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Do Government Policies Foster Environmental Performance Of Enterprises From CEE Region?

Abstract

In recent years, EU countries, including these from the Central Eastern European (CEE) region has recognised, that eco-innovation should be treated as strategic priority of their economies. The aim of this paper is to present a cross-country analysis of the connection between eco-innovation and its main drivers within firms from selected CEE countries (Bulgaria, Czech Republic, Romania) and Germany. The empirical part is based on micro-data for Community Innovation Survey (CIS) 2006-2008. Based on the results of stepwise regression between main policy actions sustaining innovation activity and eco-innovation performance we can conclude, that financial support for innovation activities has a rather limited role in promoting eco-innovation. At the same time enterprises from the CEE region regard environmental regulations as the most important drivers of eco-innovation. In Germany, a country ranked in the highest category in the Eco-Innovation Scoreboard, the variety of forces that influence eco-innovation is much more wide-ranging. This indicates that government actions should take a broader look and lay the more general bases fostering the model of a green growth.

Keywords: *Central and Eastern Europe; Eco-innovation; Environmental regulations; Community Innovation Survey (CIS)*

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1. Introduction

In last decades, the economic growth has been accompanied by increasing global environmental concerns, such as pollution, increasing scarcity of natural resources and energy security. In this context, concept of sustainable development (SD) and eco-innovation became a hot issue for policy and business practices focused on tackling eco-challenges. Advocates of the Green New Deal (UNEP 2009) or Green Growth (OECD 2011) encourage more strict environmental regulations, expecting that they will facilitate the promotion of a low carbon, green economy (UNEP 2011) and contribute to economic growth.

In the centre of this debate one can find the eco-innovation concept, defined as "... the introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources (including materials, energy, water and land) and decreases the release of harmful substances across the life-cycle" (EIO 2010).

The aim of this paper is to present a comparative cross-country analysis of the relationship between eco-innovation and its main drivers within firms from selected Central Eastern European (CEE) countries an d Germany.

In the first part of the paper, the overall innovation performance and the eco-innovation performance of European Union Member States are presented. This is followed by the theoretical part, which provides an insight into the position of eco-innovation driving forces in stimulating eco-innovation performance. The empirical part, based on micro-data from Community Innovation Survey (CIS) 2006–2008, covers the results of a stepwise regression analysis of selected eco-innovation drivers and the eco-innovation performance of CEE countries (Bulgaria, Czech Republic and Romania). The results are compared with those for enterprises from Germany. The last section contains conclusions.

2. Innovation and eco-innovation performance of CEE countries

While considering overall innovation performance, the CEE countries rank low among the European Union Member States. Based on data from Innovation Union Scoreboard 2015 we can conclude, that only Slovenia joined the group of *Innovation Followers*, with an overall innovation performance close to the EU

average. The majority of countries from the CEE region, including Croatia, the Czech Republic, Estonia, Hungary, Lithuania and Poland, form the group of *Moderate Innovators* with an innovation performance below the EU-27 average, whereas Bulgaria, Latvia and Romania are categorized as *Modest Innovators* (with an innovation performance far below the EU-27 average). Although in the last seven years the CEE countries, on average, are growing much faster that EU-15, the differences between these two groups in terms of overall innovation performance is still at a relatively high level (Innovation Union Scoreboard 2015).

Inasmuch as the transition to a resource-efficient economy is a central issue of the Europe 2020 Strategy for the EU's economy for the next decade (EC 2010, Wysokińska 2016), supervising eco performance of EU Member States is one of key issues. Thus the Eco-Innovation Scoreboard "Eco-IS", a tool to assess eco-innovation performance of EU countries has been initiated.[1] The Eco-Innovation Scoreboard ranks majority of CEE countries (despite their restructuring efforts – Wysokińska 2013, pp. 203–226) as "catching-up" countries, whereas top ranking EU countries for eco-innovation are members of the group of *Innovation Leaders* – Finland, Sweden, Germany and Denmark. As we anticipate, that there is potential relationship between overall innovation performance and the eco-innovation performance of EU Member States, a linear regression model is constructed. Based on data from the Innovation Union Scoreboard and Eco-Innovation Scoreboard for 2013, with a satisfactory level of coefficient of determination ($R^2 = 0.7234$), we can separate two groups of countries: the first being those where the level of both indicators is low; and the second being those where both indicators are significantly higher. The first cluster consists of the CEE countries, while the second one consists of innovation leaders, both in terms of overall innovation performance as well as eco-innovation indicators (Chart 1).[2]

Thus, the results presented in Chart 1 confirm that the European Union is still divided and that the convergence process, both in terms of overall innovation performance as well as eco-innovation, although advancing is still difficult to be finalized.

[1] The indicators in the Eco-Innovation Scoreboard are divided into five components covering eco-innovation inputs (including early stage investments in clean technology), eco-innovation activities (such as the percentage of firms taking resource-efficiency measures), eco-innovation outputs (such as relevant patents), resource-efficiency performance, and socio-economic outputs (such as data on turnover, employment and exports), For more information see: http://www.eco-innovation.eu.

[2] It should be borne in mind however that scores can be influenced by many structural factors, such as the relative importance of different industrial sectors or the economic trends in each country (Eco-Innovation Scoreboard, 2013), and that such factors were not taken into account.

3. Theoretical background and hypotheses' development

There is an in-depth debate in the literature about the unique features of environmental innovation as opposed to "conventional" innovation. Recent studies define eco-innovation as the development of new products, processes, services and technologies that contribute to the development and well-being of human needs and institutions while respecting the worlds' natural resources and regenerative capacity (Gerlach 2003; Yoon & Tello 2009, pp. 85–115). Under the widely discussed concepts of sustainable development and corporate social responsibility (Witkowska 2016), the meaning of eco-innovation has come to include social and institutional aspects. Thus business approach to sustainability has moved from pollution control to eco-efficiency and socio-efficiency. As compared to "conventional" innovation, eco-innovation have some major differences (Yarahmadi & Higgins 2012, pp. 400–420). Firstly, it is perceived as more risky than the "traditional" innovation, as it is not an open-ended concept. Secondly, the scope of eco-innovation can extend beyond the conventional organizational boundaries of the innovating firm to encompass broader societal milieu. It thus involves changes in social norms, cultural values and institutional structures – in partnership with stakeholders such as competitors, partners in the supply chain, consumers, governments – to leverage more environmental benefits from the innovation (OECD, 2009).

Extant research has shown that a firm's decisions on eco-innovation are influenced by a variety of factors: technology push, market pull, regulatory (push/pull) policy, industry- and firm-specific aspects. Most scholars agree that technology push factors are especially important during the initial phase of developing a new product, whereas demand factors become more important during the diffusion phase (Pavitt 1984, pp. 343–373; Hemmelskamp 1999; Horbach & Rennings 2007).

Conventionally, eco-innovation was perceived by economists and business as an additional cost burden for the firm resulting from strict environmental regulations, and reducing its competitiveness (for a literature review, see Palmer et al. 1995, pp. 119-132). This view was challenged by many scholars, particularly Michael Porter (Porter 1991) and his co-author Claas van der Linde (Porter & van der Linde 1995b, pp. 120-134) (for further debate on Porter's hypothesis, see the literature review: Ambec et al. 2011). These authors advocated that more severe but correctly designed regulations can "trigger innovation … that may partially or more than fully offset the costs of complying with them" (Porter & van der Linde 1995a, p. 98).

In this vein, this paper particularly focuses on the role of different policy measures for the eco-innovation performance of enterprises. Such policy measures include science, technology and innovation policy, and environmental as well as fiscal policy (Kemp & Pontoglio 2011, pp. 28–38; Rennings 2000, pp. 319–332).

Taxonomy proposed by Edler and Georghiou (2007, pp. 319-332) that divides policy measures into those supporting the supply side and those supporting the demand side will be applied. Public policies can act on both the demand and the supply sides to generate favourable surroundings for eco-innovation. Policy measures supporting the supply side include equity support; support for R&D in the public sector and industry; fiscal measures; education, training and mobility; and promoting networks and partnerships. The demand side of policy measures consists of regulations and standards; public procurement; technology transfer; financial or fiscal support for technology adopters and support for private demand.

Table 1 presents different policy measures concerning eco-innovation implemented in the four investigated countries. Based on the results we can conclude that the overall spectrum of policy measures supporting eco-innovation is not fully exploited among the countries from the CEE region, whereas Germany seems to use a much more diversified spectrum of measures. Only support for cooperation in the Czech Republic, Romania and Germany (with Bulgaria lagging behind) and regulations and standards seem to be used similarly in all the countries studied (see Table 1 for details).

In this part of the research special emphasis is given to public financial support for overall innovation activity, coming from local, government and European Union sources; as well as government grants, subsidies or other financial incentives for environmental innovation and existing government regulations or taxes on pollution, and their role in accelerating firms' eco-innovation performance.

Market failure, which suggests that firms under-invest in innovation activities if they are not able to capture and appropriate all potential benefits from investment in R&D, justifies governmental intervention in firms' innovative activity (Arrow 1962, pp. 608–662; Nelson 1959, pp. 297–306; Luukkonen & Niskanen 2000). It is generally expected, that increasing public support for R&D results in a*dditionality*, which can be defined as changes in the financed firms' R&D spending, behaviour or performance which would not have occurred without the public program or subsidy (Buisseret et al. 1995, pp. 587-600). While *input additionality* focuses on the degree to which public efforts enhance private R&D spending, *output additionality* deals with its leverage effect on a firm's innovation performance (Luukkonen 1998).

Garcia and Mohnen (2010) have found that financing from the central government increases the intensity of R&D spending as well as the share of innovative products in total sales. However, in the case of support from the central government and the EU, the impact of the support offered by the latter decreases.

Research concerning the *additonality* issue with respect to the Central and Eastern Europe (CEE) countries is not fully developed. Grabowski et al. (2013), based on data for CIS 2008 and 2010, evaluated the efficiency of public support in Turkey and Poland, , and found out that government support contributes to higher innovation spending by firms (*input additionality*), which in turn improves their chances to introduce product innovations, although support from local governments proved less efficient than the support from the central government or the European Union.

Different results were obtained by Weresa and Lewandowska (2014, pp. 171–191), who investigated the support of innovative activities by funds coming from the European Union among Polish large and medium-sized industrial enterprises. Based on Polish CIS 2010 data they discovered the presence of *input additionality*, but only for the expenditures on machinery and equipment, with a negative relationship between support and expenditures on external R&D. The output additionality was not proven, meaning that there was no direct connection between EU funds and the increase of innovation performance measured by the turnover of innovative products in total sales.

For the purpose of this paper the idea of "*eco-output additionality"* is created, described as "firms' enhanced eco-innovation performance resulting from public financial support". Despite existing disparities on the influence of public financial support, it is supposed that public financial support, will result, at least to some extent, in *eco-output additionality*, thus leading to the first hypothesis:

Hypothesis 1. *Financial support for innovation from local (H1a), government (H1b) or EU authorities (H1c) results in eco-output additionality and thus stimulates firms' eco-innovation performance.*

There exist a wide range of tools that can support firms' innovative activity, such as deferred tax payments, tax deductions, grants, preferential loans for R&D activities. It should be underlined however, that grants has several limitations, which arise from information asymmetries between the investors and government agencies, costly administrative formalities and often political pressure (Czarnitzki et al. 2011, pp. 217–229).

On the other hand tax incentives can be more effective than direct support for R&D (OECD 2012), as there is no subjective decisions to be made about the distribution of support among specific economic sectors, industries, and firms. Thus, more firms are encouraged to undertake innovative activities (Bloom et al. 2002, pp. 1-31). Policy makers believe, that greater public support for R&D activities leads to an increase in R&D investments, which, in turn, results in an increase in innovation performance. An example of how the *additionality* effect can be estimated is included in the works of Halpern (2010) who, while investigating Hungarian firms, found a positive relationship between subsidies and both the level of R&D expenditure and innovation performance.

In this research we suppose that financial support directly influencing eco-innovation will have more impact on eco-innovation performance than public financial support that is generally directed towards innovation activities. Thus the second hypothesis is formulated:

Hypothesis 2. *Financial incentives deliberately supporting the introduction of eco-innovation are more important for the firms' eco-innovation performance than financial support for "standard" innovation activities.*

Research shows that firms are often unable to assess the future business performance in the context of their sustainability engagement, therefore do not engage spontaneously in SD/CSR-related innovations (Kemp 2000), and their engagement in eco-innovation depends to big extent on regulations, defined as "a policy with a strictly controlled purpose that is formulated by public authorities without the involvement of private agents (Paraskevopoulou 2012, pp. 1058–1071).

Empirical studies suggest, that environmental regulation remain a key element of triggering eco-innovation (Beise & Rennings 2005, pp. 5–17). An extensive body of literature positively validates the hypothesis of the important impact of regulations and anticipation of regulation on the introduction eco-innovation in enterprises (Frondel et al. 2008, pp. 153–160; Rennings & Rexhäuser 2011, pp. 274–290). Thus environmental regulation, although rather conventional tool, creates still motivates firms to shift their efforts towards green performance (Kemp 2011). Hence, we argue, that the dominant role of regulation is one of the main driver of eco-innovation, leading us to the last hypothesis:

Hypothesis 3. *Among all eco-innovation policy actions, existing environmental regulations have the greatest impact on the introduction of eco-innovation.*

4. Sample, operationalization of variables, methods applied

The analysis of eco-innovation drivers is based on firm-level anonymous micro-data from the Community Innovation Survey (CIS) for 2006–2008, covering enterprises from Bulgaria, the Czech Republic, Romania and Germany,[3] which exceptionally included a set of 15 questions on environmental innovation, covering both the types of eco-innovation potentially introduced by firms as well as their drivers. Firms from branches with a higher impact on the environment were extracted from each country sample. These included: enterprises from NACE section B (mining and quarrying); section C (manufacturing); section D (electricity, gas, steam and air conditioning) and section H (transportation and storage).

Chi-square with column proportions (the Bonferroni method) was applied to verify statistically significant differences between country sub-samples. Within the refined sub-samples are 16 percent of firms from Bulgaria; 35 percent of firms located in the Czech Republic; 18 percent of Romanian-based firms, and 39 percent of firms in Germany which introduced product innovation, and 17, 39, 23 and 36 percent of firms (respectively in the countries under study) that implemented process innovation. In all of the analysed countries a minority of firms implemented organizational innovation (16, 42, 25 and 43 percent of firms, respectively). Also, fewer firms implemented marketing innovation (11, 37, 23 and 43 percent respectively). Small enterprises constituted 74 percent of the Bulgarian, 34 percent of the Czech, 36 percent of the Romanian and 38 percent of the German sample. As regards medium-sized and large enterprises, they constituted are 23 and 4 percent respectively in Bulgaria, 40 and 26 percent in Czech, 47 and 17 percent in Romania, and 34 percent and 28 percent in the German sample. In all surveyed countries the majority of firms are from NACE C, followed by H, D and B. The domestic (national) market was the most important target market for the analysed firms, followed by European market (EU/EFTA). The markets other than the EU/EFTA markets were the least important ones for firms in each country sample (see Table 2 for further details).

Operationalization of the variables based on the definitions derived from CIS 2008 is presented in Table 3.

[3] CIS 2008 micro data for 16 European countries (namely: BG-CY-CZ-DE-EE-ES-HU-IE-LT-LV-PT-RO-SI-SK-NO) obtained based on the "*Contract on the use of Community Innovation Survey (CIS) micro data for research purposes – CIS/2012/13*" signed on 18.10.2012 between the European Commission Eurostat, Unit B1 and the Warsaw School of Economics.

5. Results of the analysis

The exploratory nature of this part of the paper influenced the data analysis methods. To answer the research questions exploratory factor analysis (Oblimin rotation), stepwise regression, and Z Fisher were used. Factor analysis of eco-innovation for Romanian enterprises[3] using Oblimin rotation (KMO=0.872; $x^2(36) =289245.67$; $p<0.001$) allowed us to determine two underlying factors which explain 65.46% of the Variance. The first factor: "*Environmental benefits from the production of goods within the enterprise*" explains 35.88% of the Variance (Crombach's $\alpha = .856$). The second one: "*Environmental benefits from the after sales use of goods by the end user*" explains 29.58% of the Variance (Crombach's $\alpha = .781$). Details of the analysis are presented in Table 4.

In the following part, due to the limited space, the hypothesis H1 – H3 will be tested only for the extracted variables: "*Environmental benefits from the production of goods or services within the enterprise*".

Based on the results of stepwise regression we can conclude that public financial support from local authorities for innovation activities did not have a statistically significant impact on the introduction of eco-innovation within the surveyed countries, whereas public financial support from government authorities is an important factor for the introduction of eco-innovation with accompanying environmental benefits from production in the Czech Republic and Germany. Public financial support from the European Union is important only among Bulgarian enterprises. Based on these results we can argue that with respect to the introduction of eco-innovation with environmental benefits within the enterprise **hypothesis H1a** has been **rejected for all surveyed countries**, **H1b** has been **supported for Czech Republic and Germany,** and **H1c** has been s**upported** only **in case of Bulgarian enterprises**.

Government grants, subsidies or other financial incentives designed especially to spur eco-innovation, although they have a positive and statistically important impact, did not turn out to be more influential than public financial support for overall innovation performance. Thus hypothesis H2 has been rejected for all surveyed countries.

Out of five driving forces directly connected with eco-innovation and which can have a potential impact on its introduction, those related to existing regulations were ranked the highest in two countries. Thus the hypothesis H3 is supported for Bulgaria and Romania. Apart from analysing the policy drivers, due to the construction of the CIS questionnaire it was possible to also observe the impact of expected regulations or

taxes, market demand for eco-innovation, as well as voluntary codes or arrangements within the sector concerning the introduction of eco-innovation.

With respect to expected market regulations, in all the surveyed countries they have a significantly important impact on the introduction of eco-innovation. Voluntary codes or arrangements within the sector and market demand for innovation are also important eco-innovation drivers.

In the case of Bulgaria, analysis of the whole spectrum of eco-innovation drivers shows, that their importance, although statistically significant, does not play as important a role as environmental regulations. Very similar results were obtained for Romanian enterprises. It is different in the case of the Czech Republic, where voluntary codes or agreements within a sector, as well as expected regulations play equally as important role as existing regulations. This is very similar to the results obtained for Germany, where the spectrum of equally important factors for the introduction of eco-innovation is even larger.

In Romania there is no statistically significant impact of public financial support from local, government, as well as EU sources for innovation activities, on the introduction of eco-innovation, whereas in Germany such a relationship exists between public support from government authorities.

In Romania, the most influential driving forces are existing environmental regulations or taxes, which have a statistically stronger impact than expected regulations and market demand for eco-innovation. Grants and subsidies are significant, but have the lowest impact on eco-innovation.

In Germany, both existing as well as expected environmental regulations, and also market demand and voluntary codes and agreements have a positive, statistically significant influence and the same strength of impact on the introduction of eco-innovation.

The results of stepwise regression are presented in Table 5, whereas Table 6 contains a summary of the hypotheses' verification.

6. Conclusions

The aim and objective of this study was to find the relationship between public financial support, environmental regulations, and eco-innovation performance and provide evidence concerning the importance of these driving forces for the eco-innovation activity of enterprises from Bulgaria, the Czech Republic, Romania and Germany.

The results for Bulgaria revealed the *eco-innovation additionality* of public financial support from the European Union, with a simultaneous lack of impact of resources from local and government authorities. The positive impact of funds from the EU may be related to the sample structure, in which small enterprises dominated. Research shows that financial support *additionality* is much more visible within this group of enterprises, and the crowding out effect of private funds is less frequent (Kemp 2011).

The general limited role of financial support, especially that coming from EU, may result from the fact that the innovation process cannot be reduced to linear relationships only, and in addition the effects may be postponed over time. Other reasons may be the still insufficient level of such aid directed towards eco-innovation, as well existing blockages in the absorption of European funds by enterprises (Cace et al. 2011), deriving from both administrative barriers and insufficient communication (Wysokińska 2012, pp. 5–29).

On the other hand, the positive impact of support from government authorities in the Czech Republic (for both groups of innovation) and Germany (for eco-innovation with benefits for end users) may reflect the shift in the innovation policy towards environmentally-friendly innovation in these countries.

We also found, that the potential of grants and subsidies directed towards eco-innovation is not fully used by CEE enterprises. Possible reason of this limitation, may be caused by drawbacks of this stimuli, mentioned in the theoretical part (Veugelers 2012).

Finally, the results suggest that environmental regulations affects eco-innovation as firms respond to environmental regulations with higher levels of eco-innovations. It should be underlined however, that eco-innovation cannot be considered only as a systematic response to regulation (Kowalska 2014, pp. 153–158), as the positive impact of demand for eco-innovation is reflected in the findings of many authors (Rennings 2000; Horbach 2008; Doran and Ryan (2012). This study, although limited to one period of observations, deepens our understanding of the factors that initiate and boost eco-innovations in firms from countries under study.

At this point we should bear in mind however that the CIS questionnaire does not specify whether the demand comes from individual customers or other enterprises. It may also be created by the government itself. More precise questions could help to investigate this issue.

With regard to future research directions, we can conclude, that only a wider policy-mix, based on several sources of incentives, may be influential enough to convince enterprises to introduce eco-innovation and follow the path of sustainable growth (Kaźmierczak-Piwko 2012, pp. 533–543; Burchard-Dziubińska 2014, pp. 135–150).

The breadth of the results of this paper opens up research avenues for further in-depth analyses, such as the complementarity impact of different eco-innovation driving forces and thus policy interaction effects.

While this study confirms the importance of different eco-innovation drivers and is based on representative samples from the four surveyed countries, the analysis has its limitations. It covers only a single-period CIS panel, which reduced the opportunities to assess long-term trends of the causal effects under study. The statistically significant differences among the surveyed samples might also bias to some extent the results of this study, especially due to the differences in firms' size and structure, intensity of the introduction of other types of innovation, sales target markets etc.

It should be emphasized however that the presented analysis is based on representative samples of Bulgarian, Czech, Romanian and German enterprises, so the research results do reflect the real casual relationships between eco-innovation and their drivers in the context of the overall innovation performance of the above-mentioned countries.

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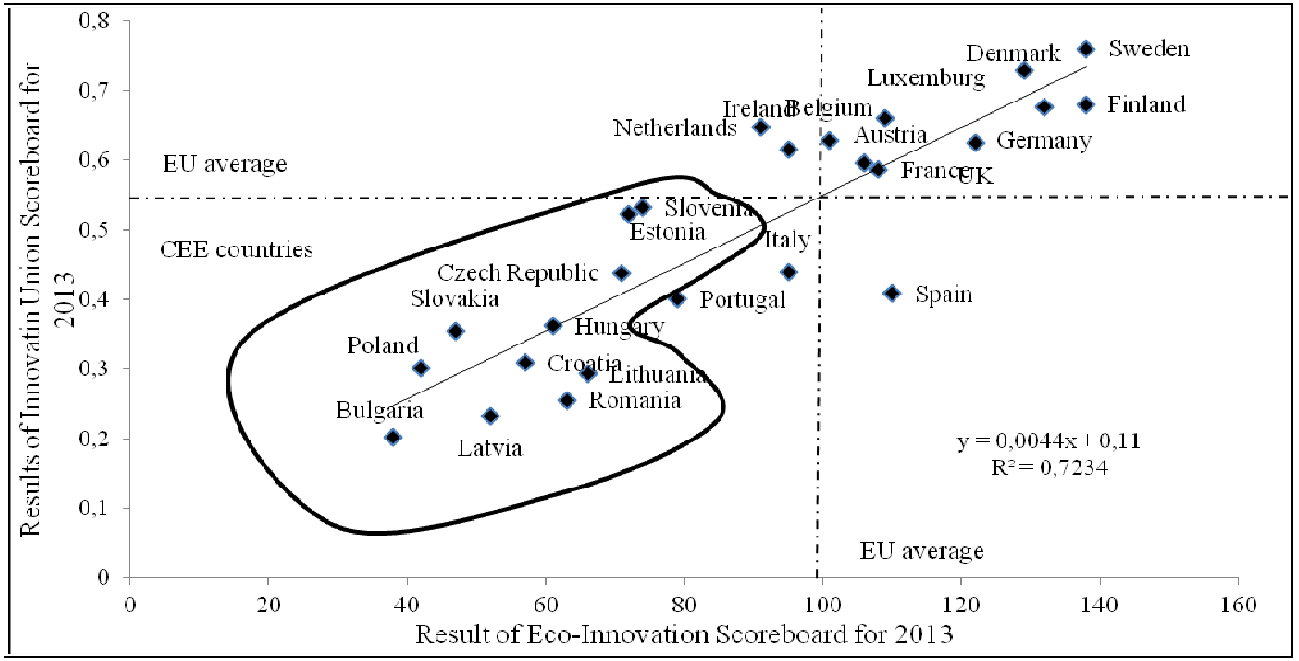
Chart 1. Relation between results of Innovation Union Scoreboard and Eco-Innovation Scoreboard for year 2013, selected EU countries



Note: there are no results for Cyprus, Greece and Malta. The "distance-to-reference" method is used, with the EU average being defined as the reference and set as a value of 100. http://database.eco-innovation.eu/indicators/view/269/1

Source: own compilation based on results of the Eco-Innovation Scoreboard 2013, Innovation Union Scoreboard 2015 (results for 2013).

Table 1. Policy measures supporting eco-innovation in Bulgaria, the Czech Republic and Germany, data for 2011

Group of policy measures	Maximum number of policy types	Bulgaria	Czech Republic	Romania	Germany
SUPPLY SIDE MEASURES					
Equity business support	2	2	-	-	2
Support for R&D in public sector and industry	3	3	1	-	3
Fiscal measures	2	1	-	-	-
Education, training	4	2	-	1	2
Networks and partnership promotion	4	2	3	3	4
Number of policy types supporting supply side	*15*	*10 (66%)*	*4 (27%)*	*4 (27%)*	*11 (73%)*
DEMAND SIDE MEASURES					
Regulations and standards	2	2	2	2	2
Public procurement	3	1	1	1	-
Technology transfer	2	-	1	2	2
Support of private demand	4	1	2	1	2
Number of policy types supporting demand side	*11*	*4 (36%)*	*6 (54%)*	*6 (54%)*	*6 (54%)*
Total number of policy types	*26*	*14 (54%)*	*10 (38%)*	*10 (38%)*	*17 (65%)*

Source: own elaboration based on EIO (2012), pp. 55–56.

Table 2. Sample description of enterprises from Bulgaria, Czech Republic, Romania and Germany from selected NACE categories, which in 2006-2008 introduced at least one type of eco-innovation

Sample characteristics		Bulgaria (BG) (n=10742)		Czech Republic (CZ) (n = 3470)		Romania (RO) (n = 6034)		Germany (DE) (n = 3940)	
		n	%	n	%	n	%	n	%
Product innovation		1712	15.9b	1216	35a	1110	18.4b	1529	38.8a
Process innovation		1850	17.2b	1351	38.9a	1399	23.2b	1408	35.7a
Organisational innovation		1743	16.2c	1450	41.8a	1532	25.4b	1693	43a
Marketing innovation		1196	11.1d	1283	37b	1412	23.4c	1694	43a
Enterprise as part of capital group		813	7.6d	1398	40.3b	723	12c	1738	44.1a
NACE	B	153	1.4a	111	3.2a	166	2.8a	87	2.2a
	C	8942	83.3a	2792	80.4a	5070	84a	3283	83.4a
	D	104	1c	176	5.1a	144	2.4a.b	161	4.1b
	H	1543	14.4a	391	11.3b	654	10.8b	409	10.6b
Size	Small	7893	73.5a	1195	34.4b	2172	36b	1503	38.1b
	Medium	2415	22.5d	1370	39.5b	2829	46.9a	1350	34.3c
	Large	434	4c	905	26.1a	1033	17.1b	1087	27.6a

Note: Each letter (a, b, c, d) denotes a subset of categories whose column proportions (Bonferroni method) differ significantly from each other at the 0.05 level (differences in lines between results for four samples).

Source: own calculations in SPSS 21 based on anonymised micro data from CIS 2008 for Bulgaria, Czech Republic, Romania and Germany.

Table 3. Description and construction of variables

Variable	Description and construction of variables
	Variable – "Eco innovation drivers"
LocSupp	"1" if during 2006-2008 firm received public financial support for innovation activities from local or regional authorities (including financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees). Excluding research and other innovation activities conducted entirely for the public sector under contract); "0" otherwise
GovSupp	"1" if during 2006-2008 firm received public financial support for innovation activities from the central government (including financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees. Excluding research and other innovation activities conducted entirely for the public sector under contract); "0" otherwise
EUSupp	"1" if during 2006-2008 firm received public financial support for innovation activities from European Union (including financial support via tax credits or deductions, grants, subsidised loans, and loan guarantees. Excluding research and other innovation activities conducted entirely for the public sector under contract); "0" otherwise
EnReg	"1" if during 2006-2008 firm introduced eco innovation in response to existing environmental regulations or taxes on pollution ; "0" otherwise
EnRegExp	"1" if during 2006-2008 firm introduced eco innovation in response to expected environmental regulations or taxes; "0" otherwise
EnGra	"1" if during 2006-2008 firm introduced eco innovation in response to the availability of government grants, subsidies or other financial incentives for environmental innovation; "0" otherwise
EnDem	"1" if during 2006-2008 firm introduced eco innovation in response to market demand from customers for eco innovation ; "0" otherwise
EnAgr	"1" if during 2006-2008 firm introduced eco innovation in response to voluntary codes within a sector; "0" otherwise

	Variable – “introduction of Eco Innovation”
EcoMat	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced material use per unit of output ; “0” otherwise
EcoEn	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced energy use per unit of output ; “0” otherwise
EcoCO$_2$	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced CO_2 production by enterprise; “0” otherwise
EcoSub	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced materials with less polluting substitutes; “0” otherwise
EcoPol	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced soil, water, noise or air pollution ; “0” otherwise
EcoWat	“1” if during 2006-2008 firm introduced eco innovation resulting in recycled waste, water, materials; “0” otherwise
EcoEnEndU	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced energy use by the end user; “0” otherwise
EcoPolEndU	“1” if during 2006-2008 firm introduced eco innovation resulting in reduced air, water, soil or noise pollution by the end user; “0” otherwise
EcoRecEndU	“1” if during 2006-2008 firm eco innovation resulting in improved recycling of product after use; “0” otherwise

Note: definitions are taken directly from the CIS 2006-2008 questionnaire.

Source: own elaboration based on questionnaire CIS 2006-2008.

Table 4. Rotated Component Matrix for eco-innovation introduced within Romanian enterprises

Components	Environmental benefits	
	from the production of goods within the enterprise *EcoEnt*	from the after sales use of goods by the end user *EcoEndU*
EcoMat	0.828	
EcoCO_2	0.786	
EcoWat	0.728	
EcoPol	0.666	
EcoSub	0.580	
EcoEn	0.566	
EcoEnEndU		0.854
EcoRecEndU		0.839
EcoPolEndU		0.629

Extraction Method: Principal Component Analysis. [a]. Rotation converged in 5 iterations.
Note: the results for Bulgaria, Czech Republic and Germany were very similar. Available on the request from the author.

Source: own calculations in SPSS 21 based on anonymised micro data from CIS 2008 for Romania.

Table 5. Determinants of eco-innovation within Bulgarian, Czech, Romanian and German enterprises – results of stepwise regression

Eco innovations and their driving forces	Bulgaria n=10742		Czech Republic n =3470		Romania n=6034		Germany n=3193	
	Beta	p	Beta	p	Beta	p	Beta	p
Public support from local authorities	-0.002d	.880	0.019	.348	-0.005d	.776	0.021c	.192
Public support from government authorities	0.011d	.439	0.056b	.007	0.035d	.067	0.043c	.008
Public support from European Union	0.055c	.000	0.007c	.754	-0.005d	.775	0.023c	.160
Government grants, subsidies	0.092c	.000	0.066b	.002	0.065c	.002	0.011c	.485

Existing environmental regulations or taxes	0.376a	.000	0.254a	.000	0.370a	.000	0.149a	.000
Expected environmental regulations or taxes	0.189b	.000	0.205a	.000	0.154b	.000	0.196a	.000
Market demand for eco innovations	0.056c	.000	0.094b	.000	0.200b	.000	0.206a	.000
Voluntary codes or agreements within sector	0.173b	.000	0.203b	.000	0.118c	.000	0.193a	.000

Note: Each letter (a, b, c) denotes a subset of categories whose column proportions (Z Fisher method) differ significantly from each other at the 0.05 level.

Source: own calculations in SPSS 21 based on anonymised micro data from CIS 2008.

Table 6. Hypotheses verification – a summary

Hypotheses	Bulgaria	Czech Rep.	Romania	Germany
H1a: *Financial support for innovation from local authorities results in eco-output additionality and thus stimulates firms' eco-innovation performance*.	Rejected	Rejected	Rejected	Rejected
H1b: *Financial support for innovation from government authorities results in eco-output additionality and thus stimulates firms' eco-innovation performance*.	Rejected	(+)**	Rejected	(+)**
H1c: *Financial support for innovation from EU authorities results in eco-output additionality and thus stimulates firms' eco-innovation performance*.	(+)***	Rejected	Rejected	Rejected
H2: *Financial incentives deliberately supporting eco-innovation are more important for the firms' eco-innovation performance than financial support for "standard" innovation activities.*	Rejected	Rejected	Rejected	Rejected
H3: *Among all eco-innovation policy actions, those related to environmental regulations have the greatest impact on the introduction of eco-innovation.*	(+)***	Rejected	(+)***	Rejected

Note: significant at***if $p<0.001$; ** if $p<0.01$; * if $p<0.05$.

Source: own elaboration based on the research results.

Streszczenie

CZY POLITYKA PAŃSTWA WSPIERA EKOINNOWACJE W PRZEDSIĘBIORSTWACH Z KRAJÓW EUROPY ŚRODKOWO–WSCHODNIEJ?

Innowacje ekologiczne powinny stanowić jeden z głównych filarów gospodarek krajów europejskich, w tym również tych z Europy Środkowo-Wschodniej. Celem niniejszego opracowania jest przedstawienie analizy porównawczej determinantów ekoinnowacji wybranych krajach EŚW. Część empiryczna opracowania oparta jest na danych jednostkowych z kwestionariusza CIS 2006-2008 dla przedsiębiorstw z Bułgarii, Czech, Rumunii i Niemiec. Wyniki regresji liniowej dla polityki wspierającej działalność innowacyjną wskazują, że wsparcie finansowe dla działań innowacyjnych ma raczej ograniczoną rolę w promowaniu innowacji ekologicznych, zaś za najważniejsze stymulatory ekoinnowacji przedsiębiorstw 'z regionu uznawane są istniejące regulacje dotyczące ochrony środowiska. W Niemczech, kraju o wyższym rankingu Eco-Innovation Scoreboard, spektrum stymulatorów ekoinnowacji jest dużo szarsze i bardziej zrównoważone. Prowadzi to do wniosku, że wysiłki rządu winny być kierowane nie tylko na doskonalenie polityki dotyczącej środowiska, ale tworzyć podstawy dla prawnego i instytucjonalnego otoczenia, promującego model zielonej gospodarki.

***Słowa kluczowe**: Europa Środkowo-Wschodnia; ekoinnowacja; regulacje; CIS*