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Economic Research-Ekonomska Istraživanja

ISSN: 1331-677X (Print) 1848-9664 (Online) Journal homepage: http://www.tandfonline.com/loi/rero20

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To cite this article: Marek Tomaszewski & Arkadiusz Świadek (2017) The impact of the economic conditions on the innovation activity of the companies from selected Balkan states, Economic Research-Ekonomska Istraživanja, 30:1, 1896-1913, DOI: 10.1080/1331677X.2017.1398099

To link to this article: https://doi.org/10.1080/1331677X.2017.1398099

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Published online: 15 Nov 2017.

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ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA, 2017
VOL. 30, NO. 1, 1896–1913
https://doi.org/10.1080/1331677X.2017.1398099

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The impact of the economic conditions on the innovation activity of the companies from selected Balkan states

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ABSTRACT

The literature review reveals diverging views on the influence of economic cycles on the innovation activity of companies. This article is a voice in this discussion. It provides, empirically verified arguments, allowing one to support or reject the accepted research hypotheses. These assume that: (1) The expectations with respect to income dynamics play a more important role in stimulating innovation activity than the dynamics of (actual) income levels; and (2) Different economic structures and levels of technological development in the chosen Balkan states, despite the geographic proximity of these states and similarity in economic situation, influence the geographic differentiation in terms of the innovation activity. The obtained research results show a greater differentiation in terms of actions of companies than previously thought. It has been confirmed that when the companies sense an improvement in economic situation, their innovation activity increases, this is, however, accompanied by a noticeable anticipatory element. It turned out that the expectations regarding an improvement in economic conditions have an additional stimulating effect on such an activity, whereas the recession itself, as well as the expectations in that respect, have a de-stimulating effect. It turned out that the expectations with regard to the future economic situation are the most important here, a factor that has been neglected so far.

ARTICLE HISTORY
Received 13 November 2015
Accepted 8 May 2017

KEYWORDS
Economic conditions; innovation; Balkan countries

JEL CODES
O31; P51; E61; O38

1. Introduction

Economic situation is an important factor that often influences a decision on whether an innovative activity should be undertaken by a company, both in developed and developing countries. This has been painfully experienced by a majority of European companies after the 2008 financial crisis. In the aftermath, the levels of innovative activity decreased in many companies, which led to the search for new strategies for coping with similar critical situations in the future.

We observe a consistent, yet prolonged, process of coming out of the economic crisis as indicated by the levels of various economic measures observed in the EU member states.

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This does not mean, however, that the economic slow-down we are experiencing now will end quickly. Economic entities in this phase of the cycle are under pressure from the fiscal environment and hence often attempt to reduce costs in the short run without fully taking into account all the factors responsible for the long-term competitive edge understood as innovative strategy. In the short-term perspective, the lack of financing for such an activity, or its reduction, can result in stretched or smaller budgets on creating and implementing new technologies, which eventually leads to delays in terms of developing new products and processes, lowering their quality or even terminating certain innovative projects.

The 2008 financial crisis also meant that more attention was paid to the determinants of recession (Parker, 2011). It seems that the problem relating to the causes of changes in economic situation and their influence on innovation activity as a source of future growth still remains open (Altuntas, Dereli, & Kusiak, 2016, pp. 58–68). It should be said that although the impact of innovation on economy seems undisputed, the problem of how exactly innovations influence economic situation (and vice versa) still lacks a more detailed study (Filippetti & Archibugi, 2011; Sharif, 2012).

2. Literature review

The problem of the impact of the economic situation on the innovative activity of companies, although not new, is still a subject of an ongoing debate (Archibugi, Filippetti, & Frenz, 2013; Dominiak & Churski, 2012; D'Estea, Iammarinob, Savonac, & von Tunzelmann, 2012; Etzkowitz & Leydesdorff, 2000). It should also be noted that the dominating approach to this problem has changed over time, undergoing a radical re-evaluation. According to Schumpeter, investments in new technologies should be treated as countercyclic measures used by the companies in the market, as during recession these serve to improve the revenues of companies. By the same token, applying his 'creative destruction' theory generates an imperative for further search in to solutions aiding moving out of recession (Lundström & Stevenson, 2005, pp. 41–116; Audretsch, 2007, pp. 63–78). Mensch's hypothesis on increasing the rate of innovation, dating from 1975, went essentially in the same direction and assumed that innovations, especially the radical ones, are more frequently implemented during recession as they may give new chances to companies trying to survive on the shrinking market (Clark, Freeman, & Soete, 1981).

The proponents of stimulating the innovative activity of companies during recession also say that recession contributes to the re-organisation of the company and an increase in the quality of the implemented innovative activity. Such an approach can be exemplified by the research and development (R&D) sector, which during the times of crisis undergoes a natural process of labour hoarding. This term describes a situation, where the most qualified workers are 'saved' in the company at the expense of the less-qualified employees (Soete, 2009). This generates new potential chances for company's development. On the other hand, the lost benefits related to the limited demand on the work of the factory-line employees should be, during recession times, a cause for companies to seek new investments in technologies (Stiglitz, 1993; Canton & Uhlig, 1999). This relates to a well-known rule that the chances for bankruptcy for companies that do not re-organise increase during recession (Aghion & Saint-Paul, 1998).

Drucker (1992) presented a contrasting view on this topic. He believed that small- and medium-sized enterprises (SMEs) become more active in terms of innovation during economic recovery. This is related to the fact that the management do not treat such activity in

any different way to other functions performed by the company (Deleersnyder, Dekimpe, Steenkamp, & Leeflang, 2009; Srinivasan, Lilien, & Sridhar, 2011). This means that such an activity should be of a procyclic character (Lamey, Deleersnyder, Steenkamp, & Dekimpe, 2012, p. 6; Axarloglou, 2003; Świadek, 2015, pp. 75–92). On the other hand, however, the price level can be considered as being of a countercyclic character (Chevalier & Scharfstein, 1996).

Sorescu and Spanjol (2008) provided an interesting contribution to the debate. These authors pointed to the fact that during recovery and recession, different forms of innovative activity are being implemented. In their research, they focused on incremental (improving) innovations and radical (pioneering) ones. The former extends the functionality of the existing products, are understandable and easily absorbed but do not offer any essential changes in comparison to the existing products. Their implementation during recession should bring immediate benefits for the company (Gielens & Steenkamp, 2007), but it does not translate into any long-lasting advantages during recovery time. These are more frequently used in companies that seek competitive advantage in terms of costs rather than new products (Bogliacino & Pianta, 2010), hence are closer to decisions of countercyclic character, especially during crisis. The radical innovations on the other hand, contrary to the incremental ones, offer essential changes and advanced technologies in comparison to the existing products. These often are a truly new quality for the customer or create a possibility of satisfying new needs. Radical innovations often involve new technologies, this increases the usefulness of such solutions and how they are applied (Sorescu & Spanjol, 2008). It has to be said however, that the effects of introducing such innovations take time. The implementation is often related to a change in perception, understanding and acceptance of the new solutions by the customers (a behavioural factor). For this reason, their implementation does not generate strong effects over a short period and, consequently, does not contribute to rapid improvements of the financial outcome for a company during recession. This means that radical innovations are often introduced during recovery time, which was confirmed by Lamey's research (2012). He showed that implementing this type of innovation is an effect of decisions made by management, who are anticipating more positive economic conditions (Shleiffer, 1986; Francois & Lloyd-Ellis, 2003). During recession, management often limit themselves to solely implementing incremental innovations (Lamey et al., 2012, p. 16).

Archibugi et al. (2013) also dealt with the problems caused by the impact of economic situation on innovative activity. They showed that during times of prosperity, companies characterised by high intensity development and accumulation of technologies that are involved in above-average innovative activity. It should be noted that the age and size of the entities were less important. During the initial stage of a crisis, large companies opted out of innovative projects, whereas the small ones did not. During recovery, it is the newly created small companies that turn out to be the most innovative, confirming the dominating role of creative destruction. They also showed that the expenditure on internal R&D is increased during prosperity, and become limited during recession times. When the economic situation begins to improve again, R&D expenditure increases once more. The situation is different in case of outsourced R&D services as these do not return so quickly to pre-crisis levels. Independently of economic phase, companies constantly get involved in innovative collaboration with other entities (Archibugi et al., 2013). In this regard, there has been no direct relationship observed between being innovative and economic situation.

This can indicate that there is a third way for defining the dependency between innovation and economic cycle (neither procyclic nor countercyclic), with theoretic considerations focusing on understanding the lack of such co-dependencies formed as a result of a more collaborative and strategic approach. This allows for companies to engage in innovative processes independent of current and future economic situation.

Brown and his research group (2009) analysed the insensitivity of relations between R&D, the current phase of economic cycle and the age of the company. It turned out that in more mature entities, representing traditional sectors of economy, raising the spending on R&D during prosperity is less noticeable than for young companies from hi-tech sectors. This is a result of a constant deficit, in terms of money transfers relating to the needs of young companies, with the older ones usually operating with a surplus. This allows older companies to behave a more stable fashion. In addition, during recovery the money-lending institutions are more willing to accept higher levels of risk, resulting in a higher number of hi-tech investment projects receiving external funding (Lerner, 2002, p. 31).

Madrid-Guijarro, García-Pérez-de-Lema, and Van Auken (2013) analysed the relation between recovery and innovative activity in Spain. The research results were as follows: (1) levels of innovativeness among SMEs decreases during economic crisis; (2) the types of innovations implemented in Spanish SMEs change depending on economic situation; and (3) innovativeness positively influences the outcome of company's activity both during recovery and recession. He emphasised that the innovative strategies of SMEs realised during recovery and recession significantly influence the functioning of a company in terms of effectiveness, and this should be taken into account during planning and implementation of national-level innovative policies.

The above considerations on the impact of economic situation on the innovative activity of companies, have not taken into account the different levels of maturity of the economic systems in question. The research, for the most part, has been conducted in relation to innovation-leader or innovation-follower states. Only the research of Madrid-Guijarro dealt with a moderate-innovator state.

It should also be emphasised that the research described here involved an *ex post* evaluation. The research described how the innovative activity of companies changed in relation to the changes in economic situation. There is a noticeable lack of research involving *ex ante* evaluation, which focuses on the impact of expectations related to the predicted changes in economic situation on the innovative activity of companies. This research approach can be especially helpful for the analysis of hi-tech companies, the activity of which is characterised by high vulnerability to changes in economic situation (Cornell & Shapiro, 1988).

In this context, the fundamental research aim was to identify the directions as well as the size of the impact of the economic situation and the expectations with respect to the way it will develop on the innovation activity of companies in the chosen group of Balkan countries. This, in turn, would allow one to determine the boundary conditions for the national innovation networks and their model structure that would take into account the specific character of the chosen group of countries.

With the main research aim in mind, three main research hypotheses have been formulated:

Hypothesis 1: *The expectations regarding the dynamics of income play a more important role in stimulating innovation activity than the actual dynamics of income;*

Hypothesis 2: *Different economic structures and varied levels of technological advances observed in the chosen Balkan states, despite the geographic proximity of these states and their similar economic conditions, influence the geographic differentiation in terms of innovation activity.*

Hypothesis 3: *The chances of particular attributes of innovation activity occurring grow proportionally to the size of the company.*

3. Methodology

The performed analysis is of static character and concerns the period between 2011–2013, in accordance with the methodological standards described in the Oslo Manual (OECD, 2005). In order to evaluate the research hypotheses, the following have been chosen as independent basic variables: the dynamics of actual income levels (increase, decrease, stabilisation) and expectations with regards to future dynamics of income levels (increase, decrease, stabilisation). Whereas, the following have been chosen as independent control variables: the size of entity (micro, small, medium, large), the type of ownership (domestic, non-domestic, mixed) and location (Albania, Croatia, Montenegro, Slovenia and Serbia). In case of the obtained income levels, their dynamics has been determined by comparing values from the 2011 year to the 2013 year. On this basis, it has been determined whether a given entity experienced an increase, decrease or stabilisation in terms of income levels.

The dependent variables have been defined as the occurrence within in a company of investment activity in terms of finances, product and process innovations and the R&D activity.

This article uses the method of logit modelling, which provides useful information in terms of odds ratio describing the strength of the relation or lack of relation between two variables. Given that there is a large number of publications dealing with the method of logit modelling (Maddala, 1983), this article is not describing it in detail. It should be noted, however, that the logit models, obtained in the context of the described problems, determine the odds ratios for a given attribute of innovation activity to be present with a specific independent variable value.

The case of an odds ratio greater than 1 indicates that given this independent variable, the odds of this attribute of innovative activity are greater than in the case of all other independent variables together. Whereas, when the odds ratio is less than 1, it means that given this independent variable, the odds of this attribute of innovative activity are lower than in the case of all other independent variables together. The difference between the obtained odds ratio and 1 indicates the level of influence of the given independent variable.

For the chosen four dependent variables, 20 multivariable models were calculated in total. Each taking into account 18 potential independent variables. Tables 3–6 contain only the statistically significant variables. In the remainder of this article only these findings have been presented and described in detail.

It should also be noted that the goal was not to use all the independent variables and their interactions in the created models. The authors made use of the variable selection schemas enabling the elimination of non-essential predictors from a model, and were interested in a model containing only the variables that increase the accuracy of predictions of the dependent variable's value in comparison to the reduced (zero) model. The method of

progressive selection was chosen, where in each new step a new variable is introduced to the model, provided that this new variable causes a significant increase in the odds ratio.

4. Description of the research sample

The empirical data, on the basis of which the calculations have been made and the obtained results interpreted, come from the fifth round of the Business Environment and Enterprise Performance Survey (BEEPS), conducted in the 2013–2014 period for the European Bank for Reconstruction and Development (EBRD) and World Bank. The survey is based on empirical data coming from 15,883 companies from 30 states in Central and Eastern Europe and Asia. With the exception of Turkey, all the analysed countries were once centralised socialist economies, which, given their level of innovative activity can be classified as either *innovation followers, moderate innovators* or *modest innovators*. The entities were chosen using the stratified random sampling method, with the strata defined depending on region, sector and the size of the company. (A more detailed information on the choice of the companies for the research can be found at http://www.enterprisesurveys.org/Methodology/.)

Three different questionnaires were used in the data collection process. The basic questionnaire contained questions characterising all the analysed entities; the second one contained questions aimed specifically at the production companies, whereas the third contained questions tailored for the services companies. The questions in questionnaires two and three were related to the production and services activity, respectively.

In total, 1244 entities were analysed from the chosen group of countries. Their structure divided into specific countries is presented in Table 1.

The analysis included retail, services and industrial companies employing at least five full-time workers. All types of public services, including army, police, health services and education, were excluded. The analysed entities belonged to the following sectors, in accordance to ISIC Rev 3.1:

- D – manufacturing,
- F – construction,
- G and H – services,
- I – transport, storage and communications.

The analysis did not cover the companies from the sectors J and K (financial intermediation and real estate, including renting and business activity) with the exception of subsector 72 dealing with computers and related activities. Moreover, the entities engaged in agricultural or mining activities were also excluded.

The innovation activity of the chosen entities is described in Table 2.

Table 1. The geographical characteristics of the analysed companies.

Country	Amount of the studied enterprises	Structure [in%]
Albania	283	22.7
Croatia	315	25.3
Montenegro	101	8.1
Serbia	315	25.3
Slovenia	230	18.6
Total	1244	100

Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

Table 2. The ratio of companies engaged in innovation activity in relation to all analysed entities (in %).

Innovative feature	The share of innovation active enterprises					
	Albania	Croatia	Montenegro	Serbia	Slovenia	Mean share
R&D expenditure	1.4	23.5	10.9	15.6	23.5	15.0
Total investment	21.9	68.7	35.6	50.5	61.6	47.7
Technical equipment and machinery investment	18.4	64.3	30.7	43.2	57.8	42.9
Innovation overall	12.7	35.7	12.9	34.9	40.3	27.3
Product innovation	8.1	17.4	6.9	20.6	26.3	15.96
Production process innovation	6.0	11.7	6.9	19.7	31.1	15.1
Marketing innovation	7.8	26.1	12.9	30.2	35.6	22.5
Logistic innovation	2.5	7.4	1.0	12.4	18.1	8.3
Quality innovation	24.4	29.1	12.9	34.9	27.9	25.8
Organisational innovation	6.0	22.6	9.9	21.0	34.0	18.7
Workers innovation	17.7	45.7	16.8	29.8	51.4	32.3
Mean share	11.5	32.0	14.3	28.4	37.1	x

Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

On the basis of the analysis performed, it can be said that the entities from Slovenia were characterised by the highest, whereas the entities from Albania with the lowest, innovation activity level. For the entities from Slovenia, all the values related to the indicators of innovation activity were higher than the average for the analysed countries. In case of Croatian entities, the indicator value related to innovation activity were lower than the average in terms of process innovations and logistics and support systems innovations. The values related to the indicators of innovation activity of employees in Serbian entities, in turn, were lower than the average.

The values of all the analysed indicators of innovative activity in the companies from Albania and Montenegro were lower than the averages for all the analysed countries taken together.

Despite close proximity, the economic conditions in the analysed countries are markedly different (Kaynak, Altuntas, & Dereli, 2017). Of the analysed countries, only Slovenia and Montenegro are those accepting the euro as a legal currency. Whereas, only Slovenia and Croatia are members of the EU. Taking GDP as a measure of economic development, Slovenia that can be described as the most developed country, with GDP per capita in 2014 at the level of $24,019. The GDP per capita of the other countries was as follows: Croatia $13,494, Montenegro $7149, Serbia $6123 and Albania $4781 (www.imf.org; EC, 2013).

5.1. The impact of the economic situation on financing innovations in the Balkan states

It is the financial aspect that is tackled first in terms of the analysis of the impact of economic situation on innovation activity of the chosen Balkan countries. The obtained multivariable model describing the impact of the chosen independent variables on the decision to finance the innovation activity by a given company is represented by the following formula[1]:

$$\hat{y}_{1i} = \underset{(0.21)}{1.03} + \underset{(-2.78)}{0.70}x_{1i} + \underset{(6.07)}{2.19}x_{5i} + \underset{(3.09)}{1.48}x_{8i} + \underset{(2.26)}{1.87}x_{13i} + \underset{(-9.68)}{0.17}x_{14i} + \underset{(-5.04)}{0.30}x_{15i} + \underset{(-5.96)}{0.40}x_{17i} \quad (1)$$

The multivariable models describing the impact of the chosen independent variables on the financing by the companies of innovation activity split into size categories, are shown in Table 3.

By comparing the impact of the particular independent variables on the financing of innovation activity, one can group them, taking into account the consequences they entail. The variables that have a stimulating effect on the financing of innovation activity in the analysed entities include non-domestic ownership and the increase in income or an expectation that this will take place in the near future. In turn, the variables with a de-stimulating effect on the financing of innovation activity include variables related to the location of the entities in Albania, Montenegro and Serbia, as well as the case of micro-companies.

When analysing the specific odds ratios describing the expectations related to the increase in income levels in the near future, the odds of innovative activity being financed by an entity are from 50% to almost 150% lower than the odds of innovative activity being financed in entities where in the previous three years there has been an increase in income levels. This means that the expectations regarding higher income levels in the future have a stimulating effect, but it is not as noticeable as value related to the already achieved income levels. This contradicts the assumptions relating to the investment demand as described in Keynes model (Begg, Fischer, & Dornbusch, 2005). Such results are also markedly different to the analogous results obtained, e.g., for the Visegrád Group countries (Świadek & Tomaszewski, 2015).

Analysing the odds ratios obtained for the independent variable describing the actual income levels in the entities, in terms of different sizes of the entities, it should be noted that it is the SMEs (with the emphasis on the medium-sized) that are characterised by the highest odds in terms of financing innovation activity. In this respect, the results are consistent with the results obtained for the Visegrád countries, where the odds of financing innovation activity were proportional to the size of the company (Dzikowski & Tomaszewski, 2013; Świadek, 2014).

Table 3. The impact of the selected factors on financing innovation activity in the Balkan countries – multivariable logit models (in odds ratio).

		Size of enterprise			
Independence variable	Total (y_{1i})	micro	small	medium	large
Micro enterprises (x_{1i})	0.70***	x	x	x	x
Revenue – growing (x_{5i})	2.19***	1.99***	2.41***	2.73***	
Revenue – decreasing (x_{7i})					0.28*
Expectation of revenue growing (x_{8i})	1.48***	1.66***			
Foreign enterprises (x_{13i})	1.87***				
Localisation in Albania (x_{14i})	0.17***	0.17***	0.45**	0.19***	
Localisation in Montenegro (x_{15i})	0.30***	0.28***			0.07**
Localisation in Serbia (x_{17i})	0.40***	0.47***		0.38**	0.08***
Localisation in Slovenia (x_{18i})			3.02***		
Localisation in Croatia (x_{15i})			1.85*		
Constant	1.03	0.71**	0.45***	1.14	8.48***
Sample size	1244	719	298	180	47
Chi square	215.42	108.02	48.97	23.94	15.22
p-value	0.00	0.00	0.00	0.00	0.00

***Significance up to 1%.
**Significance from 1% to 5%.
*Significance from 5% to 10%.
p value – the significance level of the entire model.
Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

The stimulating effect of the independent variable 'increase in income levels' on the financing of innovation activity suggests that the entities engage in such an activity in the period of recovery, as described by Barrett, Musso, and Padhi (2009), for example. Whereas, during recession (lowering of income levels) the analysed entities limit their financing of innovation activity, which is especially visible in the case of large companies. This contradicts the conclusion of Schumpeter and Mensch, where it is stated that during recession, the companies must stimulate their innovation activity even more than during recovery in order to stop the negative downward cycle, thus creating a new wave of economic growth. The results obtained for the large companies from the Visegrád countries obtained by the authors of this article are different (Świadek & Tomaszewski, 2015).

Among the factors de-stimulating the financing by companies of innovation activity, are the factors related to the location of companies that are the most important. A clear negative impact on the analysed dependent variable can be noted in the case regarding location of companies in Albania, Montenegro and Serbia. The odds ratios for the small companies from Slovenia and Croatia stand out in that respect. In both cases, the odds of financing by the small companies of innovation activity are almost two or even three times greater than in the case of small companies from Albania, Montenegro and even Serbia.

5.2. The impact of the economic situation on product innovations in companies from the Balkan countries

The next model shows the impact of the chosen independent variables on product innovations in the companies from the selected Balkan countries.

$$\hat{y}_{2i} = \underset{(-11.34)}{0.10} + \underset{(2.59)}{1.67}x_{3i} + \underset{(-1.98)}{0.72}x_{7i} + \underset{(-2.19)}{0.68}x_{9i} + \underset{(6.20)}{4.20}x_{18i} + \underset{(4.49)}{2.89}x_{17i} + \underset{(3.22)}{2.32}x_{15i} + 0.40x_{17i} \quad (2)$$

Table 4 shows multivariable models describing the impact of the chosen independent variables on product innovations in the companies (split into size categories).

Analysing the dependencies between the economic situation and product innovations, it should be noted that none of the models contain the variable describing the increase in income levels. A similar situation was observed in the models calculated for the Visegrád countries (Świadek & Tomaszewski, 2015). Whereas, a positive dependency between the expectations that the income levels increase and the occurrence of product innovations has been observed, but only in the medium-sized entities.

Whereas, the variables related to the decrease in income levels and expectations that the levels will not change, have had a clearly de-stimulating effect on product innovations. In the case of lowering of income levels, the odds of product innovations are 28%, and in micro-enterprises 46%, lower than the same odds in the case of companies that reported income increase or had their income levels stay at the same level. In turn, in the entities that expect their income levels to remain the same (this is especially the case of micro-enterprises), the odds of product innovations are 32% and 46% lower than in the case of entities that expect their income levels to change.

In the context of economic situation, the stronger impact on product innovations was observed in case of the location of the entities. Location in Croatia, Serbia and Slovenia had a stimulating effect on product innovations, whereas location in Albania and Montenegro

Table 4. The impact of the selected factors on product innovations in the Balkan countries – multivariable logit models (in odds ratio).

		Size of enterprise	
Independence variable	Total (y_{2i})	micro	medium
Medium enterprises (x_3)	1.67***	x	x
Revenue – decreasing (x_7)	0.72**	0.68*	
Expectation of revenue growing (x_8)			2.41**
Expectation of revenue stabilisation (x_9)	0.68**	0.54**	
Localisation in Albania (x_{14})		0.19***	
Localisation in Slovenia (x_{18})	4.20***	1.63**	4.15***
Localisation in Serbia (x_{17})	2.89***		
Localisation in Montenegro (x_{16})		0.14***	
Localisation in Croatia (x_{15})	2.32***		2.61**
Constant	0.10***	0.45***	0.10***
Sample Size	1244	719	180
Chi square	62.29	54.63	18.10
p-value	0.00	0.00	0.00

***Significance up to 1%.
**Significance from 1% to 5%.
*Significance from 5% to 10%.
Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

had a de-stimulating one. The observed patterns exist both in the companies in general as well as in the case of micro- and medium-sized enterprises.

Comparing the results presented in Table 4 with the results of similar analyses conducted in the case of entities from East European countries, a positive relation between the companies being medium-sized and an occurrence of product innovations can be confirmed. The odds of product innovations in the described group are 67% higher than the odds of product innovations in the companies that do not belong to this size group.

Analysing the absolute term of the model, it should be noted that all the factors that did not reach the level of individual statistical significance combined, limit the chances of product innovations occurring by as much as 90%.

5.3. The impact of the economic situation on process innovations in companies from the Balkan countries

The following model describes the impact of the chosen variables on process innovations:

$$\hat{y}_{3i} = \underset{(-13.24)}{0.05} + \underset{(2.86)}{1.79x_{3i}} + \underset{(3,50)}{1.74x_{8i}} + \underset{(7.70)}{6.62x_{18i}} + \underset{(4.75)}{3.37x_{17i}} + \underset{(1.96)}{1.79x_{15i}} \tag{3}$$

The multivariable logit models with the dependent variable being process innovations are presented in Table 5 (companies split into size categories).

Comparing the odds ratios related to the occurrences of process innovations determined for the accepted independent variables, once again one sees that the thesis that advantageous location has a more pronounced influence on innovation activity in comparison to the actual and expected income levels. This is confirmed by the higher value of odds ratios for variables related to location, than for variables related to the current or future economic situation. It should also be noted that analogously to the product innovations case, it was

Table 5. The impact of the selected factors on process innovations in the Balkan countries – multivariable logit models (in odds ratio).

		Size of enterprise			
Independence variable	Total (y_{3j})	micro	small	medium	large
Medium enterprises (x_3)	1.79***	x	x	x	x
Expectation of revenue growing (x_8)	1.74***	1.76***		2.63**	
Domestic enterprises (x_{11})			0.40**		
Foreign enterprises (x_{13})		2.62*			5.83*
Localisation in Slovenia (x_{18})	6.62***	4.94***		9.72***	
Localisation in Serbia (x_{17})	3.37***	2.51***		3.28**	
Localisation in Croatia (x_{15})	1.79*				
Constant	0.05***	0.06***	0.33***	0.07***	0.17***
Sample size	1244	719	298	180	47
Chi square	104.44	51.59	4.77	35.47	3.45
p-value	0.00	0.00	0.00	0.00	0.06

***Significance up to 1%.
**Significance from 1% to 5%.
*Significance from 5% to 10%.
Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

not possible to determine the impact of the current level of income on the occurrence of process innovations.

Whereas, in case of the variable describing the expectations with regard to future income, clear results have been obtained. The odds of the occurrence of process innovations in the companies expecting their income levels to increase are 74% higher, than those where the income will either decrease or remain at the current level. In the case of the medium-sized companies expecting their income levels to increase in the future, this difference amounts to as much as 163%. This confirms the additional hypothesis that the chances of particular attributes of innovation activity occurring grow proportionally to the size of the company.

Analysing the problem of location of the companies, one observes that the highest odds of the occurrence of process innovations are reported in those entities located in Slovenia. Also, the location of Slovenia and Croatia was also observed to have a stimulating effect on the process innovations. It should also be noted that in case of Slovenia and Serbia, the odds ratios of process innovations are proportional to the size of a company.

Non-domestic ownership and medium-size were also factors that stimulated the occurrence of process innovations. In case of non-domestic ownership, this is especially evident in the case of micro- and large enterprises. Whereas domestic ownership (especially in the case of small companies) had a de-stimulating effect on the occurrence of process innovations.

The last parameter that should be noted in the above Table 5 is the value obtained by the constant. This value, equal to 0.05, means that all the factors that did not reach the level of individual statistical significance combined, limit the odds of process innovations by as much as 95%.

5.4. The impact of the economic situation on R&D in companies from the Balkan countries

The size and direction of impact of the chosen independent values on the R&D activity are described in the next model:

Table 6. The impact of the selected factors on R&D activity in the Balkan countries – multivariable logit models (in odds ratio).

		Size of enterprise			
Independence variable	Total (y_{4i})	micro	small	medium	large
Medium enterprises (x_3)	2.77***	x	x	x	x
Large enterprises (x_4)	2.62***	x	x	x	x
Revenue – decreasing (x_7)	0.63**	0.38***			
Revenue – stabilisation (x_6)	0.48*				
Expectation of revenue growing (x_8)	2.05***	2.86***		3.34***	
Expectation of revenue decreasing (x_{10})	0.64*				
Domestic enterprises (x_{11})		0.52*	0.39**		
Foreign enterprises (x_{13})					3.47*
Localisation in Albania (x_{14})	0.09***	0.05***	0.12**	0.06***	
Localisation in Croatia (x_{15})	1.75**				6.85*
Localisation in Serbia (x_{17})				0.43*	
Localisation in Slovenia (x_{18})	2.17***		2.60**		21.27**
Constant	0.11***	0.24***	0.33**	0.34***	0.05***
Sample size	1244	719	298	180	47
Chi square	159.89	76.65	22.78	29.76	12.03
p-value	0.00	0.00	0.00	0.00	0.01

***Significance up to 1%.
**Significance from 1% to 5%.
*Significance from 5% to 10%.
Source: Authors' analysis on the basis of BEEPS V (2013–2014) data.

$$\hat{y}_{4i} = \underset{(-10.30)}{0.11} + \underset{(4.99)}{2.77x_{3i}} + \underset{(2.76)}{2.62x_{4i}} + \underset{(-2,47)}{0.63x_{7i}} + \underset{(-1.41)}{0.48x_{6i}} + \underset{(3.68)}{2.05x_{8i}} + \underset{(-1.60)}{0.64x_{10i}} + \underset{(-4.50)}{0.09x_{14i}} + \underset{(2.52)}{1.75x_{15i}} + \underset{(3.79)}{2.17x_{18i}} + \tag{4}$$

The force and direction of impact of the chosen independent variables on R&D activity in companies (split into size categories) are presented in Table 6.

Analysing the odds ratios presented in Table 6, one notices that the size of a company is the key factor in terms of engaging in R&D. The highest odds ratios were observed for large- (especially in the case of non-domestic enterprises) and medium-sized companies. Also, analysing the remaining independent value, one notices that the highest odds ratios for those variables were observed for large- and medium-sized companies as well.

Also, the expectations with regard to future income levels play an important role in terms of engaging in the R&D activity. The odds for R&D activity occurring in those companies that expect an increase in income levels are, depending on the size of the company, more than two or three times higher than in the case of the companies that expect no change or a decrease in income levels.

Also, the advantageous location of a company has a comparable impact on the R&D activity as the expectation that the economic situation will improve. This is witnessed by the odds ratios obtained for variables describing location in Croatia and Slovenia equal 1.75 and 2.17 respectively. It should also be noted that the large companies have even greater odds ratio values.

In turn, the following independent variables: lowering of the expected and actual income levels (especially in the case of micro-enterprises), domestic ownership and location in Albania and Serbia have a negative impact on R&D activity in a company. In the case of domestic ownership, the negative impact on R&D has been observed in micro- and small-sized companies. In the case of companies located in Albania, the negative impact on

R&D has been observed in an entire group and in the micro-, small- and medium-sized companies. Whereas, the negative impact of the location of the analysed entities in Serbia has been observed in the medium-sized companies.

The last parameter taken into account in Table 6 is the constant. Depending on the size of the company, it took on a value between 0.05 and 0.34. This means that the remaining factors taken into account in the analysis that that did not reach the level of individual statistical significance limit the R&D activity from 66% to 95%.

6. Conclusion

The most important factors determining the innovation activity in the selected Balkan states are the location of a given company and the dynamics of expected and actual income levels. However, size and ownership type are also important aspects.

The varied economic conditions present in these Balkan states were also reflected in terms of the innovation activity of the analysed companies. The companies from Slovenia and Croatia have had the biggest edge in that respect over the others. Whereas the companies from Albania and Montenegro were the most disadvantaged. The economic conditions in Serbia were, depending on the aspect of innovation activity, either a stimulating (process and product innovations) or de-stimulating (financial aspect and R&D) factor.

The high values of odds ratios for the independent values related to location of the companies confirms the important role played by the social and cultural, as well as economic, differences observed in these countries. This shows that despite the geographic proximity of the countries, national innovation systems differ in terms of structure, which in turn influences the innovation policies implemented. Hence, further research is needed to tease out the similarities and differences in terms of the national-level policies implemented, allowing us to design solutions that can be implemented in the less-developed economies.

Future research should also focus on the question of whether, in the analysed countries, the improvement in the economic situation means that both product and process innovations are being introduced more often, whereas in the better-developed countries the situation is much more complicated. In developed countries, in the case of economic growth, one observes an increase in radical innovations, in comparison to the incremental ones, whereas during recession it is the opposite situation (Sorescu & Spanjol, 2008).

In the context of this research, the situation of the less-developed countries, including those described as 'catching-up', leads to a conclusion that there is a need for further development and investigation into specific and complex conditions responsible for introduction of innovations. The mechanisms governing new technologies in the developed nations, both market-based and regulatory are not necessarily ideal solutions for the less-developed areas. Hence the need for searching for innovative solutions that take into account the specific character of such places and the context of their position in terms of economic relations with other countries.

In terms of further research, it is very important to search for an answer to the question of why the smallest companies played such an insignificant role in terms of innovation activity in the analysed countries. This is even more important in view of the fact that in the innovation-leader and innovation-follower countries, stimulating the innovation activity of the smallest companies is key to gaining the edge in terms of technological development in general. Whereas, the obtained research results suggest that in the analysed countries, it is the large- and

medium-sized companies that were the most innovative. In addition, the results suggest that, in order to stimulate the innovation activity in the analysed economies in terms of systemic changes, it is the medium- and large-sized companies that should be given preference over the micro- and small-sized ones. In the case of the latter, systemic changes should be directed on creating awareness of the importance of innovations. This can be achieved by pointing to the best practices already observed in the bigger entities that successfully implemented new technologies. At this level of economic development, such actions seem more effective than designing direct support mechanisms for this group of companies.

In relation to the main research aim and the research conducted by Cornell and Shapiro (1988), the importance of expectations in terms of changes to the economic situation as a factor influencing the systemic innovation activity of companies was confirmed. Expectations that income levels will rise has a significant stimulating effect on all the analysed attributes of innovative activity (in terms of product innovations this has been observed only in the case of medium-sized companies). Whereas, only in the case of the financial aspect of innovation activity, it has been observed that the impact of the current economic situation was stronger than the expectation in terms of how the economic situation will change in the future. Keeping in mind that the variable 'increase in income levels' in the models describing product innovations, process innovations and R&D was not individually statistically significant and is contained in the constant, hence it could be said that this variable has a smaller impact on the dependent variables in comparison to the variable 'expecting income levels to increase'. Hence, the first research hypothesis posed at the beginning of this article has been partially confirmed. It is worthwhile mentioning that an analogous pattern has been observed in the case of other Central and Eastern European countries such as the Czech Republic, Poland, Slovakia and Hungary.

In terms of company size, the influence of large- and medium-sized companies is much stronger than the small- and micro-sized ones, especially during economic growth. Hence, the results reported by Brown, Fazzari, and Petersen (2009) and Archibugi, Filippetti and Frenz (2013) for the hi-tech areas in the most developed countries are not confirmed where it is the traditional sectors of the economy that dominate. This concerns the financial aspect, process innovations and R&D activity. In the case of introducing new products, it was not possible to obtain parameters allowing us to compare the impact of the size of a company on the described form of innovation activity, in various phases of the economic cycle.

Also, no significant differences have been observed between the types of innovation introduced as a result of expectation in terms of changes in economic situation, contrary to the results presented by Madrid-Guijarro et al. (2013) in the case of Spain. The research on the selected group of the Balkan states confirmed that both product and process innovations are implemented when the economic situation is expected to improve.

In summary, it should be said that the auxiliary hypothesis and the main research Hypothesis 2 were confirmed, with Hypothesis 1 only partially confirmed. Surprisingly, it is the location of a given company in one of the analysed Balkan countries that proved critical and sufficient in terms of higher intensity within the new technologies area.

6.1. The limitations of the study

Given the systemic approach adopted, we should first note that World Bank was forced to limit the questionnaire to general-type questions without going deeper into the specific

character of a company. Therefore, most of the variables were dichotomous (taking the values of 0 or 1). As a result, the return rate for the survey was higher, but the data obtained had a smaller value than if they were of continuous character. Therefore, there is a need for similar but more specific analysis at the national level in order to validate the obtained results.

Another limitation of the survey conducted is its static and dichotomous character. The dichotomous character of data means that for the described log-linear models the rest distributions are not as 'expected'. This limitation, however, only slightly influences the value of the models but it can be a rationale for conducting further research in the future. While adding other variables might slightly improve the rest distribution, it would have no other justification and this on its own is not sufficient to justify adding new variables to the log-linear model.

The BEEPS survey has been repeated for the fifth time, but given that it took into account various groups of companies, and its short time period, one cannot build econometric models describing changes over time. It is possible however, to compare data but on a high level of aggregation, an approach that has already resulted in various reports by the World Bank or Community Innovation Survey (CIS) for the OECD countries, for example.

Logit modelling allowed us to present the analysed interactions between the chosen variables in an interesting, multi-layered and wide-ranging way.

Note

1. By looking at the plots of the rest distributions presented in Appendix 1, we notice that these do not have the 'expected' shape, which is related to the dichotomous character of all the independent variables. While adding other variables might slightly improve the rest distribution, it would have no other justification and this on its own is not sufficient to justify adding new variables to the log-linear model. Such limitation, related to the characteristics of the variables used, can be a rationale for continuing the research in the future.

Disclosure statement

No potential conflict of interest was reported by the authors.

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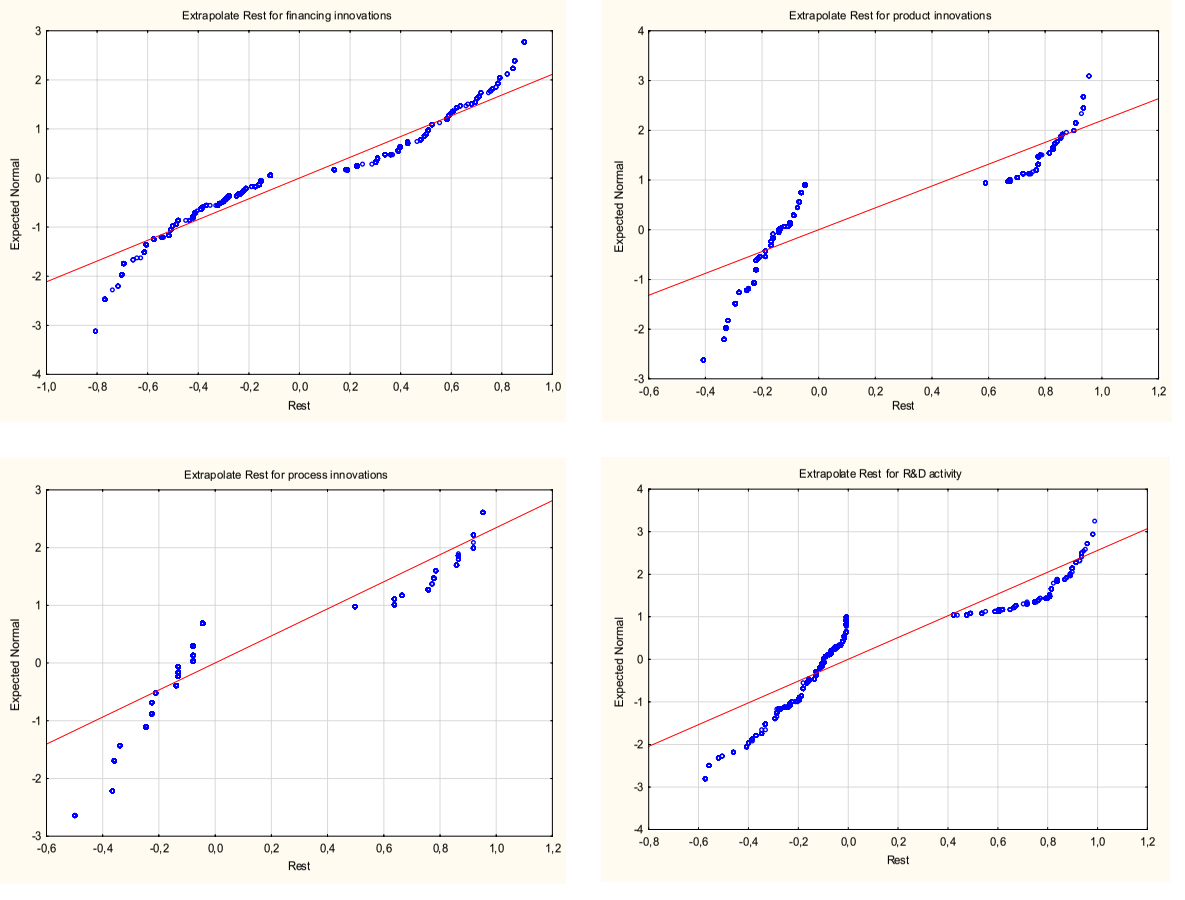
Appendix 1.



Source: Own calculations on the BEEPS V (2013–2014) survey data.