
Eco-innovation, International Competitiveness and Economic Performance of European Union Enterprises: Triangle Approach

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Abstract:

Purpose: The paper examines the links between eco-innovation, economic performance and international competitiveness of European Union enterprises.

Design/Methodology/Approach: It presents a comparative cross-country analysis based on the data of representative sample of enterprises from European Union members states from 2012-2014 Community Innovation Survey. The empirical results are based on the Path Analysis.

Findings: The results show that the eco-innovation plays an important role in increasing international competitiveness of firms, and has a positive impact on its intellectual property. However, the link between eco-innovation and firms' economic growth is not revealed.

Practical implications: Governments' efforts should be directed not only at changing the current eco-regulations, and eco-policies, but also at respective transforming the institutional environment, promoting green education, and shaping citizens' as well as businesses' commitment to sustainable objectives.

Originality value: The research points out on the positive link between international competitiveness and firms economic performance. More importantly, we find also evidence that international competitiveness act as a mediating variable between the introduction of eco-innovation and firms economic performance, which is still underdeveloped in the economic literature.

Keywords: Eco-innovation, international competitiveness, economic performance, path analysis.

JEL classification: O32, C38, M21.

Paper type: Research article.

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1. Introduction

The aim of this paper is to present a comparative cross-country analysis of the relationship between Eco-Innovation (EI), International Competitiveness (IC) and Economic Performance (EP) of enterprises from selected European Union countries.

The paper is structured as follows: Section two, the theoretical part provides an insight into the role of eco-innovation in enhancing firms international competitiveness and well as economic performance. The empirical part in section three is based on anonymized micro-data from 2012-2014 Community Innovation Survey (CIS) questionnaire. The sample of N=6150 firms covers entities from nine countries, namely, Germany, Portugal, Latvia, Spain, Croatia, Cyprus, Estonia, Lithuania and Romania. In order to verify the theoretical model of the link of three above mentioned variables Path Analysis, that is viewed as similar method to Structural Equation Modelling (SEM) is used. Next, the bootstrapping - metric that relies on random sampling with replacement was implemented. Results of empirical research are presented in fourth part of this manuscript, whereas discussion, conclusions and limitations make up the fifth part.

2. Literature Review and Hypotheses Development

2.1 Eco-Innovations (EI) and Economic Performance (EP)

Although innovation is widely recognized as an important driver of competitive advantage and resultant improvement of firm's economic performance, the propensity of many firms to eco-innovate is still limited.

The specificity of eco-innovation (EI) requires that its performance assessment has also to consider various environmental dimensions of innovative outcomes. Therefore, basing on the extant literature (Ketata *et al.*, 2015; Rauter, 2018) we conceptualize EI performance as the outcome of the firm's innovation activities with focus on, (i) sustainable product design (e.g., eco-friendly materials, life-cycle optimization), (ii) process efficiency (e.g., reduction of resource input and utilization), (iii) reduction of environmental harm (e.g., reduction of pollution, waste, and resource deployment).

EI is perceived as an additional resource/cost burden decreasing the cost advantage, while the benefits from EI are difficult to measure, deferred, and assessed differently by various stakeholders (Ambec *et al.*, 2013; Venkatraman, Nayak, 2015). The research on the influence of EI on firms' competitive advantage does not bring clear conclusions. Research conducted mostly in mature economies shows positive impact of EI on firm's competitiveness (Doran and Ryan, 2012; 2014; Gonzalez-Ramos *et al.*, 2014).

According to Ghisetti and Rennings (2014), EIs aimed at lowering energy and material costs boost cost competitiveness, whereas EIs aiming at mitigating environmental impact decrease cost competitiveness. It is claimed that EIs have at least as positive an influence on their economic performance as "traditional" innovations, and that EIs have no negative impact (Cainelli *et al.*, 2012). According to some studies, the gain in productivity caused by EI is less than that caused by "traditional" breakthroughs (Marin and Lotti, 2017).

Numerous studies show that EI has a positive impact on business economic performance (Lanoie *et al.*, 2011; Ar, 2012; Zhang and Walton, 2016). Other research, on the other hand, yield mixed results. Horvathova (2010) found that 55 percent of research found favorable benefits of EI on economic performance, 15% found negative effects, and 30% found no significant influence of company eco-engagement on economic performance in a meta-analysis.

According to research, higher productivity as a result of EIs has a beneficial impact on business profitability (Rennings and Rammer, 2009; Horbach *et al.*, 2013). EIs focused at increasing a firm's resource efficiency have a favorable influence on profitability, according to Rexhäuser and Rammer (2013), whereas EIs aiming at decreasing environmental harm have a negative impact on economic performance (profitability).

Based on the above mentioned literature, we posit the following hypotheses:

H1a. Introduction of Eco-innovation with Environmental Hazard Related Objectives (EHRO) has a positive influence on firms' Economic Performance (EP).

H1b. Introduction of Eco-innovation with Cost Saving Related Objectives (CSRO) has a positive influence on firms' Economic Performance (EP).

2.2 Eco-innovations (EI) and Firm's International Competitiveness (IC)

In general, studies on the relationship between exports and innovations reveal that innovation has a higher impact on exports and that "learning by exporting" has a lower effectiveness (Monreal-Pérez *et al.*, 2012; Lewandowska and Gobiowski, 2014).

There is a lack of research on the relationship between EIs and a firm's worldwide competitiveness. Because EIs have a good impact on a company's competitiveness, it is reasonable to believe that this engagement will also help the company's international competitiveness, resulting in increased exports. EI, according to Costantini and Mazzanti (2012), contributes to international competitiveness and may encourage the export of "green" products. The following possibilities are proposed in this context:

H2a. Introduction of Eco-innovation with Environmental Hazard Related Objectives (EHRO) has a positive influence on firms' International Competitiveness (IC).

H2b. Introduction of Eco-innovation with Cost Saving Related Objectives (CSRO) has a positive influence on firms' International Competitiveness (IC).

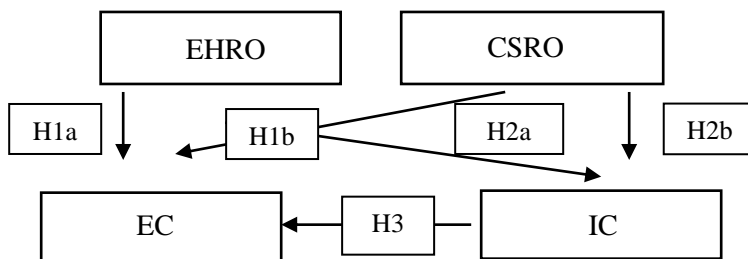
2.3 Firm's International Competitiveness (IC) and Economic Performance (EP)

In the international business literature there are many examples of a positive relationship between the degree of internationalization of the company and its results (Delios and Beamish 1999; McDougall and Oviatt 1996; Schwens *et al.*, 2018). Various studies point to the learning process following the sales to foreign markets ("learning by exporting" concept), which results in increased productivity, sales growth, investments in R&D, but also in new solutions in the products that are offered (Love and Ganotakis, 2013; Mińska-Struzik, 2014).

Aguilera-Caracuel (2012) revealed that high organizational learning capability and more complex experience of environmental international diversification are positively related to a firm's proactive environmental strategy. International institutional pressures stimulate the adoption of firm's proactive environmental practices (Hojnik *et al.*, 2018). Taking these arguments into account, we place further:

H3. International Competitiveness (IC) of an enterprise has a positive impact on its Economic Performance (EP).

Figure 1. The conceptual model



Note: EHRO – Eco-innovation with Environmental Hazard Related Objectives; CSRO - Eco-innovation with Cost Saving Related Objectives; IC - International Competitiveness; EC - Economic Performance;

Source: Own elaboration.

3. Materials and Methods

3.1 Sample Characteristics

The whole initial sample consisted of 98809 enterprises, including 26168 from NACE section A, 25408 from section B, 12810 from section C and 3231 from section D. The remainder of the sample (31192) comes from the rest of NACE sections, and include also service enterprises. In the model we introduced only entities with the full coverage of information. For that reason we ended up with the final sample of N = 6150 (Table 1).

Table 1. Split of the final sample of European Union enterprises that was introduced to the model

| Country | Model sample (N) | Model sample split (percent) |
|-----------|------------------|------------------------------|
| Cyprus | 127 | 2.1 |
| Germany | 3713 | 60.4 |
| Estonia | 59 | 1.0 |
| Spain | 268 | 4.4 |
| Croatia | 249 | 4.0 |
| Latvia | 444 | 7.2 |
| Lithuania | 9 | .1 |
| Portugal | 1273 | 20.7 |
| Romania | 8 | .1 |
| Total | 6150 | 100.0 |

Source: Own calculations in SPSS 21.

3.2 Defining and Measuring Eco-Innovation, International Competitiveness and Economic Performance for the Purpose of the Empirical Study

The theoretical model consists of three related variables, Eco Innovation (EI), International Competitiveness (IC), and Economic Performance (EP).

For the purpose of this research, we define *Eco-innovation (EI)* (innovation with environmental benefits) as a “new or significantly improved product (good or service), process, organisational method or marketing method that creates environmental benefits compared to alternatives. The environmental benefits can be the primary objective of the innovation or a by-product of other objectives and the environmental benefits of an innovation can occur during the production of a good or service, or during its consumption or use by the end user of a product. The end user can be an individual, another enterprise or the government” (CIS 2012-2014, part 1).

We also assume that *International Competitiveness (IC)* is defined as a firm’s capability to achieve higher performance than its competitors in the global arena (Cerrato and Depperu, 2011) and is measured with the use of two dimensions, scope of the international presence (number of foreign markets served) and intensity of the presence measured by the percent of total turnover from sales outside the country (CIS 2012-2014, part 1.3 and 14.2).

Economic Performance (EP) would be measured by the change in total turnover (CIS 2012-2014, part 11.1).

3.3 Variables Operationalisation

The profile of CIS data determines the measurement of selected variables (Table 2).

Table 2. *Variables operationalization*

| Abbreviation | Variables operationalization |
|---------------------|--|
| EI | Eco innovation (EI) |
| EHRO | Environmental Hazard Related Objectives |
| ECOENO | “1” if indication for reduced energy use; “0” otherwise. |
| ECOENU | “1” if indication for reduced CO ₂ ‘footprint’, “0” otherwise. |
| ECOPOL | “1” if indication for reduced air, water, noise, soil pollution; “0” otherwise. |
| ECOPOS | “1” if indication for reduced air, water, soil or noise pollution by end user, “0” otherwise. |
| ECOREP | “1” if indication for replaced a share of fossil energy with renewable energy sources, “0” otherwise. |
| CSRO | Cost-Saving Related Objectives |
| ECOREA | “1” if indication for facilitated recycling of product after use for end user, “0” otherwise. |
| ECOREC | “1” if indication for recycled waste, water, or materials for own use or sale, “0” otherwise. |
| ECOEXT | “1” if indication for extended product life through longer-lasting, more durable products, “0” otherwise. |
| ECOMAT | “1” if indication for reduced material or water use per unit of output; “0” otherwise. |
| ECOSUB | “1” if indication for replaced a share of materials with less polluting or hazardous substitutes, “0” otherwise. |
| IC | International Competitiveness |
| MAREUR | “1” if indication for other European Union or associated countries “0” otherwise. |
| MAROTH | “1” if indication for all other countries , “0” otherwise. |
| SLO12 | From more than 0% to 100% if indication for total turnover from sales to clients outside own country in 2012. |
| SLO14 | From more than 0% to 100% if indication for total turnover from sales to clients outside own country in 2014. |
| EP | Economic Performance |
| TURN | Percent of change between total turnover between 2012 and 2014. |

Source: Own elaboration based on microdata from CIS 2012-2014. Abbreviations are taken directly from CIS questionnaire.

Principal Component Analysis was applied to identify the dimensions of the space of Eco-Innovation (EI) as well as International Competitiveness (IC).

Analysis of *Eco Innovation* using Equamax rotation with Kaiser normalisation (KMO=0.753; $\chi^2 = 11297.699$; df=45; p<0.001) allowed us to determine 2

underlying constructs which explain 42.999% of the Variance. The first construct named *Environmental Hazard Related Objectives (EHRO)* explains 23.463% of the Variance (Crombach's $\alpha = .797$), the second one – *Cost Saving Related Objectives (CSRO)* explains 19.535% of the Variance (Crombach's $\alpha = .607$). The construct EHRO consists of 5 items: ECOENO, ECOENU, ECOPOL, ECOPOS and ECOREP. The construct CSRO comprises 5 items: ECOREA, COREC, ECOEXT, ECOMAT and ECOSUB (Table 3 and Table 4).

Table 3. Total Variance Explained for Rotated Component Matrix of eco-innovation objectives

| Factor | Extraction sums of squared loadings | | | Rotation sums of squared loadings | | |
|--------|-------------------------------------|------------------------|-------------------------------------|-----------------------------------|------------------------|-------------------------------------|
| | Eigenvalue | Explained Variance (%) | Accumulative explained Variance (%) | Sums of squared | Explained Variance (%) | Accumulative explained Variance (%) |
| 1 | 3.114 | 31.140 | 31.140 | 2.346 | 23.463 | 23.436 |
| 2 | 1.186 | 11.859 | 42.999 | 1.954 | 19,535 | 42.999 |

Source: Own elaboration in SPSS 21based on microdata from CIS 2012-2014.

Table 4. Rotated Component Matrix of eco-innovation objectives to be attained by the enterprise or as benefit for end user

| Eco-innovation objectives | Factor | |
|---------------------------|--|---------------------------------------|
| | Environmental Hazard Related Objectives (EHRO) | Cost Saving Related Objectives (CSRO) |
| ECOENO | .760 | -.100 |
| ECOENU | .686 | .175 |
| ECOPOL | .683 | .154 |
| ECOPOS | .635 | .337 |
| ECOREP | .422 | .191 |
| ECOREA | .152 | .749 |
| ECOREC | .037 | .607 |
| ECOEXT | .230 | .602 |
| ECOMAT | .087 | .496 |
| ECOSUB | .408 | .448 |

Source: Own elaboration in SPSS 21based on microdata from CIS 2012-2014.

Analysis of *International Competitiveness* allowed us to determine 1 underlying construct (KMO=0.638; $\chi^2 = 96227.19$; df=6; $p < 0.001$) which explain 64.4% of the Variance (Cronbach's $\alpha = .778$). The construct named *International Competitiveness* consists of 4 items: MAREUR, MAROTH, SLO12, SLO14. All mentioned above constructs were calculated as summarised scales and normalised into interval from 0 to 1, where 0 means that none of the objectives and eco-effects respectively were indicated, and 1 meaning that all possible objectives respectively included in the construct were indicated. Further all of them were interpreted in percentages.

3.4 Methods Applied

The relationship between the research variables was tested with the use of the Path Analysis (Wright, 1934), that can be viewed as similar to structural equation modelling (SEM) – one in which only single indicators are employed for each of the variables in the causal model. Path Analysis examines strength of the linear direct and indirect relationship between two independent variables and one dependent variables. Next, the bootstrapping – a method for assigning measures of accuracy to sample estimates (Efron, 1979) – followed by correction Bootstrap for Goodness-of-Fit Measures (Bollen-Stine, 1992) were applied.

4. Results

The statistical approach to testing the hypotheses employed Path Analysis, method - Generalized Least Squares (GLS), with the module AMOS 23, program PS IMAGO. Because of the number of distinct sample moments are equal to the number of distinct parameters to be estimated, the model is saturated and the quality of fitted model to the data is untestable. The model was bootstrapped (10000 repeating), what additionally supported the obtained results.

The analysis revealed, that there is no relation between both the introduction of Eco-Innovation with Cost Saving Related Objectives (CSRO) and the introduction of Eco-Innovation with Environmental Hazard Related Objectives (EHRO), and Economic Performance (EP). Based on these results hypothesis *H1a* and hypothesis *H1b* were rejected.

The positive relation between the introduction of both types of Eco-Innovation (CSRO and EHRO) and International Competitiveness (IC) was revealed, thus supporting hypotheses *H2a* and *H2b*.

Based on the results of Path Analysis we also found out a positive influence of International Competitiveness (IC) on firms' Economic Performance (EP) which allowed us to support hypotheses *H3*. The details are presented in Table 7.

Table 7. Results of Path Analysis for Integrated Model of relation between Eco-Innovation, International Competitiveness and Economic Performance

| Variable | Relation | Variable | Estimate | S.E. | C.R. | P | Hypotheses |
|--|----------|----------|----------|------|--------|------|----------------|
| Influence of the introduction of (EHRO) and (CSRO) on Economic Performance (EP) | | | | | | | |
| EG | <--- | EHRO | .028 | .016 | 1.726 | .084 | H1a (Rejected) |
| EG | <--- | CSRO | -.029 | .020 | -1.467 | .142 | H1b (Rejected) |
| Influence of the introduction of (EHRO) and (CSRO) on International Competitiveness (IC) | | | | | | | |
| IC | <--- | EHRO | .093 | .015 | 6.202 | *** | H2a (+)*** |
| IC | <--- | CSRO | .060 | .018 | 3.301 | *** | H2b (+)*** |
| Influence of International Competitiveness (IC) on Economic Performance (EP) | | | | | | | |
| EG | <--- | IC | .050 | .014 | 3.622 | *** | H3 (+)*** |

Source: Own elaboration based on results of Path Analysis.

5. Discussion and Concluding Remarks

Our focus was on assessment of the impact of the introduction of eco-innovation on firms' international competitiveness as well as on firms' economic performance. We suggest that the interplay between various EI with different objectives should be analyzed to apply appropriate sequence in their introduction and proper intensity of EI activities in a context of expected outcomes, such as increased competitiveness, improved business performance, and eco-benefits (Cheng *et al.*, 2014).

Another important outcome is the fact, that there is no straightforward relation between the introduction of eco innovation and firms' economic growth. This suggests, that the innovation process is not linear. However, in the medium/long term the positive impact of EI on productivity and financial results are likely (Marin, 2014).

As EI affects directly or indirectly different groups of stakeholders expecting various eco-benefits, the development and introduction of novel eco-solutions requires linkages with various stakeholders (also those apart from supply chain partners) such as competitors, governments, local authorities, and NGOs, to leverage more eco-benefits from the innovation (OECD, 2009; Yarahmadi and Higgins, 2012). All this implies the holistic approach in EI management.

European Union enterprises, which in many cases are focused on making a profit as soon as possible, without taking into account the long-term development perspective, should recognize that investing in eco-innovation will bring benefits in the long run in the form of achieving a competitive advantage in an area that would be impossible to achieve in traditionally run economy and building international competitive advantage (Klima, 2018).

This study is not without limitations. It should be noted, that in general, CIS data are to be used cautiously, as they are anonymous and in case of many questions, can reflect the perception of the respondent, not the real activities of enterprises.

Also, despite the representativeness of the initial sample of CIS 2012-2014 survey, the extracted number of innovative firms is relatively small, and consists mainly of German enterprises, what influences the results of the study. And lastly, data covering a longer time period than one wave of Community Innovation Survey panel would be particularly useful for study of the causal effects.

Despite these drawbacks, it should be underlined, that there is no better and more reliable data to conduct survey related to innovativeness within European Union

member states on the representative samples of enterprises, that allows to make international comparisons.

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