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TURNOVER GROWTH AND ECO-INNOVATION: A EUROPEAN OVERVIEW

Mara Madaleno,[1] Mónica Meireles,[2*] Marta Ferreira Dias[1] and Margarita Robaina[1]

[1] Department of Economics, Management, Industrial Engineering and Tourism, and GOVCOPP, University Aveiro, Portugal
[2] ISCTE Business School – Department of Economics and BRU-IUL, ISCTE-IUL – Lisbon University Institute, Lisbon, Portugal

* Corresponding author: monica.meireles@iscte-iul.pt, ISCTE-IUL, Av.ª das Forças Armadas, 1649-026 Lisboa, Portugal

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ABSTRACT
This study investigates the relationship between eco-innovation actions and firm performance, considering the turnover growth, on a sample of 63303 European enterprises (13 different countries; 10 new EU members and 3 old ones). For this we use the Community Innovation Survey from 2012-2014 performing a statistical and cross-section analysis of the eco-innovation measures adopted, comparing the countries within the sample. Results indicate that in new EU members there is a U-shaped relationship between the number of eco-innovation benefits and turnover growth. Moreover, size is an important variable to explain the relationship between eco-innovations and turnover growth as well as employment growth. Policy makers should be aware of the additional costs incurred by firms in adopting eco-innovation strategies and differentiate among different size enterprises.

INTRODUCTION

Eco-innovation strategies are used by firms, with the aim of reducing environmental impact or natural resource consumption, either their motivation is voluntary or compulsory. The understanding of how eco-innovation strategies affect firm performance is still widely debated (Jové-Llopis and Segarra-Blasco, 2018). If, for a long time, economists, policy-makers and business managers believed that eco-innovation strategies necessarily increased firms' internal costs but not their profits, recent evidence (Jové-Llopis and Segarra-Blasco, 2018; Barbieri et al., 2016; Dixon-Fowler et al., 2013; Albertini, 2013) reveal diversity in the empirical results, ranging from negative, to non-significant and to positive links between eco-innovation and firm performance. Thus, mixed evidence turns clear that this relationship is still poorly understood and indicates the need to investigate this linkage. Conclusions undertaken might help managers to bring a win-win strategy for firms and society, as well as to help designing more effective eco-innovation policies in the future. A recent literature survey regarding the relationship between eco-innovation and performance is provided by Barbieri et al. (2016). However, different concepts are used in the literature to measure firm performance such as: productivity (value added, gross output, turnover per employee), growth (in terms of sales or turnover growth) and financial measures (operating margins, return on sales, Tobin's Q).

This study contributes to the previous literature in several ways. First, the European sample of firms is mostly composed by small and medium enterprises (considering the entire sample contained within the CIS 2014 survey, a great part of the enterprises have less than 50 employees – 59.89% of our sample). It must be stressed the relevant role of small and medium enterprises in the European economies, which have received lower attention regarding that most of the studies focus on large firms (Jo et al., 2015; Jové-Llopis and Segarra-Blasco, 2018). Moreover, short run costs incurred by these firms regarding eco-innovations are higher and they face higher financial constraints, with lower access to external financing sources (Ghisetti et al., 2016). Second, there are few studies that focus on the eco-innovation strategies and when they exist they are presented in a disguised way, considering individual countries and outdated sample (see Mavi et al, 2018, and references therein; Jové-Llopis and Segarra-Blasco, 2018). The existent literature for European countries does not consider the more recent CIS 2014 survey, as far as we are aware. Finally, despite the fact that the connection between eco-strategies and firm performance has been examined extensively for individual countries that have been members of the EU for many years, little is known for more recent members.

This work analyses the relationship between turnover growth (TG) and eco-innovation strategies for a sample of European firms, whose data is available in the CIS 2014 survey. As far as we are aware we are the first to use this more recent data and survey to analyse this relationship. The study has, however, some limitations, namely with respect to the data availability in the sample that does not allow us to take a deeper look on other factors that influence turnover growth, a different number of firms within each country answering the survey and regarding the fact that we had to

restrict the analysis to a cross section regression. Nevertheless, results suggest that different eco-innovation strategies have different influence over different EU countries, and that undertaking eco-innovation strategies does not always lead to higher turnover growth. These conclusions are important contributions for both consumers, policy makers and enterprises, in recognizing that eco-innovation has important and distinctive roles. For consumers, it contributes to a more environmental consciousness consumption, for producers it helps realizing that eco-innovation investments are also important for turnover growth, and for policy makers by giving clues about how to delineate policies to increase and facilitate the introduction of eco-innovations within firms, namely the access to finance.
The remaining of this article is structured as follows. Section 2 presents a brief literature review. Section 3 presents the database, some descriptive statistics, the variables and the econometric methodology. Section 4 shows our main findings and results and section 5 presents our conclusions and the consequent policy implications.

LITERATURE REVIEW

The European community innovation survey (CIS) is an harmonized tool designed to provide information about innovation in European Union enterprises. Using the 2014 CIS, this study extends the understanding of financial performance implications of innovation by focusing on the area of environmental innovation, thus extending the understanding of turnover performance implications of environmentally friendly practices of European firms. Models should be proposed in order to help firms achieve greater understanding of the dynamics of eco-innovation and structure, to easier the integration of sustainable processes within them.
Eco-innovation strategies are expected to have a positive effect over the environment but its effect over firm performance is less straightforward. There are arguments in literature pointing out that investing in environmental activities reduces negative externalities but involves a cost to the enterprise with no direct benefit, eroding the enterprise competitiveness (Palmer et al., 1995). There is also the opposite overview that eco-innovation activities would offset operational costs and increase firm performance in the long term (Porter and Linde, 1995). Porter and Linde (1995) argue that well designed eco-regulation (pollution taxes and tradable permits) may stimulate innovation that improves productivity and in turn increases enterprise benefits (the Porter hypothesis). Thus, eco-regulation is a means whereby a firm may benefit from environmental and economic performance (turning valid also the environmental Kuznets curve hypothesis) at the same time. A recent literature survey regarding the relationship between eco-innovation and performance is provided by Barbieri et al. (2016).
Regarding the relationship between eco-strategies and productivity, Riillo (2017) used turnover per employee for a sample of 890 Italian firms finding that green practices are U-shaped related to performance. Turnover per employee is also used by Doran and Ryan (2012) and Doran and Ryan (2016) for a sample of 2181 Irish firms in the Community Innovation Survey (CIS) 2006-2008. They found a positive and significant effect of eco-innovation on firm performance and that only two out of nine types of eco-innovation positively impacted firm performance (reduced CO_2 "footprint" and recycled waste, water or materials). Using value added for a sample of 12 OECD countries and considering sector level (patents) Soltmann et al. (2015) also found that green practices are U-shaped with respect to performance. Marin and Lotti (2017), for a sample of 11938 Italian manufacturing firms, used real value added per employee, to find that eco-innovations exhibit a lower return relative to other innovations. Using a sample of 5989 Dutch firms, Van Leeuwen and Mohnen (2017) used gross output per employee to conclude that resource-saving eco-innovations increase total factor productivity (TFP) effect and the end-of-pipe eco-innovations tend to reduce TFP. Finally, for a sample of 555 Italian firms, Antonioli et al. (2016) conclude that some firms' productivity performance is positively related to eco-innovation (in a positive way revenue over total labour cost and non-significant value added per employee).
With respect to eco-strategies and growth, and using turnover growth, Cainelli et al. (2011) found a negative effect of eco-innovation on turnover growth, and a negative but not significant effect of labour productivity growth, considering a sample of 773 Italian service firms (using CIS II). By contrast, Colombelli et al. (2015), considering 456240 firms from 6 European countries, found that firms producing eco-innovations are characterized by higher growth rates than those generating generic innovations. Also Hojnik and Ruzzier (2016) and Jové-Llopis and Segarra-Blasco (2018) used turnover growth. The formers, for a sample of 223 Slovenian firms, found a positive and significant effect between eco-innovation and firm growth. The latters, using a sample of 11336 small and medium enterprises located in 28 European countries, based on the European Commission's Eurobarometer Survey 426, found that not all eco-strategies are positively related to better performance. They found that European enterprises using renewable energy and recycling or designing products that are easier to maintain, repair or reuse, perform better, where those that aim at reducing water or energy pollution seemed to show a negative correlation to firm growth. Jové-Llopis and Segarra-Blasco (2018), using an ordered logistic model, also found a U-shaped relationship between eco-strategies and firm growth, indicating that a greater breadth of eco-strategies is associated with better firm performance.
Based on the work of Jové-Llopis and Segarra-Blasco (2018), this study focus on the role of the European enterprises' eco-strategies in improving their eco-performance, by analysing whether they create economic opportunities, with respect to firm growth as measured by turnover growth. For the effect, data from the 2014 CIS of the European Commission, with two years' frequency, is used. In 2014, a separate section on environmental innovations was

introduced (section 13). This section asks directly if the enterprise has introduced any innovation with environmental benefits, during the three years 2012-2014, providing a valuable opportunity to examine the role of eco-innovation strategies in firm growth.

DATA AND METHODOLOGY

Several firms from several different sectors answered the CIS2014, where eco-innovations are measured on ten different areas of environmental impacts. The question to be answered was: "During the three years 2012 to 2014, did your enterprise introduce a product (good or service), process, organisational or marketing innovation with any of the following environmental benefits?" 1) Environmental benefits obtained within your enterprise: 1.1) Reduced material or water use per unit of output (ECOMAT); 1.2) Reduced energy use or CO_2 'footprint' (reduce total CO_2 production) (ECOENO); 1.3) Reduced air, water, noise or soil pollution (ECOPOL); 1.4) Replaced a share of materials by less polluting or hazardous substitutes (ECOSUB); 1.5) Replaced a share of fossil energy by renewable energy sources (ECOREP); 1.6) Recycled waste, water, or materials for own use or sale (ECOREC). 2) Environmental benefits obtained during the consumption or use of a good or service by the end user: 2.1) Reduced energy use or CO_2 'footprint' (ECOENU); 2.2) Reduced air, water, noise or soil pollution (ECOPOS); 2.3) Facilitated recycling of product after use (ECOREA); 2.4) Extended product life through longer-lasting, more durable products (ECOEXT). Respondents had to answer 10 dichotomous questions, yes or no. Six referred to impacts stemming from environmental benefits within the enterprise (EBWE), while the remaining four referred to areas of environmental impacts related to after sales use of a product by its end user (EBEU). All environmental innovations had to be introduced during the three years' period, 2012 to 2014.

A cross-section data analysis was implemented considering that our dependent variable is a growth rate. The independent variables are represented by a binary-choice variable x=1 if the event occurs and 0 otherwise. A cross-section regression was run for one dependent variable, the turnover growth, where firms were asked about the enterprise's total turnover between 2012 and 2014. Turnover is defined as the market sales of goods and services, including all taxes except VAT. Turnover is a useful measure of a business's health, though it's often confused with profit, and even if it is sometimes referred to as gross revenue, or income, it is different to profit, which is a measure of earnings. Turnover is one of the key measures of a business's performance. It's used throughout the life of a business, from planning and securing investment, through measuring performance, to valuing a company in the event of a sale. The main drawback is that it is a cross-sectional dataset and so the problem of simultaneity is somewhat unavoidable, but so far this has been a problem common to all studies that use CIS.

Independent variables include EBWE (dichotomous variables: 1 if the firm adopted any of these 6 innovations and 0 otherwise) and EBEU (dichotomous variables: 1 if the firm reported any of these 4 benefits and 0 if not). EBWE is related to the first set of eco-innovators, where each firm might have adopted 0 to 6 innovations with environmental benefits from the production of goods or services, process, organizational or marketing within the enterprise. EBEU respects to the second set of eco-innovators, where each firm might have implemented 0 to 4 innovations with environmental benefits obtained during the consumption or use of a good or service by the end user. We also include the eco-innovation breath (EcoBreath) as independent variable, measured by the number of eco-innovations introduced by firms. Altogether, each firm might have reported from 0 to 10 innovations with environmental benefits. EcoBreath is defined as a count variable by referring to the ten different types of eco-innovations that the CIS 2014 encompasses as in Jové-Llopis and Segarra-Blasco (2018). Also, similar to these authors, we will use the variable EcoBreath2 (the square of the number of eco-strategies implemented by each firm).

As independent variables we also include a dummy variable indicating whether or not a firm is undertaking any eco-strategy to be more efficient and environmental friendly (Eco: 1 if the firm has adopted any of the 10 strategies and 0 otherwise). To avoid multicollinearity issues, separate estimations were performed. As control variables we include size (a dichotomous variable) measured by the number of employees (Size1: 1 if under 50, 0 otherwise; Size2: 1 if from 50 until 249 employees, 0 otherwise; Size3: 1 if from 250 and more, 0 otherwise), the employers growth rate and the percentage of the enterprise's employees with a tertiary degree in 2014 (Empud1: 1 if less than 25%; Empud2: 1 if more than 25%; 0 otherwise).

Table 1 presents some statistical results regarding our sample. The highest number of firms available in the sample is that of Bulgaria. There are more small enterprises within the sample (59.89%) except in Slovakia where all firms answering the survey are medium to high enterprises. Cyprus has no medium and high firms answering the survey. Even if with several differences among countries, most of the firms stated to have introduced product, process, organizational or marketing innovations, and by order, with environmental benefits regarding reduced energy use or CO_2 footprint (reduced total CO_2 production – 11.44%), recycled waste, water, or materials for own use or sale (10.07%) and reduced air, water, noise or soil pollution (8.92%).

Table 1: Distribution of the sample by countries and firm size (period 2012-2014)

	Countries			Number firms valid answers (eco-innovation type X = 1)												
Country	New EU	Firms	Percent	ecomat	ecoeno	ecopol	ecosub	ecorep	ecorec	ecoenu	ecopos	ecorea	ecoext	SIZE1	SIZE2	SIZE3
BG-Bulgaria	yes	14202	22.43	367	333	369	315	103	332	227	286	253	289	10959	2738	505
CY-Cyprus	yes	1346	2.13	81	114	85	68	54	128	62	52	59	39	1346	0	0
CZ-Czech Republic	yes	5191	8.20	646	819	588	429	180	728	608	448	384	506	2830	1357	1004
DE-Germany	no	6281	9.92	1451	2299	1454	833	722	1282	1488	984	822	781	2960	1720	1601
EE-Estonia	yes	1756	2.77	151	187	124	114	56	140	143	107	67	97	1086	583	87
EL-Greece	no	2507	3.96	334	431	313	290	95	385	396	280	370	311	1796	541	170
HR-Croatia	yes	3252	5.14	343	365	343	271	101	344	295	310	274	243	1921	1086	245
HU-Hungary	yes	6813	10.76	378	399	341	374	140	332	299	252	203	259	4258	1936	619
LT-Lithuania	yes	2409	3.81	234	444	315	197	80	173	274	234	143	152	1359	780	270
LV-Latvia	yes	1491	2.36	100	138	104	82	26	83	88	82	71	71	903	454	134
PT-Portugal	no	7079	11.18	1192	1378	1227	1123	416	2092	1004	880	1159	985	4735	1899	445
RO-Romania	yes	8190	12.94	147	145	216	115	38	193	111	159	114	124	3757	3373	1060
SK-Slovakia	yes	2786	4.40	175	188	167	98	40	161	129	109	94	96	0	2408	378
Total		63303	100	8.84%	11.44%	8.92%	6.81%	3.24%	10.07%	8.09%	6.61%	6.34%	6.24%	59.89%	29.82%	10.30%
ES-Spain	no	30333	Taken out due to missing eco-innovation data (0 in all 10 questions)													
NO-Norway	Schengen	5045	Taken out due to missing eco-innovation data (0 in all 10 questions)													

Regarding the distribution of the sample by country for the dependent and independent variables, table 2 shows that environmental benefits are mostly within the enterprise (EBWE) rather than to environmental impacts related to after sales use of a product by its end user (EBEU). When answering to the question were any of these environmental benefits due to product (ecoprd), process (ecoprc), organizational (ecorg) or marketing (ecomkt) innovations we observe that most of the eco-innovations implemented are due to process innovations (5.89%) followed by product innovations (4.62%). About 19.53% of the firms in the sample are undertaking any eco-strategy to be more efficient and environmental friendly. The percentage of enterprise's employees with a terciary degree in 2014 was 75.93% (if less than 25%) and 24.07% (if more than 25%). Wit respect to turnover growth both average and standard deviation values are higher in Bulgaria, as expected considering the number of firms. However, Lithuania and Croation also present high turnover means as well as volatility values. In terms of employment growth Lithuania and Latvia also present high averages and standard deviation, even if the number of firms answering the survey in each is smallest as compared to other EU countries. Overall new EU countries present higher turnover and employment growth as compared to older EU members.

Figures 1 evidences the distribution of positive and negative turnover and employment growth by countries. Except in Cyprus and Czech Republic, where most of the firms evidence negative turnover, turnover gwoth is positive. The same happens with employment growth (mostly positive, except in Cyprus where 41.4% of the sample has reported negative turnover growth during 2012-2014. It is also evidenced that null employment growth within the period is higher than turnover growth and Germany is the country reporting high null turnover growth.

Table 2: Distribution of the sample by countries (period 2012-2014): dependent and independent

											turnover growth		employment growth	
Country	EBWE	EBEU	ECOBREATH	ECO	ecoprd	ecoprc	ecorg	ecomkt	empud1	empud2	average	stdv	average	stdv
BG-Bulgaria	704	510	302	758	354	380	321	139	10094	4108	0.72	4.30	0.39	1.74
CY-Cyprus	192	105	133	215	105	192	84	38	688	658	0.02	1.01	0.05	0.54
CZ-Czech Republic	1299	997	582	1439	0	0	0	0	5191	0	0.15	1.94	0.09	0.60
DE-Germany	2797	1783	1428	3004	0	0	0	0	4793	1488	0.13	1.16	0.07	0.38
EE-Estonia	313	218	139	335	126	169	59	41	1704	52	0.32	2.42	0.26	1.34
EL-Greece	708	619	277	802	357	401	287	191	1546	961	0.18	2.34	0.11	0.86
HR-Croatia	631	475	258	682	186	246	206	67	2321	931	0.54	3.80	0.27	1.33
HU-Hungary	738	525	377	820	352	238	113	70	5290	1523	0.25	1.87	0.11	0.65
LT-Lithuania	610	416	272	649	219	521	142	68	2409	0	0.67	4.16	0.42	1.74
LV-Latvia	217	160	111	244	126	148	92	37	851	640	0.52	3.79	0.35	1.70
PT-Portugal	2593	1820	1053	2733	818	1122	702	277	5311	1768	0.23	1.80	0.12	0.82
RO-Romania	319	251	118	344	134	150	132	61	5821	2369	0.47	3.21	0.18	1.17
SK-Slovakia	306	209	165	340	148	159	83	35	2049	737	0.32	2.21	0.14	0.83
Total (%)	18.05	12.78	8.24	19.53	4.62	5.89	3.51	1.62	75.93	24.07				

Note: Total (%) refers to the ratio between the sum of firms stating the variable and the total number of firms in the sample (63303).

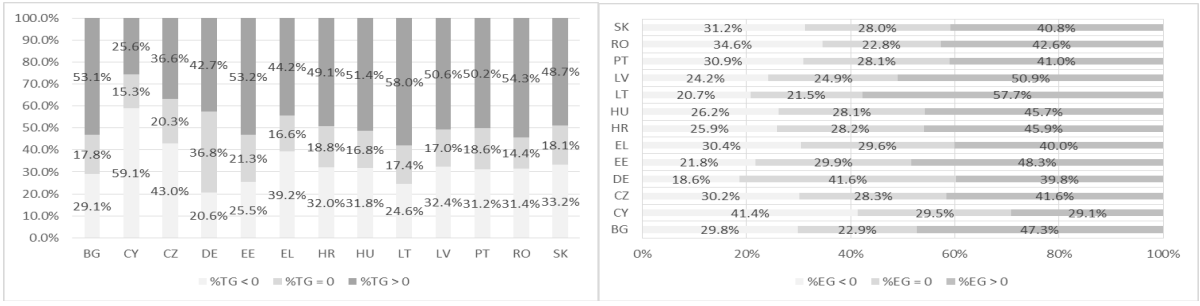

Figure 1: Positive, null and negative turnover (TG) and employment growth (EG) distribution (2012-2014 period)

EMPIRICAL RESULTS

Considering cross-section regressions performed, table 3 presents the estimation results by country. From this table it is visible a U-shaped relationship between the number of eco-innovation strategies and turnover growth but only statistically significant in Slovakia. Moreover, Ecobreath influences negatively turnover growth in Bulgaria, Cyprus, Estonia and Hungary, with statistical significance, all new EU members. An inverted U-shaped relationship seems to be evident in Czech Republic, Croatia and Romania, although with no statistical significance. In all countries employment growth seems to be an important variable to explain positively and significantly turnover growth, although the percentage of persons with a higher degree does not reveal to be statistically signicant, except in Cyprus where the sign is negative. As such, a lower value of terciary degree (if less than 25%) seems to affect negatively turnover growth in Cyprus.

Table 3: Regression results by country (period 2012-2014): dependent variable turnover growth

Y=TG X	EBWE	EBEU	ECOBREATH	ECOBREATH2	empud1	SIZE1	SIZE2	Emp.Growth	F-test	Prob > F
BG	0.325**	-0.325**	-0.459***	0.117	0.008	0.403***	0.251***	1.069***	24.02	0.000
CY	0.066	-0.066	-0.155*	0.048	-0.141***			0.796***	22.75	0.000
CZ	0.005	-0.005	0.078	-0.053		-0.054	-0.110*	0.607***	3.43	0.002
DE	0.012	-0.012	-0.038	0.008	-0.047	0.04	-0.013	1.068**	2.58	0.012
EE	0.180**	-0.180**	-0.269**	0.067	-0.062	0.106	0.033	0.514*	0.03	0.082
EL	0.012	-0.012	-0.135	0.038	-0.136	0.172***	0.052	0.475**	3.95	0.000
HR	-0.099	0.099	0.429	-0.206	-0.029	0.401***	0.226**	0.842***	4.71	0.000
HU	-0.174***	0.174***	-0.300***	0.107	-0.072	0.008	-0.043	1.131***	4.63	0.000
LT	0.113	-0.113	-0.228	0.043		0.133	-0.037	1.036***	3.02	0.006
LV	0.032	-0.032	-0.476	0.305	-0.07	0.221	0.143	0.934***	3.47	0.001
PT	-0.004	0.004	-0.069	0.041	-0.035	0.052	0.026	0.809***	4.78	0.000
RO	-0.314	0.314	0.239	-0.052	-0.028	0.052	0.026	0.812***	5.80	0.000
SK	0.104*	-0.104*	-0.348***	0.180***	0.033		0.276***	0.827***	5.48	0.000

Note: *,**,*** represent statistically significant at 10%, 5% and 1% respectively.

With respect to environmental benefits obtained within the enterprise (EBWE) only in Bulgaria, Estonia and Slovakia they are positive and statistically significant, whereas being negative for EBEU (where each firm might have implemented 0 to 4 innovations with environmental benefits obtained during the consumption or use of a good or service by the end user). In Hungary the opposite happens with respect to coefficient signs, being statistically significant, where results seem to evidence the same coefficient signs in Portugal, Romania and Croatia, despite the fact that they reveal not to be statistically significant. As such, and provided our results we cannot corroborate previous authors findings of a positive relationship between eco-innovation strategies and turnover growth, and this may be related to the fact that most of the firms in the sample are small ones which implies that they have higher costs associated to eco-innovation strategies to be implemented and theses costs are being reflected in terms of turnover growth. Neverthless, there are differences among countries and EU policy makers should be aware of these differences when forcing countries to translate the EU directives in national terms, especially in the new EU members.

CONCLUSIONS AND FURTHER RESEARCH

This work analyses the relationship between turnover growth and eco-innovation strategies for a sample of 63303 firms from 13 different EU countries, 10 new EU members and 3 former EU. The data is available in the CIS 2014 survey, the most recent one including a section respecting eco-innovation strategies adopted within firms. As far as we are aware, we are the first to use this more recent data and survey to analyse this relationship, using a cross-section

regression. Although a lot more remains to be done within the field, we have considered different EU countries within a sole sample to be able to analyse if the relationship changes among them. The study has however some limitations namely with respect to the data availability in the sample that does not allow us to take a deeper look on other factors which influence turnover growth and because we had to restrict the analysis to a cross-section regression.

Results evidence that for new EU members the additional costs incurred in terms of eco-innovation strategies might lead to decreased turnover growth and thus policy makers within the EU should be aware that, being the sample mostly composed by SMEs, that these additional cost might dissuade firms to implement the needed eco-strategies to comply with EU rules. Further, in some countries (new EU members mostly) there is evidence of a U-shaped relationship between the number of eco-innovation strategies implemented and turnover growth. This work might be expanded in the future to include each of the eco-innovation strategies statements into estimations and by exploring the different economic activity sectors for each of the countries with available data. Another opportunity of future research is to explore the stated factors of driving the firm decisions to introduce innovations with environmental benefits. In fact, all these issues are already being explored in an ongoing work by the authors.

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