736.00	12.00
GDP/hab ($)	8642.32	5577.96	8253.50	44132.04	321.03

According to this database to achieve the proposed models we used panel data regression models. The analysis show the situation in all countries in CEE, so a pooled regression model was considered and then we tested whether specific effects are found in each country that can influence the results. We managed this by using a panel regression with fixed effects variable both within among cross section and time series. Models were restricted to present the results of all situations with only cross-section fixed effects or period fixed effects, but also where it meets both the cross-section and period fixed effects. In all these cases the results were the same as in the initial regression. This was expected because the economies of these states had the same evolution in the analyzed period, a recovery period until 1999, then a sharp growth till 2008 and a period of decline from 2009, the economic crisis that affected the global economy.

Also we tested for random effects with both cross-section and period data. To see if these models are valid Hausmann test was used, but the result for p-value statistics for most regressions tested was below 10%, which makes the models more inconclusive. Finally, we used the simple pooled time regression especially since our interest was to show the relationship between economic growth and innovation in the CEE countries and the specific effects of this relationship at the country level can be a research question of our further studies.

In the analysis we used logarithmic specifications for variable that were not determined as percent of GDP of in index form. These was useful in order to reduce the data size and for an easier analysis. Our aim was to find the

correlations between them and not the size of their coefficients. The regressions have the following form:

$$L\_PATENTS = C(1) + C(2)\times L\_GDPHAB + C(3)\times EDUCATION + C(4)\times FDIONGDP + C(5)\times UNEMPLOY + C(6)\times RESEARCH + C(7)\times HDI + \varepsilon$$

$$GDPGROWTH = C(1) + C(2)\times L\_PATENTS + C(3)\times HDI + C(4)\times FDIONGDP + C(5)\times EDUCATION + C(6)\times RESEARCH + C(7)\times UNEMPLOY + \varepsilon$$

We have tested for identifying multi-colliniarity. The correlation matrix for the model variables is presented in Table 3. We did not consider in the same regression the variables correlated at a higher level than 0.3

Table 3

The correlation matrix

	GDPgrowth	Unemploy	Education	Research	FDIongdp	HDI	Resear-chers	Patents	GDP/hab
GDPgrowth	1.00								
Unemploy	-0.05	1.00							
Education	-0.01	-0.19	1.00						
Research	-0.18	-0.38	0.04	1.00					
FDIongdp	0.13	-0.09	-0.02	-0.15	1.00				
HDI	-0.07	-0.39	-0.10	0.66	-0.01	1.00			
Researchers	-0.08	-0.42	0.10	0.77	-0.11	0.79	1.00		
Patents	-0.12	-0.14	-0.04	0.78	-0.14	0.41	0.54	1.00	
GDP/Hab	-0.15	-0.33	0.01	0.86	-0.11	0.80	0.82	0.74	1.00

4. Results

To test the hypotheses outlined in section two we used the models presented in the methodology section. In support with our hypothesis is Table 4 which presents the regression results performed in the CEE countries during 1996-2010. Given that the number of researchers is strictly correlated to the number of patents we had not considered appropriate to test this variable also.

As we suggested, a state economic development (proxy: GDP/capita) is a determinant for the degree of innovation of a country (proxy: the number of patents registered). We found a positive correlation so, as the state has a stronger economy, it will invest more in research. R&D intensity, as the percent of the R&D activities funds in GDP, resulted to be significantly and positively correlated, so a greater allocation of funds in this direction will bring an increase in CEE countries innovation. The same result is reflected by the human development index. These results are conclusive with the literature (Freeman et al., 1982, Coad, Rao, 2008, pp. 633-648).

Model 1. Dependent variable: The number of patents registered

Model 1 is a pooled data regression between the degree of innovation and its determinants in the CEE countries. The regression uses 225 observations for 15 countries in 15 years. We did not consider in the same regression the variables correlated at a higher level than 0.3. The symbols *, **, *** represent significance levels of 10%, 5% and 1%.

Table 4

The estimation of the dependent variables

	(1)	(2)	(3)	(4)
Variable				
C	1.32	9.00***	0.22	5.51***
	(1.24)	(16.01)	(0.17)	(13.23)
L_GDPHAB	0.66***			
	(6.19)			
EDUCATION	-19.61**	-34.82***	-17.01*	-26.87***
	(-2.00)	(-3.51)	(-1.72)	(-3.38)
FDIONGDP	-3.25*	-4.75***	-3.41**	-0.91
	(-1.94)	(-2.71)	(-2.03)	(-0.65)
UNEMPLOY		-9.50***		
		(-6.40)		
RESEARCH				204.17
				(13.15)
HDI			8.23***	
			(6.04)	
R-squared	17.87%	18.69%	17.28%	45.93%
Adjusted R-squared	16.76%	17.59%	16.16%	45.19%

Unemployment has a negative correlation with the level of innovation, an increase in this rate means a decrease of the number of potential employees of the R&D sector and this implies a decrease in the number of patents applications. A surprising result is recorded by the education expenses. It is significant but negatively correlated with innovation. In most CEE countries, as in the case of Romania, the research is not always seen as a component of education and therefore a higher resource allocation in education will lead to a decrease in research funding. Foreign funds negatively affect the level of innovation, because often foreign investors are uninterested in CEE countries research, focusing on production with the existing technologies mostly imported from the Western Europe.

Model 2. Dependent variable: The economic growth

Model 2 is a pooled data regression between the economic growth and its determinants in the CEE countries. The regression uses 225 observations for 15 countries in 15 years. We did not consider in the same regression the variables correlated at a higher level than 0.3. The symbols *, **, *** represent significance levels of 10%, 5% and 1%.

	(1)	(2)	(3)
Variable			
C	0.08***	0.09**	0.05***
	(3.55)	(2.12)	(3.30)
L_PATENTS	-0.05***		
	(-2.85)		
EDUCATION	-0.25	-0.14	-0.09
	(-0.87)	(-1.41)	(-0.34)
FDIONGDP	0.06	0.09**	0.06
	(1.43)	(1.86)	(1.34)
UNEMPLOY	-0.07*		-0.08*
	(-1.66)		(-1.75)
RESEARCH			-1.78**
			(-3.02)
HDI		-0.06	
		(-1.41)	
R-squared	6.34%	2.87%	12.34%
Adjusted R-squared	5.89%	2.56%	11.56%

In this case we presented the innovation related determinants of economic growth. The fact is that the human development index and level of education resources are not significant with the economic growth. R&D spending level and the number of patents are significant but have a negative coefficient. This suggests the existence of a catch-up process, which is typical for the neoclassical growth theory. The CEE countries, with the exception of Germany, have a relatively low number of patents given to the high economic growth. Many innovations were imported from more developed countries and so the interest of domestic research was reduced. The average annual increase in the number of patents in these countries was approximately 2%, showing that they are able to increase their innovation potential for further economic growth.

5. Conclusions

Development level of a country is the engine of innovation, allocating funds to research and development is the main source of support offered in this respect. Welfare, seen with the help of the human development index, has a key role in enhancing the innovation in a country. Regarding innovation factors that influence growth, they fail to make a significant contribution in the case of the ECE countries. These countries had a rapid economic growth, but a growth not based on the innovation process. Innovation is in a catch-up process, related to the growth rate.

Acknowledgements

This work was cofinaced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/107/1.5/S/77213„ Ph.D. for a career in interdisciplinary economic research at the European standards".

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