Economic Research-Ekonomska Istraživanja

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/rero20

Four types of eco-innovation for Baltic firms

Antonella Biscione, Annunziata de Felice, Teodoro Gallucci & Giovanni Lagioia

To cite this article: Antonella Biscione, Annunziata de Felice, Teodoro Gallucci & Giovanni Lagioia (2022) Four types of eco-innovation for Baltic firms, Economic Research-Ekonomska Istraživanja, 35:1, 196-212, DOI: 10.1080/1331677X.2021.1889393

To link to this article: https://doi.org/10.1080/1331677X.2021.1889393

Published online: 01 Mar 2021.

ECONOMIC RESEARCH-EKONOMSKA ISTRAŽIVANJA
2022, VOL. 35, NO. 1, 196–212
https://doi.org/10.1080/1331677X.2021.1889393

Four types of eco-innovation for Baltic firms

Antonella Biscione[a], Annunziata de Felice[b], Teodoro Gallucci[c] and Giovanni Lagioia[c]

[a]Department of Bioeconomic Strategies in the European Union and in the Balkans, Catholic University "Our Lady of Good Counsel", Tirana, Albania; [b]Department of Law, University of Bari Aldo Moro, Bari, Italy; [c]Department of Economics Management and Business Law, University of Bari Aldo Moro, Bari, Italy

ABSTRACT
Using the Community Innovation Survey data, in this paper we explore the external and internal drivers influencing the four types of eco-innovation in the Baltic manufacturing sector. For this purpose, we estimate a quadrivariate probit model to reveal potential complementarities across the four types of eco-innovation and identify the differences among sectors and countries. The empirical findings show that: i) some factors such as future eco-policies and voluntary actions are significant for most categories eco-innovation; ii) cost saving is the main driver for the eco-process; iii) government grants, subsidies or other financial incentives and current regulation are never significant and finally iv) cooperation is a crucial driving factor for the productive process.

ARTICLE HISTORY
Received 2 September 2020
Accepted 7 February 2021

KEYWORDS
multivariate probit model; eco-innovation; external drivers; internal drivers; manufacturing sector; Baltic area

JEL CODES
Q55; Q58; L6

1. Introduction

This paper investigates the external and internal factors that affect eco- innovation strategies in manufacturing firms in Baltic countries. In recent years there has been, among scholars and policy makers, a significant increase in terms of attention to environmental problems. There is a widespread consensus that eco-innovation is a key strategy as it is a combination of economic and environmental goals of firms (Del Rio et al., 2017).

Most research explores the determinants of eco-innovations in the European developed countries (i.e. Madaleno et al., 2020; Marzucchi & Montresor, 2017) or consider European countries in general (i.e. Cainelli et al., 2020; Ghisetti et al., 2015). Only few papers are devoted to eco-innovation in Transition countries (Biscione et al., 2021; Cooke, 2011; Horbach, 2016) and particularly in the Baltic area (Melece & Hazners, 2017; Melece, 2015). Exploiting the Eco-Innovation Index[1] provided by Eurostat, these works analyze the eco-innovation performance in EU member states highlighting that the Baltic countries, with respect to the other EU countries, are

CONTACT Antonella Biscione a.biscione@unizkm.al

characterized by a low eco-innovation level. Therefore, there is no comprehensive empirical evidence from microeconomic literature on eco-innovation in Baltic area. The only empirical paper that investigates the Baltic area in comparison with other transition countries is carried out by Biscione et al. (2021). Using CIS 2014 data survey and applying a multivariate probit model, they find that Baltic manufacturing firms, in comparison with the firms operating in the other transition countries taken into account, are less sensitive to implement eco-product and eco-organization. Differently from the analysis conducted by Biscione et al. (2021) we focus only on Baltic countries (Estonia, Latvia and Lithuania). These are transition economies with common features such as similar history and economic structure. All three countries are mainly specialized in low-tech productions, though they all have their own specific economic characteristics (de Felice et al., 2019) and for a long time they had obsolete firms with an inefficient technology inherited from the Soviet system (Miskinis et al., 2020).

Therefore, the aim of this paper is to contribute to the literature on eco-innovation by analyzing the effect of internal and external drivers on the firm's decision to adopt an eco-innovation strategy in Baltic manufacturing sector. The attention on the manufacturing sector is due to: (i) the potential eco-innovative strategies that this sector presents and (ii) the high awareness of firms about environmental standards and certifications (EIO, 2013). In contrast to Biscione et al. (2021), we consider four types of eco-innovation: (i) eco-product, (ii) eco-process, (iii) eco-organization and (iv) eco-marketing. We use cross-sectional data taken from the Community Innovation Survey -CIS 2014 to get a multivariate probit model to explore if the eco-innovative strategies of firms are complementary or replace each other.

The main finding to be claimed for this work is that not only cost saving is the main driver for the eco-process in Baltic manufacturing sector, but also future environmental regulations influence firms' decisions to introduce eco-innovation; in fact, our empirical evidence show that Baltic firms appear to be anticipating decisions on the expected regulation and giving it the same importance as the current regulation. Findings show that the success of eco-innovation endeavors depends on integration and cooperative interaction developed among firms, institutional and external partners.

The remainder of this paper is organized as follows: Section 2 focuses on the literature review and conceptual background of the eco-innovation drivers. Section 3 deals with data and variables, while Section 4 displays and discusses the methodology and the empirical findings. The last Section summarizes and concludes the paper.

2. Conceptual background and literature

To study the main drivers of eco-innovation we focus on external and internal factors (Arnold & Hockerts, 2010; Bossle et al., 2016; Carrillo-Hermosilla et al., 2010; Del Rio, 2009; Del Rio et al., 2017; Galliano & Nadel, 2013; Horbach, 2008).

Among the external drivers, environmental regulation plays a significant role in leading to eco-innovation (Arfaoui, 2018; Brunnermeier & Cohen, 2003; Cainelli et al., 2012; Chen et al., 2012; 2020; Demirel & Kesidou, 2011; Jaegul et al., 2011; Jaffe & Palmer, 1997; Johnstone et al., 2010; Kammerer, 2009; Kesidou & Wu, 2020;

Mazzanti & Zoboli, 2009; Popp, 2006; Xing et al., 2019; Zhang et al., 2020). Especially, strict environmental regulations and flexible environmental policy tools are institutional factors that boost the firms to adopt environmental innovation (Ghisetti & Pontoni, 2015; Pereira Sanchez & Vence, 2015). In contrast, the role of future regulation is controversial. According to the results obtained by Horbach et al. (2012), future regulation drives the German firms' environmental innovation decision, whereas the analysis carried out by Biscione et al. (2021) shows that future regulation does not affect the eco-innovation actions in the European transition countries.

Also, cooperation with external partners is crucial for eco-innovation (De Marchi, 2012). De Marchi (2012) analyses Spanish manufacturing firms and R&D cooperation. He finds a positive influence of cooperation on eco-innovation, especially the cooperation with external partners or with stakeholders (Wagner, 2007). Analyzing French firms, Mothe et al. (2018) find the same results.

Crucial is the role played by sector and market dimension in eco-innovation. The empirical results depend on the sectors examined (Marin & Lotti, 2017). Firms in low-tech industries, such as textile, footwear and plastics are less likely to trigger environmental innovation. Conversely, most of the chemicals and pharmaceutical firms introduce green innovations (Brunnermeier & Cohen, 2003; Horbach, 2008). Different technological opportunities, consumers' awareness, international competitiveness, and restrictions could explain the disparity across sectors (Brunnermeier & Cohen, 2003).

Market dimension refers to penetration in a new market segment where the company sells its product (Horbach et al., 2013; Tsai & Liao, 2017). In other words, it reflects the entry conditions of foreign markets where countries adopt regulations for the imported goods. The reason is to apply stringent environmental criteria to prevent non-ecological goods from entering the markets (Tsai & Liao, 2017). It follows that firms that export their products applying strict environmental regulations will be encouraged to implement eco-innovation (Chiarvesio et al., 2015; Shi & Xu, 2018; Tsai & Liao, 2017).

Related to the external driver is the reputation or brand image. Firms use brand image to communicate the safety and the positive environmental effect of their products (Galliano & Nadel, 2013; Srivastava, 2007) and reassure the stakeholders on the green quality of their products (Cazals, 2009). A firm with a good reputation has a comparative advantage with respect to the others (Roberts & Dowling, 2002). For this purpose, enterprises choose to invest resources in advertising and corporate social responsibility (CSR) to improve their reputation (Lloyd-Smith & An, 2019).

CSR is a component of firm voluntary actions for environmental changes (Antonioli & Mazzanti, 2009; Le Bas & Poussing, 2013). Voluntary actions with their positive impact on environmental innovation are stimulated not only by CSR but also by a better technological performance or a better competitive position connected to cost reduction (Le Bas & Poussing, 2013).

Despite the incentive role of external drivers, the decision to adopt an eco-innovation depends also on internal factors. These drivers allow to evaluate costs, benefits, and risks that arise from the implementation of environmental innovation (Bossle et al., 2016; He et al., 2018). Generally, the internal reasons can contribute to generate proactive sustainability behaviors (Chen et al., 2012). Among the internal drivers, cost saving is the most relevant (Demirel & Kesidou, 2011; Green et al., 1994; Horbach, 2008; Horbach et al., 2012; 2013; Rave et al., 2011), as well as the need for efficiency (Bossle et al., 2016). Horbach et al. (2012) find that cost saving is the main reason for energy-saving process innovations.

Environmental management system (EMS), as cost saving, is crucial to boost cleaner technologies. Analyzing the European countries, Wagner (2007) reveals that EMS positively affects the probability of firms to implement an environmental innovation process. On the contrary, Frondel et al. (2007) state that the adoption of environmental management systems (EMS) is associated negatively with cost saving since the firms expect that the adoption of EMS may be expensive.

Also R&D activities affect a company's decision to trigger eco-innovation. The effect of R&D on eco-innovation is not clear, and in fact empirical findings are controversial (Horbach et al., 2013; Kesidou & Demirel, 2012). Positively correlated with product and process environmental innovation is the firm size (Horbach et al., 2013; Kammerer, 2009; Kesidou & Demirel, 2012). Usually small and medium firms have less resources compared to the large ones. It follows that large companies have a greater economic availability to carry out an environmental innovation strategy. They have a greater economic capacity to engage innovations that also generate benefits for the environment. Therefore, a limited number of employees could be a barrier if small firms lack human, technical and financial resources (Del Rio, 2009).

At last, firm's economic performance is a prerequisite to develop eco-innovation strategies. Many studies (Del Chiappa et al., 2018; Doran & Ryan, 2012, Przychodzen & Przychodzen, 2015; Horbach et al., 2012; Tseng & Bui, 2017) witness that there is a direct relationship between economic performance and the environmental innovation.

Summing up, previous studies have highlighted the effect of internal and external drivers, in particular in European developed countries and in transition economies. Our paper is a contribution to this literature, but differently from prevailing literature, our analysis empirically investigates these effects on firms' environmental innovation in Baltic countries.

3. Data collection and variables

In this paper we examine the effect of internal and external factors on eco-innovation activities employing data taken from the Community Innovation Survey (CIS). It is one of the most popular datasets exploited to investigate innovation and eco-innovation practices in European countries. CIS surveys collect information on firms' innovation activities in the manufacturing sector and are drawn from firms' responses to a postal questionnaire developed by the Eurostat under the methodological recommendations of the Oslo Innovation Manual (OECD, 2005). CIS data have an additional advantage, they allow a comparison across countries as they are constructed using the same questionnaire and approach. At the same time, CIS data have some limitations. First of all, CIS is a cross-sectional dataset. Second, CIS data contain limited financial information that is relevant to the observation of the firm growth.

Finally, some indicators are available for some countries but not for others, this does not allow us to use certain variables in the analysis.

We employ CIS 2014[2] [1] that spans the 2012–2014. The initial dataset has been filtered twice. We selected only firms from the manufacturing sectors (Divisions 10-33 NACE Rev.2 classification (see Table A1 in Appendix). In fact, for Baltic countries, CIS 2014 data provide information on a sample of 2457 firms of the manufacturing sector distributed as follows: (i) 941 for Estonia; (ii) 540 for Latvia and, finally, (iii) 976 firms for Lithuania. The survey also gives details about four types of eco-innovations (eco-process, eco-product, eco-marketing and eco-organizational) introduced by the firms during the years 2012–2014. Then, we have chosen firms that have adopted at least one of the eco-innovations. The sub-sample examined to observe the eco-innovation consists of 896 companies. In the Baltic countries, considered as a whole, the companies that, in the last three years, have triggered at least one eco-innovation are about 40% of the sub-sample under observation. Only 5% of the firms have decided to mix the four types of environmental innovation.

Eco-innovation is our dependent variable and a look at the types of eco-innovation outcomes allows us to differentiate between 4 types of eco-innovations although this distinction should be not overemphasized since firms decide to mix different types of eco-innovations.

Our correlated variables from the questionnaire of the CIS 2014 contain a large number of variables that allow us to account for the determinants that affect firms' eco-innovation activities. Firms surveyed, through a self-reported assessment, provide information on the importance of the different aspects of eco-innovation. They replied using a 4-point ordinal scale ranging from not relevant to highly relevant, which were converted into dummies: "highly relevant" or "medium relevant" versus the rest. Table 1 presents an exact definition and descriptive statistics of the set of variables that we employ in our estimation.

With reference to external factors, the questionnaire provides information on present and future regulations and the compliance of rules and standards. General subsidies and tax reductions are considered for eco-innovations. External drivers that trigger an eco-innovation are also cooperation, reputation, corporate social responsibility and market geographic dimension. Concerning internal determinants, Environmental Management Systems introduced between 2012–2014 (EMS 2012–2014) are considered. They play a significant role since they allow us to understand the firm's eco-innovation capacity (Horbach et al., 2012). Firm's efficiency is related to cost saving (Bossle et al., 2016) as well as to turnover (Eiadat et al., 2008; Murat Ar, 2012; Tseng et al., 2013). The latter is included in our study as a measure of the firm's performance.

Another internal driver added in our estimations is R&D: the firm that makes intramural and extramural R&D has a greater probability to adopt an eco-innovation strategy (Horbach et al., 2012). Further variables are employed in the estimation to account for other internal determinants that affect firms' eco-innovation. We introduce the affiliation of a firm to a group, the firm's dimension and the industry sector, the latter allows us to observe the technological context where the firms undertake their activities (Galliano & Nadel, 2013). In addition, industry sector, size and country

Table 1. Definition of variables and descriptive statistics.

Name of variable	Description	Mean	Std. Dev.
Eco-Innovation			
Eco-process	Takes value 1 if company introduces process innovations that generate Environmental Benefits, 0 otherwise	0.512	0.500
Eco-product	Takes value 1 if company introduces product (goods or services) innovations that generate Environmental Benefits, 0 otherwise	0.311	0.463
Eco-marketing	Takes value 1 if company introduces marketing innovations that generate Environmental Benefits, 0 otherwise	0.095	0.293
Eco-organization	Takes value 1 if company introduces organizational innovations that generate Environmental Benefits, 0 otherwise	0.185	0.389
External Drivers			
Present Regulations	Takes value 1 if for company existing environmental regulations are medium or highly relevant to trigger an eco-innovation; 0 otherwise	0.367	0.482
Future Regulations	Takes value 1 if for company environmental regulations or taxes expected in the future are medium or highly relevant to trigger an eco-innovation; 0 otherwise	0.440	0.497
Env. Subsidies and Grants	Takes value 1 if for company government grants, subsidies or other financial incentives for environmental innovations are medium or highly relevant; 0 otherwise	0.538	0.499
Reputation	Takes value 1 if for company improving reputation is medium or highly relevant to trigger an eco-innovation; 0 otherwise	0.636	0.481
CSR	Takes value 1 if for company to meet requirements for public procurement contracts is medium or highly relevant to trigger an eco-innovation; 0 otherwise	0.269	0.269
Cooperation	Takes value 1 if has cooperation arrangements for product and/or process innovation activities; 0 otherwise		
National Market	Takes value 1 if a company sells goods and/or services in the national market; 0 otherwise	0.045	0.207
European Market	Takes value 1 if a company sells goods and/or services in the European market; 0 otherwise	0.093	0.291
International Market	Takes value 1 if a company sells goods and/or services in the international market; 0 otherwise	0.832	0.374
Internal Drivers			
Cost saving	Takes value 1 if for company high cost of energy, water or materials are medium or highly relevant to trigger an eco-innovation; 0 otherwise	0.632	0.483
EMS	Takes value 1 if a company has procedures in place to regularly identify and reduce your company's environmental impacts, 0 otherwise	0.302	0.459
Small Companies	Takes value 1 if a company has 10-49 employees; 0 otherwise	0.521	0.500
Medium Companies	Takes value 1 if a company has 50-249 employees; 0 otherwise	0.382	0.486
Large Companies	Takes value 1 if a company has more than 250 employees; 0 otherwise	0.096	0.295
Affiliation	Takes value 1 if a company is part of an enterprise group, 0 otherwise	0.362	0.481
Performance	Takes value 1 1 if a company presents a turnover $\geq$ to the median turnover value (2400000 euros), 0 otherwise	0.474	0.499
Research & Development	1 if a company introduce internal and/or external R&D for product and/or process innovation activities; 0 otherwise	0.548	0.498
Foroth	Takes value 1 if a company is a part of this sector, 0 otherwise	0.118	0.322

(*continued*)

Table 1. Continued.

Name of variable	Description	Mean	Std. Dev.
Foodbev	Takes value 1 if a company is a part of this sector, 0 otherwise	0.114	0.318
Textiles	Takes value 1 if a company is a part of this sector, 0 otherwise	0.170	0.375
Woodpap	Takes value 1 if a company is a part of this sector, 0 otherwise	0.179	0.383
Cochem	Takes value 1 if a company is a part of this sector, 0 otherwise	0.105	0.307
Metals	Takes value 1 if a company is a part of this sector, 0 otherwise	0.171	0.377
Elecmot	Takes value 1 if a company is a part of this sector, 0 otherwise	0.143	0.350

Source: Our Elaboration on data CIS14.

dummies represent also control variables able to capture the specific differences across firms.

4. Empirical strategy and results

The purpose of the econometric estimations presented in this paper is to observe how both internal and external factors affect the decision to boost an eco-innovation strategy in the manufacturing sector in the Baltic area.

Compared to the available CIS surveys, the CIS 2014 questionnaire gives information on four categories of innovation that could generate two types of environmental benefits. The latter may be generated within the firms or may depend on consumption or use of a good or service by the end user. In this work, the four types of eco-innovations are identified through dummies: "eco-innovative good or service" (eco-product), "eco-innovative production process or method" (eco-process), "eco-innovative organizational change" (eco-organizational) and eco-innovative marketing solution (eco-marketing).

As for empirical strategy, we estimate a quadrivariate probit model addressing eco-product, eco-process, eco-marketing and eco-organizational innovations. We employ a multivariate probit model since it allows a simultaneous estimation of the four types of eco-innovation.

The model presents the same structure as that of a seemingly unrelated regression (SUR) model with the exception that the dependent variables are binary indicators. As for the SUR model, the equations do not necessarily have to include the same set of explanatory variables. Therefore, this model fits with our theoretical background, the explanatory variables vary across equations since the determinants of the four types of eco-innovations are different.

We specify the following equation relating to the key explanatory factors plus controls to the probability that a firm decides to introduce one of the four types of eco-innovation outcomes:

$$y_{ih} = x'_{ih}\beta_{ih} + \varepsilon_{ih}$$

y_{ih} is the binary variable of whether firm i introduces one of the four types of eco-innovation outcome, where h indicates the type: (i) eco-innovative good or service; (ii) eco-innovative production process or method; (iii) eco-innovative organizational change and finally (iv) eco-innovative marketing solution. Moreover, β_h represents the vector of coefficients, x_{ih} is the matrix of explanatory variables and ε_{ih} are the error terms.

We employ the multivariate approach because of its usefulness for analyzing firms' eco-innovation. First, since the eco-innovation variables are not mutually exclusive, this joint estimation of eco-innovation equations provides a realistic scenario in which firms simultaneously decide to introduce a group of eco-innovations that can be complementary or substitute for each other. Second, this approach allows us to compare shared variables that impact the decisions to launch different eco-innovations. Third, this method incorporates a correlation structure for the unobservable and unmeasurable factors related to different eco-innovation outcomes.

The error term is the sum of two components, one specific for each equation that describes the outcome of interest and one common to the others:

$$\varepsilon_{ih} = \eta + u_{ih}$$

To sum up, the multivariate approach allows us to predict several correlated binary outcomes in a joint way and to control for potential correlation of the error terms.

In order to evaluate if the multivariate approach fits, we perform the likelihood ratio test on the null hypothesis that the correlation coefficients ρ of the error terms are jointly equal to zero. The rejection of the null reveals that the multivariate probit approach is preferred to the univariate one.

Table 2 collects the estimation findings. Column 1 contains the specification for eco-process, Column 2 shows the finding for eco-product, Column 3 reports the results for eco-marketing and Column 4 displays the results for eco-organizational. The last part of the table shows the four pairwise correlation coefficients across equation errors.

Among the external drivers, cooperation with stakeholders has a significant and positive association with the decision to adopt a process environmental innovation. Firms, in fact, do not always have all the resources to innovate on their own, thus the need to cooperate with external partners (Chesbrough, 2003, 2006). In particular, in the Baltic area, cooperation could be considered as a driving factor to develop network systems among firms, institutions and external partners. Our results on existing environmental regulation are not consistent with the previous literature. This shows how firms tend to favor "end of pipe" innovation (Biscione et al., 2021; Galliano & Nadel, 2013; Horbach et al., 2012). Conversely, the expectations of a future regulation are significant and positively associated with the three types of eco-innovation (eco-product, eco-organization and eco-marketing). It seems that Baltic firms anticipate the decisions on the expected regulation and give it the same importance as the existing regulation.

Also, reputation or brand image is a crucial external driver. It is strongly significant and positively related to the adoption of product and marketing eco-innovation. This suggests that firms use brand image to communicate the safety and the positive environmental effect of their products (Galliano & Nadel, 2013; Srivastava, 2007). Strictly related to the reputation are the voluntary actions, the latter are significantly and positively associated with the decision to implement eco-innovation organization. Differently from Biscione et al. (2021), voluntary actions are also associated with the

Table 2. Multivariate probit regressions. Drivers of process, product, marketing and organizational eco-innovations.

	Types of eco-innovation			
	Eco-process	Eco-product	Eco-marketing	Eco-organization
External Drivers				
Present Regulations	0.048	−0.01	−0.161	−0.02
	[0.138]	[0.127]	[0.166]	[0.133]
Future Regulations	0.243	0.291**	0.356*	0.463***
	[0.16]	[0.143]	[0.19]	[0.15]
Env. Subsidies and Grants	−0.017	0.07	0.141	0.127
	[0.156]	[0.134]	[0.168]	[0.143]
Reputation		0.844***	0.405*	
		[0.154]	[0.228]	
CSR	−0.169	0.326**	0.400**	0.374***
	[0.149]	[0.134]	[0.169]	[0.142]
Cooperation	0.338***	0.002		
	[0.128]	[0.121]		
Ref. International Market				
European Market	0.176	0.530**	−0.657*	−0.565*
	[0.258]	[0.238]	[0.385]	[0.328]
National Market	0.599	0.026	−0.332	0.168
	[0.426]	[0.434]	[0.613]	[0.475]
Internal Drivers				
Cost saving	1.865***			
	[0.15]			
EMS	0.009			
	[0.124]			
Ref. Small Companies				
Medium Companies	0.477***	−0.129	0.117	0.145
	[0.174]	[0.169]	[0.219]	[0.188]
Large Companies	0.563**	−0.062	0.292	0.497**
	[0.223]	[0.211]	[0.274]	[0.228]
Affiliation	0.064	−0.067	−0.166	0.281**
	−0.137	−0.132	−0.172	−0.134
Performance	−0.268	0.147	−0.389*	−0.062
	[0.18]	[0.178]	[0.229]	[0.192]
R&D	0.066	0.536***		
	[0.128]	[0.121]		
Ref. Foroth				
Foodbev	0.038	−0.003	0.196	−0.257
	[0.218]	[0.207]	[0.257]	[0.221]
Textiles	−0.187	0.193	−0.247	−0.179
	[0.246]	[0.238]	[0.332]	[0.253]
Woodpap	0.450*	−0.393*	−0.467	−0.139
	[0.230]	[0.227]	[0.322]	[0.234]
Cochem	0.438**	−0.094	0.131	−0.089
	[0.212]	[0.201]	[0.256]	[0.212]
Metals	0.456*	0.159	0.055	−0.042
	[0.244]	[0.236]	[0.314]	[0.258]
Elecmot	0.123	0.112	−0.197	−0.262
	[0.201]	[0.195]	[0.257]	[0.210]
Ref. Estonia				
Lithuania	0.688***	−0.006	−0.467**	−0.098
	[0.184]	[0.169]	[0.194]	[0.169]
Latvia	0.508**	0.374*	−0.216	0.606***
	[0.209]	[0.195]	[0.240]	[0.197]
ρ1	1			
ρ2	−0.161***	1		
ρ3	0.128	0.417***	1	
ρ4	0.218***	0.052	0.511***	1
Log likelihood ratio test of H0: ρ21 = ρ31 = ρ41 = ρ32 = ρ42= ρ43 = 0				
LR $X^2(6)$	93.5023***			
Log pseudolikelihood	−1134.645			
Number of Observations	724	724	724	724

Robust Standard errors in brackets; statistical significance.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Our Elaboration on data CIS14.

eco-product and eco-marketing strategies. These findings underline the relevance of demand and stakeholder pressure on environmental innovation strategy to promote: (i) eco-innovation decisions toward the external environment and (ii) social activities of firms (Les Bas & Poussing, 2013).

R&D activity exhibits a significant and positive association only with eco-products. In this respect, the plausible interpretation is that firms invest in R&D to improve the green quality of products. Looking at the firm's business performance, our findings show a significant, even though negative, association with the eco-marketing. This result is in contrast with the literature (Horbach, 2008; Rennings & Rammer, 2011) although, as stated by Eiadat et al. (2008), "*This is not surprising: innovation is by its nature a risky business and [… an …] eventual success will involve broken eggs*".

Moving on to the geographic market dimension, we find that firms oriented to the European market, have a significant and positive correlation with the eco-product since the European countries, sensitive to environmental issues, adopt regulations for imported products (Tsai & Liao, 2017). Instead, the same variable is associated negatively with eco-marketing with a statistical significance level equal to 10%. This result could probably be due to the difference that still prevails between the green strategies adopted by the Baltic countries and the standards established by the European Union (Grundey & Zaharia, 2008).

Going to the internal drivers, cost-saving represents the one that influences the adoption of an eco-innovation process. In fact, our results reveal that an enterprise's propensity to introduce eco-process is strongly affected by the cost saving. As expected, and in line with previous studies, cost saving could be considered as the combined result of the change in the production process and the research of firm's efficiency (Biscione et al., 2021; Bossle et al., 2016; Horbach, 2016). Corporate affiliation is only positively associated with the adoption of environmental organizational innovation. This result is in contrast with our expectation, but in line with Biscione et al. (2021). Corporate affiliation is not related to eco-process and eco-product. In this respect, the plausible explanation is that even a company belonging to a group could have an eco-innovative behavior other than the head office.

With regard to sector-specific effects, only the manufacture of coke and refined petroleum products and the manufacture of wood and wood products are significant and positively associated with eco-process innovation strategies given the strong environmental impact of these peculiar sectors in the Baltic area. Other internal drivers are important to explain the firm's decision to boost eco-innovation rather than industry-specific characteristics. Turning to the company dimension, our results show a positive association with the decision to implement an eco-innovation not for all levels. Firm dimension could be a possible obstacle for environmental innovation, for small firms it is more difficult to trigger eco-innovations. Even if firm size has any effect on the propensity of a firm to implement an environmental product or marketing innovations, our empirical result is in agreement with previous literature, for instance, firm dimension affects positively eco-innovation activities in general (King & Lenox, 2009; Melnyk et al., 2003; Triguero et al., 2013).

Country-specific dummies display differences. We have chosen Estonia as a country reference since this country improved its environmental performance from 2012 to 2014. According to the Environmental Performance Index[3], between 2012 and 2014, Estonia rose from 50th to 20th, on the contrary, during the same period, Latvia's ranking dropped from 2nd to 40th place, while Lithuania's ranking dropped from 17th to 49th place. Compared to Estonian firms, Latvian firms present a significant and positive association with eco-process, this result is probably due to the sustainable energy solutions adopted by firms. On the other hand, Latvian firms present a significant and negative association with eco-marketing. In sum, this result shows that firms have not yet found eco-solutions. The Lithuanian firms, on the contrary, show a significant and positive relationship with three types of eco-innovation: process, product and organization. This means that Lithuanian firms produce goods with a cleaner production, resource, and energy efficiency (EIO, 2015).

Lastly, based on the multivariate probit model estimates, it can be concluded that the error terms are correlated in most of all equations. Table 2 shows that there is a statistical significance of most correlation coefficients (ρ) between the error terms. Also, the likelihood ratio test on the null hypothesis that ρ is equal to zero is rejected. These results confirm the need for multi-equation estimation since it is more appropriate compared to estimation of four independent binary probit models.

5. Conclusion

This study comprehensively investigated the external and internal drivers of eco-innovation activities in the Baltic manufacturing sector using CIS 2014 data survey collected by Eurostat. To achieve the objective, we used a multivariate probit model. We have applied this model for two sets of reasons: (i) it allows us to reveal possible complementarities across the four types of eco-innovation (eco-process, eco-product, eco-organizational and eco-marketing) and (ii) it enables us to highlight the differences found across sectors and countries.

The empirical evidence shows that some specific drivers are common for some types of eco-innovation and others are particularly significant for each eco-innovation strategies. For instance, the need to increase the efficiency level captured by cost saving is the main driver of eco-process. Expectations of the future environmental regulations and voluntary actions are positively associated with eco-product, eco-marketing and eco-organization. Brand image, on the contrary, is positively associated with eco-product and eco-marketing, while R&D activities are positively and significantly related only to eco-product strategies. Cooperation is a crucial factor for the eco-process, as it allows to reduce the use of inputs and to gain efficiency. In other words, cooperation arrangement could be considered as a guiding factor to elaborate public policy able to develop network systems between firms, institutional and external partners. We have also found that if the market dimension is positively associated with the eco-product innovation, it has a negative association with the eco-marketing innovation. Thus, firms should increase their focus on sustainable incentive in marketing and greening strategies to promote the company's business performance. This often means that greening strategies are high cost and companies' turnover becomes negative as shown by our findings. Finally, government grants, subsidies or other financial incentives and current regulations are never related to the firms' decision to launch an eco-innovation.

Clearly, our empirical findings should be interpreted taking into account some limitations. These concern mainly the generalizability of the results since our analysis is based on a survey carried out over a short time span. In fact, we use cross-sectional data, so nothing can be stated on causality. Future research exploiting panel data could empirically examine the direction of causality.

The second limitation is related to the covariates employed in our model. CIS2014 contains information that can only be used for eco-process and eco-product strategies. Particularly, the survey does not include information on R&D activities and cooperation arrangements consider two important variables related to the decision to adopt eco-marketing and eco-organizational strategies.

Nevertheless, from our results it is possible to draw some suggestion for policy makers. In this context, policy makers should adopt measures able to replace existing paths based mainly on taxes, government grants, subsidies or other financial incentives with more environmentally friendly ones. Therefore, government policies should focus on more targeted initiatives aimed at raising awareness of entrepreneurs and managers about how firms can achieve eco-innovation given their technological and organizational capacities. This is the only way to achieve long-term results, rather than short-term environmental goals. In order to provide more detailed suggestions to policymakers on the design of actions, further research should be conducted at sector level. This type of analysis would allow us to observe the characteristics of each sector and define more specific measures.

Notes

1. The Eco-Innovation Index shows the eco-innovation performance in the EU Member States. In particular, it measures the eco-innovation level of a country by using 16 indicators clustered in five dimensions: (i) eco-innovation inputs; (ii) eco-innovation activities; (iii) eco-innovation outputs; (iv) resource efficiency and finally (v) socio-economic outcomes.
2. We use the 2014 CIS to analyze the determinants of eco-innovation in the Baltic region, since it is the latest available survey that provides data on eco-innovation measures.
3. The Environmental Performance Index gives information on the state of sustainability of a country. It is an index developed by Yale University and Columbia University in collaboration with the World Economic Forum and the Joint Research Centre of the European Commission.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Antonioli, D., & Mazzanti, M. (2009). Techno-organizational strategies, environmental innovation and economic performances. Micro- evidence from SME-based industrial district. *Journal of Innovation Economics*, *3*(1), 145–158.

Arfaoui, N. (2018). Eco-innovation and regulatory push/pull effect in the case of REACH regulation: Empirical evidence based on survey data. *Applied Economics*, *50*(14), 1536–1554. https://doi.org/10.1080/00036846.2017.1368989

Arnold, M. K., & Hockerts, K. (2010). The greening Dutchman: Philips' process of green flagging to drive sustainable innovations. *Business Strategy and Environment*, *20*(6), 394–407.

Biscione, A., Caruso, R., & de Felice, A. (2021). Environmental innovation in European transition countries. *Applied Economics*, *53*(5), 521–535. https://doi.org/10.1080/00036846.2020.1808185

Bossle, M. B., Barcellos, M. D. D., Vieira, L. M., & Sauvée, L. (2016). The drivers for adoption of eco-innovation. *Journal of Cleaner Production*, *113*, 861–872. https://doi.org/10.1016/j.jclepro.2015.11.033

Brunnermeier, S. B., & Cohen, M. A. (2003). Determinants of environmental innovation in US manufacturing industries. *Journal of Environmental Economics and Management*, *45*(2), 278–293. https://doi.org/10.1016/S0095-0696(02)00058-X

Cainelli, G., D'Amato, A., & Mazzanti, M. (2020). Resource efficient eco-innovation for a circular economy: Evidence from EU firms. *Research Policy*, *49*(1), 103827– 103811. https://doi.org/10.1016/j.respol.2019.103827

Cainelli, G., Mazzanti, M., & Montresor, S. (2012). Environmental innovations, local networks and internationalization. *Industry & Innovation*, *19*(8), 697–734. https://doi.org/10.1080/13662716.2012.739782

Carrillo-Hermosilla, J., del Río, P., & Könnölä, T. (2010). Diversity of eco- innovations: Reflections from selected case studies. *Journal of Cleaner Production*, *18*(10–11), 1073–1083. https://doi.org/10.1016/j.jclepro.2010.02.014

Cazals, C. (2009). Qualités et innovations environnementales dans la viticulture et l'arboriculture fruitière: l'apport des mondes de production. *Revue D'économie Industrielle*, *126*(126), 31–52. https://doi.org/10.4000/rei.3968

Chen, Y. S., Chang, C. H., & Wu, F. S. (2012). Origins of green innovations: The differences between proactive and reactive green innovations. *Management Decision*, *50*(3), 368–398. https://doi.org/10.1108/00251741211216197

Chen, Y., Wang, C., Nie, P., & Chen, Z. (2020). A clean innovation comparison between carbon tax and cap-and-trade system. *Energy Strategy Reviews*, *29*(1), 100483. https://doi.org/10.1016/j.esr.2020.100483

Chesbrough, H. W. (2003). The era of open innovation. *MIT Sloan Management Review*, *44*(3), 35–41.

Chesbrough, H. W. (2006). Open Innovation: A New Paradigm for Understanding Industrial. In H. W. Chesbrough, W. Vanhaverbeke, & J. West (eds.), *Open innovation: researching a new paradigm*. Oxford University Press.

Chiarvesio, M., De Marchi, V., & Di Maria, E. (2015). Environmental innovation and internationalization: Theory and practice. *Business Strategy and the Environment*, *24*(8), 790–801. https://doi.org/10.1002/bse.1846

Cooke, P. (2011). Transition regions: Regional-national eco-innovation systems and strategies. *Progress in Planning*, *76*(3), 105–146. https://doi.org/10.1016/j.progress.2011.08.002

de Felice, A., Biscione, A., & Martucci, I. (2019). Knowledge and innovation: An empirical analysis of firm's organization in the Baltic countries. *Electronic Journal of Knowledge Mngagement*, *17*(1), 34–48.

De Marchi, V. (2012). Environmental innovation and R&D cooperation: Empirical evidence from spanish manufacturing firms. *Research Policy*, *41*(3), 614–623. https://doi.org/10.1016/j.respol.2011.10.002

Del Chiappa, G., Usai, S., Cocco, A. & Atzeni, M. (2018). Sustainable tourism development and climate change: A supply-side perspective. *Journal of Tourism, Heritage & Services Marketing*, *4*(2), 3–9.

Del Rio, P. (2009). The empirical analysis of the determinants for environmental technological change: A research agenda. *Ecological Economics*, *68*(3), 861–878.

Del Rio, P., Romero-Jordàn, D., & Penasco, C. (2017). Analyzing firm-specific and type-specific determinants of eco-innovation. *Technological and Economic Development of Economy*, *23*(2), 270–295.

Demirel, P., & Kesidou, E. (2011). Stimulating different types of eco-innovation in the UK: Government policies and firm motivations. *Ecological Economics*, *70*(8), 1546–1557. https://doi.org/10.1016/j.ecolecon.2011.03.019

Doran, J., & Ryan, G. (2012). Regulation and firm perception, Eco-innovation and firm performance. *European Journal of Innovation Management*, *15*(4), 421–441. https://doi.org/10.1108/14601061211272367

Eiadat, Y., Kelly, A., Roche, F., & Eyadat, H. (2008). Green and competitive? An empirical test of the mediating role of environmental innovation strategy. *Journal of World Business*, *43*(2), 131–145. https://doi.org/10.1016/j.jwb.2007.11.012

EIO. (2013). *Europe in transition: Paving the way to a green economy through eco-innovation. Eco-Innovation Observatory.* Funded by the European Commission, DG Environment, Brussels.

EIO. (2015). *Eco-innovation in Lithuania. Eco-Innovation Observatory.* Funded by the European Commission, DG Environment, Brussels.

Frondel, M., Horbach, J., & Rennings, K. (2007). End-of-pipe or cleaner production? An empirical comparison of environmental innovation decisions across OECD countries. *Business Strategy and the Environment*, *16*(8), 571–584. [Database] https://doi.org/10.1002/bse.496

Galliano, D., & Nadel, S. (2013). Les determinants de l'adoption de l'éco-innovation selon le profil stratégique de la firme: le cas des firmes industrielles françaises. *Revue D'économie Industrielle*, *142*(142), 77–110. https://doi.org/10.4000/rei.5576

Ghisetti, C., Marzucchi, A., & Montresor, S. (2015). The open eco-innovation mode. An empirical investigation of eleven European countries. *Research Policy*, *44*(5), 1080–1093. https://doi.org/10.1016/j.respol.2014.12.001

Ghisetti, C., & Pontoni, F. (2015). Investigating policy and R&D effects on environmental innovation: A meta-analysis. *Ecological Economics*, *118*(5), 57–66. https://doi.org/10.1016/j.ecolecon.2015.07.009

Green, K., McMeekin, A., & Irwin, A. (1994). Technological trajectories and R&D for environmental innovation in UK firms. *Futures*, *26*(10), 1047–1059. https://doi.org/10.1016/0016-3287(94)90072-8

Grundey, D., & Zaharia, R. M. (2008). Sustainable incentives in marketing and strategic greening: The cases of Lithuania and Romania. *Baltic Journal on Sustainability*, *14*(2), 130–143.

He, F., Miao, X., Wong, C. W. Y., & Lee, S. H. N. (2018). Contemporary corporate eco-innovation research: A systematic review. *Journal of Cleaner Production*, *174*(Supplement C), 502–526. https://doi.org/10.1016/j.jclepro.2017.10.314

Horbach, J. (2008). Determinants of environmental innovation new evidence from German panel data sources. *Research Policy*, *37*(1), 163–173. https://doi.org/10.1016/j.respol.2007.08.006

Horbach, J. (2016). Empirical determinants of eco-innovation in European countries using the community innovation survey. *Environmental Innovation and Societal Transitions*, *19*, 1–14. https://doi.org/10.1016/j.eist.2015.09.005

Horbach, J., Oltra, V., & Belin, J. (2013). Determinants and specificities of eco- innovations. An econometric analysis for the French and German industry based on the Community Innovation Survey. *Industry & Innovation*, *20*(6), 523–543. https://doi.org/10.1080/13662716.2013.833375

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact the role of regulatory push/pull, technology push and market pull. *Ecological Economics*, *78*, 112–122. https://doi.org/10.1016/j.ecolecon.2012.04.005

Jaegul, L., Veloso, F. M., & Hounshell, D. A. (2011). Linking induced technological change, and environmental regulation: Evidence from patenting in the U.S. auto in industry. *Research Policy*, *40* (9), 1240–1252. https://doi.org/10.1016/j.respol.2011.06.006

Jaffe, B., & Palmer, K. (1997). Environmental regulation and innovation: A panel data study. *Review of Economics and Statistics*, *79*(4), 610–619. https://doi.org/10.1162/003465397557196

Johnstone, N., Haščič, I., & Popp, D. (2010). Renewable energy policies and technological innovation: Evidence based on patent counts. *Environmental and Resource Economics*, *45*(1), 133–155. https://doi.org/10.1007/s10640-009-9309-1

Kammerer, D. (2009). The effects of customer benefit and regulation on environmental product innovation. Empirical evidence from appliance manufacturers in Germany. *Ecological Economics*, *68*(8–9), 2285–2295. https://doi.org/10.1016/j.ecolecon.2009.02.016

Kesidou, E., & Demirel, P. (2012). On the drivers of eco-innovations: Empirical evidence from the UK. *Research Policy*, *41*(5), 862–870. https://doi.org/10.1016/j.respol.2012.01.005

Kesidou, E., & Wu, L. (2020). Stringency of environmental regulation and eco-innovation: Evidence from the eleventh Five-Year Plan and green patents. *Economics Letters*, *190*, 109090. https://doi.org/10.1016/j.econlet.2020.109090

King, A. A., & Lenox, M. J. (2009). Lean and Green? An empirical examination of the relationship between lean production and environmental performance. *Production and Operations Management*, *10*(3), 244–256. https://doi.org/10.1111/j.1937-5956.2001.tb00373.x

Le Bas, C., & Poussing, N. (2013). Firm voluntary measures for environmental changes, eco-innovations and CSR: Empirical analysis based on data surveys. *SSRN Electronic Journal*, *66*(4), 1–19.

Lloyd-Smith, P., & An, H. (2019). Are corporate responsibility and advertising complements or substitutes in producing firm reputation? *Applied Economics*, *51*(21), 2275–2288. https://doi.org/10.1080/00036846.2018.1540858

Madaleno, M., Robaina, M., Ferreira Dias, M., & Meireles, M. (2020). Dimension effects in the relationship between eco-innovation and firm performance: A European comparison. *Energy Reports*, *6*(1), 631–637. https://doi.org/10.1016/j.egyr.2019.09.038

Marzucchi, A., & Montresor, S. (2017). Forms of knowledge and eco-innovation modes: Evidence from Spanish manufacturing firms. *Ecological Economics*, *138*, 208–221.

Marin, G., & Lotti, F. (2017). Productivity effects of eco-innovation using data on eco-patents. *Industrial and Corporate Change, 26*(1), 125–148.

Mazzanti, M., & Zoboli, R. (2009). Embedding environmental innovations in local production systems: SME strategies, networking and industrial relations. *International Review of Applied Economics*, *23*(2), 169–195. https://doi.org/10.1080/02692170802700500

Melece, L. (2015). Eco-innovation and its development in Baltic states. *Management Theory and Studies for Rural Business and Infrastructure Development*, *37*(3), 415–424. https://doi.org/10.15544/mts.2015.36

Melece, L., & Hazners, J. (2017). *Factors influencing Latvian small and medium enterprises towards eco-innovation* [Paper presentation]. Proceedings of the 16th International Scientific Conference Engineering for Rural Development, Latvia University of Agriculture (pp. 1466–1473). https://doi.org/10.22616/ERDev2017.16.N333

Melnyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, *21*(3), 329–351. https://doi.org/10.1016/S0272-6963(02)00109-2

Miskinis, V., Galinis, A., Konstantinaviciute, I., Lekavicius, V., & Neniskis, E. (2020). Comparative analysis of energy efficiency trends and driving factors in Baltic states. *Energy Strategy Reviews*, *30*, 100514. https://doi.org/10.1016/j.esr.2020.100514

Mothe, C., Nguyen-Thi, U. T., & Triguero, A. (2018). Innovative products and services with environmental benefits: Design of search strategies for external knowledge and absorptive capacity. *Journal of Environmental Planning and Management*, *61*(11), 1934–1954. https://doi.org/10.1080/09640568.2017.1372275

Murat Ar, Y. (2012). The impact of green product innovation on firm performance and competitive capability: The moderating role of managerial environmental concern. *Procedia - Social and Behavioral Sciences*, *62*, 854–864. https://doi.org/10.1016/j.sbspro.2012.09.144

OECD. (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data* (3rd ed.). OECD.

Pereira Sanchez, A., & Vence, D. (2015). Environmental policy instruments and eco-innovation: An overview of recent studies. *Innovar Revista De Ciencias Administrativas Y Sociales*, *25*(58), 65–80.

Popp, D. (2006). International innovation and diffusion of air pollution control technologies: The effects of NO_x and SO_2 regulation in the US, Japan, and Germany. *Journal of Environmental Economics and Management*, *51*(1), 46–71. https://doi.org/10.1016/j.jeem.2005.04.006

Przychodzen, J., & Przychodzen, W. (2015). Relationships between eco-innovation and financial performance Hungary. *Journal of Cleaner Production*, *90*(1), 253–263.

Rave, T., Goetzke, F., & Larch, M. (2011). *The determinants of environmental innovations and patenting: Germany reconsidered*. Ifo Working Paper No. 97.

Rennings, K., & Rammer, C. (2011). The impact of regulation-driven environmental innovation on innovation success and firm performance. *Industry & Innovation*, *18*(3), 255–283. https://doi.org/10.1080/13662716.2011.561027

Roberts, P. W., & Dowling, G. R. (2002). Corporate reputation and sustained superior financial performance. *Strategic Management Journal*, *23*(12), 1077–1093. [Database] https://doi.org/10.1002/smj.274

Shi, X. Z., & Xu, Z. F. (2018). Environmental regulation and firms' exports: Evidence from the eleventh Five-Year Plan in China. *Journal of Environmental Economics and Management*, *89*(C), 187–200. https://doi.org/10.1016/j.jeem.2018.03.003

Srivastava, S. K. (2007). Green supply-chain management: A state of the literature review. *International Journal of Management Reviews*, *9*(1), 53–80. https://doi.org/10.1111/j.1468-2370.2007.00202.x

Triguero, A., Moreno-Mondejar, L., & Davia, M. A. (2013). Drivers of different types of eco-innovation in European SMEs. *Ecological Economics*, *92*(92), 25–33. https://doi.org/10.1016/j.ecolecon.2013.04.009

Tsai, K. H., & Liao, Y. C. (2017). Sustainability strategy and eco-innovation: A moderation model. *Business Strategy and the Environment*, *26*(4), 426–437. https://doi.org/10.1002/bse.1926

Tseng, M. L., & Bui, T. D. (2017). Identifying eco-innovation in industrial symbiosis under linguistic preferences: A novel hierarchical approach. *Journal of Cleaner Production*, *140*(3), 1376–1389. https://doi.org/10.1016/j.jclepro.2016.10.014

Tseng, M.-L., Wang, R., Chiu, A. S. F., Geng, Y., & Lin, Y. H. (2013). Improving performance of green innovation practices under uncertainty. *Journal of Cleaner Production*, *40*, 71–82. https://doi.org/10.1016/j.jclepro.2011.10.009

Wagner, M. (2007). On the relationship between environmental management, environmental innovation and patenting: Evidence from German manufacturing firms. *Research Policy*, *36*(10), 1587–1602. https://doi.org/10.1016/j.respol.2007.08.004

Xing, M., Tan, T., & Wang, X. (2019). Environmental R&D subsidy spillovers and privatization in a mixed duopoly. *Economic Research-Ekonomska Istraživanja*, *32* (1), 2995–3015. https://doi.org/10.1080/1331677X.2019.1658530

Zhang, S., Yu, Y., Zhu, Q., Qiu, C. M., & Tian, A. (2020). Green innovation mode under carbon tax and innovation subsidy: An evolutionary game analysis for portfolio policies. *Sustainability*, *12*(4), 1385. https://doi.org/10.3390/su12041385

Appendix

Table A1. Sector sample classification.

Divisions	Description	Acronym
10-12	Manufacture of food products, beverages and tobacco products	Foodbev
13 – 15	Manufacture of textiles, wearing apparel and leather and related products	Textiles
16 – 18	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw, plaiting materials and manufacture of paper and paper products, and printing and reproduction of recorded media	Woodpap
19 – 23	Manufacture of coke and refined petroleum products, of chemicals and chemical products, of basic pharmaceutical products and pharmaceutical preparations, of rubber and plastic products and of other non-metallic mineral products	Cochem
24 – 25	Manufacture of basic metals and of fabricated metal products, except machinery and equipment	Metals
26 – 30	Manufacture of computer, electronic and optical products, of electrical equipment, of machinery and equipment n.e.c., of motor vehicles, trailers and semi-trailers and of other transport equipment	Elecmot
31 – 33	Manufacture of furniture, Other manufacturing and Repair and installation of machinery and equipment	Foroth

Source: Our Elaboration on data CIS14.

Table A2. Relationships between the four types of eco-innovation.

	Eco-process		Eco-product		Eco-marketing		Eco-organizational	
Eco-process	No	Yes	No	Yes	No	Yes	No	Yes
No	438	0	332	106	418	20	399	39
Yes	0	459	286	173	394	65	331	127
Eco-product								
No	332	286	618	0	597	21	535	82
Yes	106	173	0	279	215	64	195	84
Eco-marketing								
No	418	394	597	215	812	0	701	110
Yes	20	65	21	64	0	85	29	56
Eco-organizational								
No	399	331	535	195	701	29	730	0
Yes	39	127	82	84	110	56	0	166

Source: Our Elaboration on data CIS14.