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INNOVATION ACTIVITIES AND FIRM PERFORMANCE: EMPIRICAL EVIDENCE FROM TRANSITION ECONOMIES

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Abstract

The aim of this paper is to investigate the determinants of innovation activities and their impact on firm performance. For the empirical analysis of the study we employ Business Environment Enterprise Performance Surveys (BEEPS) firm-level data conducted by the World Bank and the European Bank for Reconstruction and Development (EBRD) in 2002, 2005 and 2009. To examine the relationship between innovation activities, ownership structure and firm performance we apply instrumental variable (IV) technique, which enables us to control for the endogeneity between innovation activities undertaken by firms and their performance. Our findings suggest that firm's size, R&D intensity, foreign ownership, competition, skilled workers and export activity have a positive and significant impact on their incentive to undertake innovation activities. Considering the determinants of productivity, we find evidence that firms that have undertaken innovation activities (instrumented variable) and owned by foreign ownership, having a higher degree of skilled workers and that European Union member country firms perform better.

Keywords*: Innovation Activities, Ownership Change, Productivity, IV Technique*

JEL Classification: *O31, G32, J24.*

Introduction

Based on the statistics which show that US experienced increasing average annual labour productivity from 1.2 percent in the 1973-1995 period to 2.3 percent from 1995 to 2006, whereas in 15 EU countries (members up to 2004) productivity growth slows down with annual rate of 2.4 percent in the 1973-1995 period to 1.5 percent from 1995 to 2006, one can say that there is evidence showing that US experienced higher labor productivity growth than EU (Ark et al., 2008). Several studies have shown that the US increase in labor productivity is attributable to intensive development of innovation activities (O'Mahony et al., 2010; Crescenzi and Rodriguez-Pose, 2011). In order to increase the innovation activities undertaken by firms in the EU, the Lisbon Strategy set a goal for Europe to become "the world's most competitive and dynamic knowledge-based economy in the world, capable

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of sustaining growth with more and better jobs and greater social cohesion" by 2010. This aspiration also presents the first priority area of the 'Europe 2020' Strategy, which is 'smart growth' through the development of knowledge, innovation, and education (EC, 2010). Accordingly, EU has set an ambitious target - the Barcelona objective - of increasing R&D expenditures to 3 per cent of GDP in particular by improving the conditions for R&D investment by the private sector, and developing a new indicator to track innovation (EC, 2010). In order to accomplish these goals, OECD has prepared an 'innovation strategy', containing the following major themes: i) the "openness" of innovation; ii) the central role of entrepreneurship; iii) creating and applying knowledge; iv) applying innovation to address global and social challenges; and v) improving the governance of policies for innovation.

The literature on the relationship between innovation activities and firm performance (henceforth innovation-performance relationship) varies on different ways of defining innovation and on the measures employed, with challenges faced related to the problem of finding relevant variables for measuring innovation activities. The most often employed measures in the empirical literature are: R&D expenditure – as a measure of input; patents - as a measure of output; and introducing new product/ new process - as output accepted by the market. We further investigate the empirical evidence on the relationship between innovation activities and firm performance. The main focus is on the data and methodology used in these studies. This stream of literature mainly applies a structural approach to modeling innovation.

For the purpose of this paper we empirically investigate the innovation-performance relationship. A dataset derived from the Business Environment and Enterprise Performance Survey (BEEPS) of 2002, 2005 and 2009 is employed, and we apply instrumental variable technique.

The structure of the paper is as follows. In the next section we review the literature related to the innovation-performance relationship, with the main focus on the model and the determinants of innovation activity. Section 3 elaborates the sample and the data. Section 4 considers the methods of investigation and the empirical estimations. The interpretation of the results is provided in section 5. Section 6 concludes the study.

Empirical evidence on innovation and ownership

The empirical literature on investigating innovative behavior and its effect on firm performance face two major methodological challenges: (i) how to measure innovation or technological change and (ii) which estimation technique to apply for taking into consideration the endogeneity problem. The first methodological challenge is accompanied with the difficulty of getting appropriate data which correspond to the definition of innovation. Consequently, the empirical studies have mainly adjusted their analysis of innovation depending on available measure of innovation, by using proxies which reflect some aspects of the innovation process.

In defining innovation activities undertaken by companies most of the empirical evidence follows Joseph Schumpeter, who defined innovation in a broad sense, as (1934, p.66): *"carrying out of new combinations" that include "the introduction of new goods (…), new methods of production (…), the opening of new markets (…), the conquest of new sources*

of supply (…) and the carrying out of a new organization of any industry". He was the first to develop a three-stage classification: invention, innovation and diffusion, known as Schumpeterian trichotomy (Jaffe et al., 2004; pp. 63). Innovation in the Schumpeterian scheme encompasses one of the three stages, however it is often used broadly to refer to all stages of the technological change process.

Following Schumpeter's definition of innovation activities, most of the empirical literature defines innovation as the development of new products and/or new processes introduced to the market. OECD (2005) Oslo manual guiding the collection of data on innovation reflects this perspective by defining innovation as: "... the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations (p. 46). An alternative definition of innovation adopted more recently by policymakers in the UK and also applied in the literature (Stoneman, 2010; Battisti et al., 2011) regards innovation as the 'successful exploitation of new ideas'. If this is scrutinized further (i) new ideas – involve new product/process or service, (ii) exploitation – presents the applicability of the idea, (iii) successful – implies that the innovation is adapted by the market (from firm level viewpoint the target is increased profitability).

Based on these definitions, the most common measures used in the literature for analyzing the innovative process are as follows: i) a measure of the inputs into the innovative process, such as R&D expenditure, ii) an intermediate output, such as the number of inventions which have been patented, and iii) a direct measure of innovative output, new product or new process. These proxy measures for the innovation process have their limitations. Not all R&D expenditures end in innovation output since this measure reflects only the resources committed to producing innovative output, but not the innovative process. The number of patents does not indicate whether this output has a positive economic value or whether it has successfully been introduced in the market. Whereas the new product and/or process is acknowledged as a proxy that directly quantifies the effect of innovation and its success in the market.

Considering the other methodological challenge, one can put it into two dimensions: (i) the determinants of innovation and the impact of size and market structure on the process, and (ii) the impact of innovation on productivity, firm performance and economic welfare (Stoneman, 2010).

Schumpeter (1928, 1942) developed the ideas on which most of the theoretical and empirical analyses of the economics of innovation are based. His theoretical framework on the relationship between firm size and dynamic market performance is characterized with two contradicting waves. According to Schumpeter Mark I of The Theory of economic Development, it is the new (often small) firms that carry out innovation (1934, p.66). According to the second fundamentally different view, Schumpeter Mark II of Capitalism, Socialism, and Democracy, it is the established (large) firms that generates technological progress (1943, p.82).

Another determinant related to the Schumpeterian hypothesis is the market structure, indicating positive relationship between innovation and monopoly power. According to him monopolists, compared to competitive firms, have stronger incentives to innovate because of the gains captured without being imitated by rivals. Schumpeter's theory was supported

by Galbraith (1952) saying that inventions are costly and only large firms with monopoly power have the necessary resources for undertaking them.

The first economist who contradicts the Schumpeterian view that monopoly stimulates innovation is Arrow (1962). He indicates that firms operating in a competitive market have a stronger profit related incentive to innovate than monopolist. This is so because of what Arrow called the 'replacement effect' that is an innovative monopolist replaces one profitable investment with another, therefore has less incentives for undertaking changes. Furthermore, innovation yields greater net profit in a perfectly competitive industry than in monopoly because: the payoff to innovation for the monopolist is the additional monopoly profit from the new product or process compared to the gains from the existing technology; whereas the payoff to innovation for the innovating firm in a competitive industry is the net gain of the all profit that flows from successful innovation.

Guided by the Schumpeterian theories, the literature on innovation activities has mainly focused on empirical investigation of the impact of market structure and firm size on innovation activities undertaken by a firm. There are numerous surveys summarizing the findings of this stream of literature (Kamien and Schwartz, 1982; Scherer, 1980, Baldwin and Scott, 1987; Cohen and Levin, 1989 and Symeonidis, 1996) but they come to inconclusive results.

The findings of the empirical literature summarizing the evidence of the impact of market structure and firm size on innovation point out two main hypotheses regarding innovation: (i) large firms tend to have higher innovation activities, and (ii) highly concentrated markets (characterized by imperfect competition) are more conducive to technical change. Cohen and Levin (1989) outline some arguments for large firms being more innovative: i) they can use internal funds to finance the risky R&D activities; ii) they have an advantage in financial markets in terms of access to additional sources to finance their innovation activities; iii) they may better exploit economies of scale and scope in R&D activities; iv) they are able to spread fixed costs of innovation over higher levels of sales, and so on.

Earlier studies found support for the Schumpeterian hypothesis that large size companies tend to have higher R&D intensity (Galbraith, 1952). Scherer (1965a, 1965b) evidenced that the relationship between R&D intensity and sales is an inverted U shape. Some other studies obtained similar results to Scherer (Malecki, 1980 and Link, 1981), or even negative relationship between R&D and size (Kamien and Schwartz, 1982). Cohen and Klepper (1996) put forward a somehow different conclusion compared to previous studies that large firms are characterized with higher investment in innovation and are more engaged in innovation activities, however innovation output diminishes with firm size.

Considering the second hypothesis, the literature on the innovation-market structure relationship is broad and inconclusive. Symeonidis (1996) expects that R&D intensity will be higher in companies with higher market power because: (i) they will have higher levels of cash flow and can thus use profits to finance their R&D activities; and (ii) they are more advanced in appropriating the returns from innovation since they are in a better position to benefit from patents, therefore have a higher incentives to innovate. The empirical evidence on the innovation-market structure relationship (Farber, 1981; Geroski, 1990; Scherer and Huh, 1992) has generally concluded that the relationship between innovative output and market structure shows weak positive results. This is also confirmed by Aghion et al.'s

(2002) study of innovation in transition economies which concluded that new firms drive innovation and that for these firms competitive pressures raise innovation.

More recent literature on innovation has moved toward identifying appropriate models to empirically investigate the technological change. The innovation-performance relationship has been a matter of significant interest among researchers for some period. The more recent literature has enriched the models used for empirically investigating such relationship. The most common way found in the literature for modeling the relationship between innovation activities and firm performance is the multistage approach.

The growing power of simulation techniques has had its impact on numerous recent studies (Loof and Heshmati, 2006; Grifith at al., 2006; Damijan et al., 2008) which apply a similar model to Crepon et al. (1998) known as the CDM model, named by the three authors Crépon, Duguet and Mairesse. It is a structural model with four stages following the basic form as to whether firms would invest in innovation or not; then they decide how much effort to put into innovation; then knowledge is produced as a result of this investment and output is produced using knowledge. This model is formalized in four equations: i) the firm's decision to engage in sufficient efforts to result in observable R&D investment; ii) the intensity with which the firm undertakes R&D; iii) the innovation or knowledge production function; and iv) the output production function, where knowledge is an input. By employing the CDM model the most recent studies tend to control for the endogeneity of innovation.

Hall and Mairesse (2006) summarize papers that have employed similar models to CDM for their analysis of innovation. They conclude that important progress has been made in modeling and employing appropriate econometric estimation methods by using innovation survey data. They emphasize that better results are obtained when researches combine the survey data with census-type information on the accounting data of the firms, which enables the measurement of final outcomes in the form of profitability and productivity. Most of these studies provide a positive impact of innovation on productivity growth.

The sample and the data

For the empirical analysis of this chapter we use the World Bank/EBRD's Business Environment Enterprise Performance Surveys (BEEPS) firm-level data conducted in 2002, 2005 and 2009. Out of the overall BEEPS dataset we make use of the data on fourteen Central Eastern and South-Eastern European Economies. Since there are European Union member countries, we are able to provide comparative analysis between countries that joined EU recently (list of nine EU countries - CEE (alphabetic order): Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia) and those in South-eastern Europe (list of five South- East European countries – SEE (alphabetic order): Albania, Bosnia and Herzegovina, Croatia, Macedonia and Serbia & Montenegro). The major advantages to be emphasized for this dataset are that: (i) it provides a large number of observations comparable for TEs for 2002, 2005 and 2009, consisting of the pooled data; and (ii) it includes three year retrospective information for each survey round which makes available data on firms over a nine-year period. The BEEPS questionnaire consists of questions which allow us to specify the variables of our interest by following the theory. For the purpose of our investigation we employ the pooled data for 2002, 2005 and 2009 in order to utilize the advantage of a larger number of observations having the final

sample consisted of 9,354. Table 1 gives the description of the variables employed in the model and their expected signs.

Table 1. Description of the variables and expected signs

Dependent variable	
LNproductivity	Labour Productivity = Sales / number of employees
Innov_act	Dummy for innovative firms (product and/or process)

Independent variables		Expected signs
Size	Number of employees	- / +
*R&D intensity**	Amount spent on R&D / Sales	+
dInvestR&D	Invested in R&D (indicator variable = 1 if the firm has invested in R&D)	+
Direct_exports	% of establishment sales as direct exports	+
dFRGNinv	Foreign Ownership – (=1 if the % share of foreign capital in the company > 10 percent)	-/+
dDOMprivate	Domestic Ownership– (=1 if the % share of domestic capital in the company >10 percent)	-/+
dSTATE	State Ownership	-
FRGNcomppress	Pressure from foreign competitors - Effect on decisions to develop new products	- / +
Skilled_workers	Share of employees with university degree	+
Age	Firm experience – year since establishment	+
Agesq	Firm experience – year since establishment squared	+
EU_members	dummy = 1 if EU member country	+
NEU_members	dummy = 1 if non-EU country or candidate for EU	-
Sector	The industry in which the firm operates	

**The R&D intensity variable has a large number of missing data. This is partly because the question regarding research and development activities varied across surveys. In the previous surveys the question was: 'Amount spent on research and development in last fiscal year'; whereas in 2009 they were asked if they 'Invested in research and development (in-house or outsourced) in last 3 years?' This is why we estimate another mode by replacing the R&D intensity with dummy variable of whether the firms have invested in R&D or not which allows for larger number of observations*

According to the statistics on the pooled data, the average labor productivity has increased by 25 percent from 2002 to 2005, while it has doubled from 2005 to 2009. The size of the companies in the sample is varying on average from 90 to 140 employees. On average firms' R&D investments are approximately 4 percent (R&D expenditure to sales ratio). The average of firms that have exported directly is 10 – 12 percent. Firms were established mainly 16 to 20 years ago (the eighties – nineties). For companies surveyed in 2002, on average 33 percent of the employees had a university degree, and this percentage dropped to 14 percent in 2009. Considering innovation activities, 62 percent of the companies have indicated that they had introduced new product and/or process in 2002, and the number of innovative firms had increased by 25 percent by 2009. The next section continues with the empirical investigation of the determinants of innovation activities and their impact on firm performance. Pooled data procedures on CEE and SEE countries are applied.

Methods of investigation and empirical findings

In order to explain the extent of innovation activity in CEE and SEE countries, we empirically investigate the relationship between a firm's innovation and labour productivity. We follow the approaches and techniques employed by studies that have empirically estimated this relationship. We apply the instrumental variable (IV) technique (Green, 2012). The empirical estimations of the innovation-performance relationship are generated in two steps. The first model presents the probability of the firms to innovate (probit model) which reveals the importance of individual factors on firms' innovation activity. The second estimations present a semi-logarithmic specification of the productivity model, which incorporates the predicted values of the first regression in conjunction with ownership structure and other firm characteristics.

The general model we will refer to can be written as follows:

$$Innov\_activity_{it}^{*} = f_0 + f_1 Size_{it} + f_2 R\&Dintensity_{it} + f_3\, Direct\_export_{it} + f_4\, dFRGNinv_{it} + f_5 dDOMprivatei_{it} + f_6 FRGNcomppressi_{it} + f_7 Skilled\_workers_{it} + f_8 T1 + f_9 T2 + \varepsilon_{it} \quad (1)$$

$$LNproductivity_{it} = \theta_0 + \theta_1\, PrInnov\_activity_{it} + \theta_2\, dFRGNinv_{it} + \theta_3\, dDOMprivate_{it} + \theta_4\, Skilled\_workers_{it} + \theta_5\, Age_{it} + \theta_6 Agesq_{it} + \theta_7 EU\_members + \theta_8 Sector + \theta_9 T1 + \theta_{10} T2 + \varepsilon_{it} \quad (2)$$

The impact of individual factors, such as size, share of R&D expenditure on total sales (or dummy invested in R&D variable), dummy for foreign and domestic ownership, direct exports, pressure from foreign competitors, share of employees with university degree, and age on the probability to innovate of a firm i in period t. Innovation activities as dependent variable (Inno_activitiesit) present product and/or process innovation. The justification for taking the decision to treat product and process innovation in one common variable relies on the almost identical results of their separate estimations.

Following the methodological approach applied in the literature and because of the suspected endogenous relationship between innovation activities and firm performance the IV technique is applied. The regression coefficients and corresponding p-values of the probit model regression of the probability to innovate together with the empirical results of productivity model are presented in Table 2.

Before moving on to the interpretation of the coefficient, the diagnostics of the regressions are provided. The obtained results indicate that we have insufficient evidence to reject the null hypothesis that the model has a correct functional form at 5 percent level of significance. The diagnostic tests suggest that there is insufficient evidence to accept the null hypothesis that the residuals have normal distribution. Furthermore, there is insufficient evidence to reject null hypothesis of homoscedasticity in the model.

Considering the instrumental variable regression, the validity test of the instruments employed, F-test, shows that they are jointly significantly different from zero. The statistics of 20.20 indicates the strength of the instruments. After considering the diagnostics of the model we continue with the interpretation of the coefficients.

Table 2. The determinants of the probability to innovate and the productivity model

	DEPENDENT VARIABLE:			
Independent Variables	Innovation Activities		***LNproductivity***	
	Probit model		IV regression	
	Coeff.	*p-values*	*1st stage Coeff.*	*IV Coeff.*
Size	0.13***	(0.000)	.00	-0.00
Innov_act (instr.)				**1.50*** **
Inv_RnD	**0.67*** **	**(0.000)**		
Direct_export	0.00	(0.298)		
dFRGNinv	0.22***	(0.002)	.11***	-0.01
dDOMprivate	0.17**	(0.012)	.13**	-0.29**
FRGNcomppress	0.07***	(0.000)		
Skilled_workers	0.01***	(0.000)	.01**	0.00
Age	0.00	(0.612)	.00	-0.01**
Agesq	-0.00	(0.267)	4.32	0.01*
EU_members	-0.25**	(0.046)	-.06**	0.24***
Sector	-0.01***	(0.001)	-.01**	0.01***
D1: 1- if year =2002	-0.52**	(0.078)		
D2: 1-if year=2005	-0.49**	(0.043)		
Constant	0.65	(0.113)	0.7***	9.04***
Observations	**5,281**			1,220
Instruments:				
Inv_RnD			√	√
Direct_export			√	√
LR chi2	654.2			
Pseudo R2	0.1028			
R-squared				-0.144
F-statistics				9.019
Log Likelihood				-1916
Sargan statistics				0.333
Cragg-Donald Wald F statistic			20.20	20.20

*Note: Standard errors in parentheses, and *** p<0.01, ** p<0.05, * p<0.1*
**The model reflects results with R&D intensity as determinant of innovation*
*** The model reflects results with dummy invest in R&D as determinant of innovation*

Discussion of the results

Two major models are estimated using the BEEPS 2002, 2005, and 2009 dataset: (i) the innovation *probit* model - with the undertaken innovation activities (dummy variable) employed as dependent variable and (ii) the productivity semi-logarithmic model - with the labor productivity as dependent variable. The *probit* model results - show significant effect of some of the innovation activities determinants, which are in accordance with the theoretical literature. The consideration of size as a determinant explaining innovation goes back to Schumpeter (1942) who stated that large firms in concentrated markets are more advantageous in innovation. The positive and significant sign of the firm size supports this hypothesis indicating that larger firms in transition economies tend to undertake more innovation activities than smaller ones.

According to new growth theory, R&D activities are expected to lead to product and process innovation. Becheikh et al. (2006) on a review of empirical studies published between 1993 and 2003 bring together a set of variables related to the innovation process, and find that R&D expenditure does not necessarily lead to a new product and/or process. For the TEs, we mentioned in the previous section that not all firms that undertake innovation activities have indicated they will invest in R&D. However, the R&D variable in the regression appears to have positive and significant relationship with innovation activities.

Ownership structure is shown to influence productivity both directly and indirectly, through innovation activities (Hill and Snell, 1989). Carlin et al. (2001) find significant effect of privatization on new product restructuring. Moreover, a new product directly increases sales and productivity growth, implying an indirect effect of ownership on enterprise growth. We employ variables of private foreign and domestic owned firms (state companies as base category) in innovation and productivity models. We expect that foreign ownership plays an important role in explaining innovation, considering it as external source of information for innovation. According to this, the results show that foreign owned firms with more than 10 percent of ownership are significantly positively related to firms' innovation activities, indicating that they are more innovative than state owned firms. The same applies to the domestic owned firms.

The literature on innovation suggests that a moderate degree of competition is better than either monopoly or intense competition. The data provides a qualitative perception variable of foreign competition pressure on decision to develop a new product. We employ this variable for having the impact of competition, and the results show positive significant coefficient of the variable. The firms' innovative activities are higher if the firm faces competitive pressure from foreign firms.

The role of human capital on the decision of the firms to innovate has gained importance in the most recent literature. We employ the level of education of the employees as the share of employees with university degree. The coefficient of this variable is significant and positively related to the decision to innovate.

The firm's export activity may have an effect on the innovation behaviour of the firm. We suppose that firms learn from trade in terms of innovation (learning-by-exporting hypothesis) and thus exporting firms will improve their innovation activities to remain competitive in international markets. The variable included in the model is the percentage of direct exports to sales to indicate the effect on innovation activities. The regression results show a positive

significant impact of export intensity on innovation activities when using R&D intensity as an independent variable. However the results show insignificant coefficient when applying the other alternative variable of R&D, the dummy invested in R&D. The Age of the firm together with age squared appears to be insignificant in both *probit* model specifications. We control for time and sector in the model.

The interpreted coefficients are statistically significant at 1 percent level of significance, offering evidence that the Ho hypothesis, (θ_{it} =*0*) can be rejected for these cases. On the other hand age and age squared are statistically insignificant at 1 percent, 5 percent and 10 percent level of significance. Therefore their calculated *p values* lie in the region of acceptance, so we fail to reject the Ho hypothesis. According to chi2 statistics the explanatory variables are jointly significant (since Prob>chi2 = 0.000) at 1 percent level of significance, therefore the null hypothesis that all regressors are jointly insignificant may be rejected.

Productivity model regression – is estimated using instrumental variable techniques (instruments used for innovation activities are R&D intensity and direct export). The validity of the instruments is tested for both models, but only invest in R&D and direct export showed to be valid instruments. The results show positive and statistically significant impact of instrumented variable, undertaken innovation activities, on firm performance. This impact confirms our hypothesis that more innovative firms' tend to perform better.

The IV model appears to have insignificant coefficients of foreign ownership and skilled workers, thus we do not interpret their impact. Whereas domestic ownership appears to have negative significant coefficient, indicating that private domestic firms are not performing better than state owned firms. The firms' age also has negative significant coefficient indicating that new firms outperform older ones. The EU membership dummy variable is positive and significant, showing that EU member state firms' perform better than the ones that operate in non-EU countries. Generally, one can notice that different estimation techniques bring us to slightly different results. By controlling for the endogeneity through IV we provide more reliable and robust econometric results for the labor productivity model.

Conclusion

This study critically reviews the empirical literature on innovation-performance relationship. The main focus is on the determinants of innovation and the methodology employed in the innovation literature. Following the applied methodology, this paper continues with the empirical investigation of the determinants of innovation, and their impact on firm performance.

From the review of the empirical evidence on innovation activities, one can come to the conclusion that the measurements of innovation variables that are most commonly employed are related with the Schumpeterian definition of innovation. In other words, whether the firms have introduced new products or have changed their production lines is an indicator for a firm to be innovative. Based on the definition there are also studies that have employed a measure of input such as R&D intensity of the firm, or measure of output such as patents. However, these measurements are criticized in the literature as they do not indicate whether they enhance a firm's performance or whether they have been successfully introduced in the market.

Another challenge faced by the literature on innovation is related to the determinants of innovation activities. Following the Schumpeterian hypothesis on the relationship between the size of the firm and the market structure, these determinants are most often employed in the innovative behaviour models. The most recent literature extends these models by incorporating other factors such as ownership structure, human capital development, export intensity, availability of financial resources and other firm-level characteristics.

Considering the methodology employed for the empirical estimation of the innovation activities model, the simulation techniques or structural models are the most often used in the literature. However, because of the specific data necessary for estimating the four stage model (the CDM model) some of the studies have applied some of the stages depending on data availability.

The empirical investigation on the determinants of innovation activities and their impact (including ownership structure) on firm performance is provided using BEEPS 2002, 2005, and 2009 in fourteen CEE and SEE countries. For the purpose of the investigation we employ the pooled data for 2002, 2005 and 2009 consisting of 9,354 observations. The same models corresponding to the methodology requested for the pooled data are estimated. The first model presents the probability of the firms to innovate (*probit* model) which reveals the determinants of firms' innovation activity.

The general findings for the *probit* model indicate that size, dummy invested in R&D, foreign ownership, foreign competitive pressure, the share of employees with university degree and export intensity are significant determinants and positively affect the firms innovative activities. The findings of the productivity model show that the innovative activities variables, together with private foreign ownership and the share of employees with university degree, have significant positive coefficients indicating that these determinants enhance firm performance.

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