Eco-Efficiency Actions and Firm Growth in Portugal

Mara Madaleno[1], Mónica Meireles[2], Marta Ferreira Dias[1], Daniel Magueta[3], Margarita Robaina[1]

[1]Universidade de Aveiro, GOVCOPP, DEGEIT (PORTUGAL), maramadaleno@ua.pt, mfdias@ua.pt, mrobaina@ua.pt
[2]ISCTE Business School (PORTUGAL), monica.meireles@iscte-iul.pt
[3]Universidade de Aveiro, ESTGA (PORTUGAL), dmagueta@ua.pt

Abstract

This study investigates the effect of eco-efficiency actions on firm performance, considering the turnover growth, on a sample of 7083 enterprises located in Portugal. Empirical results suggest that in general, for all the sectors involved, the undertaking of an eco-strategy aimed at being more resource efficient is related with increased growth in turnover. They also seem to show that there exists an inverted U-shaped relationship between the number of eco-innovation strategies implemented and turnover growth, allowing us to conclude that while in an initial stage an increase on the number of eco-innovations implemented by a firm increases turnover growth, in a second stage it will lead to decreased turnover growth. This may induce the existence of an optimal value for eco-innovation-strategies implemented within the firm. The substitution of fossil fuels by renewable sources also seems to be an important strategy that benefits turnover growth, as well as the environmental benefit of recycled waste, water or materials for own use or sale.

KEYWORDS
Eco-innovation, Eco-strategy, Turnover Growth, Portugal.

1 Introduction: eco-innovation strategies - firm performance

The understanding of how eco-innovation strategies, to reduce environmental impact, 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-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.

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 exists 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). 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).

Regarding the relationship between eco-strategies and productivity, Riilo (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, Antonieli et al. (2016) conclude that some firms' productivity performances are 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.

Finally, considering the relationship between eco-strategies and finance performance, Wagner et al. (2002) used return on capital employed, return on sales and return on equity, using data from 37 firms located in Germany, Italy, The Netherlands and UK finding a negative and non-significant relationship. Earnhart and Lizal (2007) used operating profits for a sample of 436 Czech Republic firms to find that better pollution control neither improves nor undermines financial success. Ghisetti and Rennings (2014), considering a sample of 1063 German firms, and Rexhäuser and Rammer (2014), considering a sample of 3618 German firms, both used operating margins, reaching the same conclusion (reduction in the use of energy or materials per unit of output positively affects firms' competitiveness, but externality reducing innovations hamper firms' competitiveness). For a sample of 439 Polish and Hungarian publicly traded firms, Przychodzen and Przychodzen (2015) used return on equity and return on assets to find that green research and development is positively related to financial performance. More recently, Trumpp and Guenther (2017) used return on assets and total share return for a sample of 696 manufacturing and services firms publicly traded in the CDP Global 500, S&P 500 and FTSE 350, finding a U-shaped relationship between corporate environmental performance and profitability. Finally, Miroshnychenko et al. (2017) used Tobin's Q and also return on equity to conclude that internal green practices (pollution prevention and green supply chain management) are the major eco-drivers of financial performance, for a sample of 3490 publicly-traded companies from 58 countries.

Based on the work of Jové-Llopis and Segarra-Blasco (2018), this study focus on the role of the Portuguese 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.

Applying a cross-sectional data regression analysis for 7083 Portuguese firms, our empirical developments offer interesting results. First, we validate the Porter hypothesis by identifying an inverted U-shaped relationship between turnover growth and eco-innovations. Second, product innovations with environmental benefits drive higher turnover growth than do process, organizational and marketing innovations. Third, undertaking eco-innovation strategies lead to higher turnover growth. Fourth, results are sensitive to the type of section (or sector). Despite this, 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 strategies to increase and facilitate the introduction of eco-innovations within firms, namely the access to finance.

This study contributes to the previous literature in several ways. First, the Portuguese sample of firms is mostly composed by small and medium enterprises (considering the entire sample contained within the CIS 2014 survey, 4738 of the enterprises have less than 50 employees, 1900 state to have between 50-249 employees, and only 445 revealed to have 250 employees or more). It must be stressed the relevant role of small and medium enterprises in the Portuguese economy, 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, sector analysis of eco-innovations at firm level are still scarce (Wagner et al., 2002; Aragón-Correa et al., 2008; Jové-Llopis and Segarra-Blasco, 2018), and those that exist are usually applied to one or a few sectors. Different sectors have different environmental costs and adopt different eco-innovation strategies, thus turning important an analysis at the sector level. Third, there are few studies that focus on the Portuguese eco-innovation strategies and when they exist they are presented in a disguised way, considering also other countries and or not at the sector level (see Mavi et al, 2018, and references therein; Jové-Llopis and Segarra-Blasco, 2018). The existent literature on Portugal 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 countries that

have been members of the EU for many years, little is known for the individual case of Portugal, and at the sector level.

The remaining of this article is structured as follows. Section 2 presents the database, some descriptive statistics, the variables and the econometric methodology. Section 3 shows our main findings and results and section 4 presents our conclusions and the consequent policy implications.

2 Data and methodology

Several firms from several different sectors answered the CIS2014, where eco-innovations are measured on ten different areas of environmental impacts.[1] 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?" 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. Despite a total of 7083 Portuguese firms have answered the survey, only 4167 enterprises provided valid answers with respect to eco-innovation strategies adopted.

We implement a cross-section data analysis 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. 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

1 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 CO2 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).

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) 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). Instead of using dummies as control variables for sectors we perform different regression estimates considering different economic activity sectors.[2]

Previous environmental empirical databases using CIS data or similar ones offer only aggregate information at the country level. However, we will have one dimension in the same database allowing sector views and different perspectives on the data. The main drawback with our cross-sectional dataset, inducing simultaneity, is unavoidable, but so far, it has also been a problem common to all studies using CIS or similar databases with only one year of observations across different firms (Doran and Ryan, 2012, 2016; Van Leeuwen and Mohnen, 2017; Jové-Llopis and Segarra-Blasco, 2018).

Table 1 displays the characteristics of the sample for Portugal and by sector group. Correlation values were also computed but not presented due to space restrictions. Turnover growth has a negative correlation with most of the variables, as well as Empud2 and Size1.

From table 1 we are able to observe the characteristics of the sample group. About 58.8% of the firms state they had introduced, at least, one eco-innovation during the analysis period (2012-2014). Only turnover growth presents higher volatility, followed by EcoBreath, being both variables those which present higher mean values. The sector with higher number of valid answers is the manufacturing and the size

2 From the available survey sample we had available the following sectors (NACE1 codes). Section C – Manufacturing (divisions 10-33): 13, 16-18,21-33,14-15, 19-20; Sections D + E – Electricity, Gas Steam and air conditioning supply (35) + Water supply, sewerage, waste management and remediation activities (divisions 35 + 36-39): 35, 36, 37-39. Section F – Construction (divisions 41-43): 42-43. Section G – Wholesale and retail trade, repair of motor vehicles and motorcycles (divisions 45-47): 46-47. Section H – Transportation and Storage (divisions 49-53): 49-53. Section J – Information and Communication (divisions 58-63): 58, 61, 59-60, 62-63. Section K – Financial and Insurance activities (divisions 64-66): 64-66. Section M + Q – Professional, scientific and technical activities (divisions 69-75): 71, 73, 74, 69-70, 72, 75 and Section Q – Human health and social work activities (divisions 86-88): 86. Available number of companies by section: C – 3382, D+E – 278, F – 568, G – 1191, H – 495, J – 347, K – 300, M+Q – 522.

of the firms with a higher percentage of valid answers is the one with less than 50 employees. Most of the firms confirm to have introduced a product (good or service), process, organisational or marketing innovation with the environmental benefit, obtained within the enterprise, of recycled waste, water, or materials for own use or sale (50.23%), followed by reduced energy use or CO_2 'footprint' (reduce total CO_2 production) (33.09%) and reduced air, water, noise or soil pollution (29.45%). Regarding turnover growth, 2209 firms stated to have a negative turnover growth within the period and 1315 affirmed to have a null turnover growth, while 2887 revealed to have a positive turnover growth between 0 and 0.5 and 672 firms declared to have turnover growth higher than 0.6. Provided that there is statistical evidence that the sample has 4 outliers with respect to turnover growth (higher than 213.3) we have removed these 4 firms from the sample and proceeded with the model estimations.[3]

Table 1
Descriptive Statistics and Sample Distribution

Variable	Mean	Std.Dev.	Valid Obs.
ECOMAT	0.2863	0.4521	4167
ECOENO	0.3309	0.4706	4167
ECOPOL	0.2945	0.4559	4167
ECOSUB	0.2695	0.4438	4167
ECOREP	0.0998	0.2998	4167
ECOREC	0.5023	0.5001	4167
ECOENU	0.2412	0.4279	4167
ECOPOS	0.2112	0.4082	4167
ECOREA	0.2784	0.4483	4167
ECOEXT	0.2366	0.4251	4167
EcoBreath	1.6182	2.6197	7083
Eco	0.3860	0.4869	7083
EBWE	0.3662	0.4818	7083
EBEU	0.2571	0.4371	7083
ECOPRD	0.2992	0.4580	2734
ECOPRC	0.4104	0.4920	2734
ECORG	0.2568	0.4369	2734
ECOMKT	0.1017	0.3023	2734
Empud1	0.7500	0.4331	7083
Empud2	0.2500	0.4331	7083
Size1	0.6689	0.4706	7083
Size2	0.2682	0.4431	7083
Turn. Growth	169.5783	14242.14	7083

EcoBreath (% firms with respect to valid answers when X=1)

X	ECOMAT	ECOENO	ECOPOL	ECOSUB	ECOREP	ECOREC	ECOENU	ECOPOS	ECOREA	ECOEXT
1	0.65%	1.63%	0.41%	0.55%	0.24%	6.07%	0.36%	0.24%	0.55%	0.62%
2	1.61%	2.74%	1.44%	1.39%	0.60%	7.06%	1.66%	0.70%	2.90%	1.94%
3	3.22%	3.70%	2.50%	2.62%	0.60%	6.89%	2.28%	1.01%	3.36%	2.42%
4	3.29%	3.55%	3.67%	3.02%	0.74%	5.86%	1.97%	1.80%	2.98%	2.50%
5	4.06%	4.30%	4.34%	4.20%	1.01%	5.83%	2.45%	2.21%	2.95%	2.62%
6	3.77%	4.08%	4.10%	3.22%	1.30%	5.14%	2.74%	2.69%	3.17%	2.93%
7	3.43%	4.03%	4.01%	3.31%	1.03%	4.30%	3.65%	3.60%	3.29%	2.62%
8	2.74%	3.17%	3.05%	2.81%	0.96%	3.26%	3.07%	2.93%	2.81%	2.28%
9	3.10%	3.12%	3.14%	3.05%	0.72%	3.05%	3.17%	3.17%	3.05%	2.95%
10	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%
TOTAL	28.63%	33.09%	29.45%	26.95%	9.98%	50.23%	24.12%	21.12%	27.84%	23.66%

	% firms with respect to valid answers when X=1 and Y=1											% firms with respect to valid answers when Y=1							
Y X	ECO	EBWE	EBEU	ECOPRD	ECOPRC	ECORG	ECOMKT	EMPUD1	EMPUD2	Size1	Size2	C	D+E	F	G	H	J	K	M+Q
ECOMAT	28.63%	28.63%	20.71%	16.46%	24.54%	14.96%	6.47%	21.65%	6.98%	14.01%	10.03%	16.37%	1.46%	3.17%	2.93%	1.51%	0.74%	0.91%	1.54%
ECOENO	33.09%	33.09%	23.81%	18.51%	26.88%	16.39%	6.18%	25.05%	8.04%	15.41%	12.12%	18.43%	1.73%	2.95%	3.91%	2.38%	1.13%	0.77%	1.80%
ECOPOL	29.45%	29.45%	22.17%	16.39%	24.51%	15.25%	6.22%	23.88%	5.57%	15.21%	10.22%	18.24%	1.54%	2.98%	2.76%	1.82%	0.55%	0.43%	1.13%
ECOSUB	26.95%	26.95%	21.09%	16.86%	22.31%	14.37%	6.33%	21.48%	5.47%	14.47%	9.00%	16.80%	0.94%	2.66%	3.02%	1.32%	0.50%	0.41%	1.30%
ECOREP	9.98%	9.98%	7.68%	6.62%	8.74%	5.63%	2.89%	7.56%	2.42%	4.78%	3.46%	5.38%	0.62%	1.25%	1.46%	0.41%	0.31%	0.07%	0.48%
ECOREC	50.23%	50.23%	34.25%	22.49%	33.03%	22.13%	8.71%	39.21%	11.02%	28.77%	15.93%	28.56%	2.35%	4.66%	6.34%	2.98%	1.34%	1.42%	2.59%
ECOENU	24.12%	22.63%	24.12%	16.17%	19.79%	12.36%	6.00%	17.85%	6.26%	12.65%	8.02%	13.20%	1.13%	1.78%	3.19%	1.92%	1.10%	0.41%	1.39%
ECOPOS	21.12%	19.97%	21.12%	13.64%	17.37%	11.30%	5.60%	16.56%	4.56%	11.71%	6.74%	12.46%	1.15%	1.73%	2.57%	1.51%	0.46%	0.29%	0.96%
ECOREA	27.84%	26.33%	27.84%	15.58%	21.10%	14.05%	7.21%	22.22%	5.62%	16.97%	8.14%	15.57%	0.96%	2.86%	4.54%	1.49%	0.77%	0.48%	1.42%
ECOEXT	23.66%	22.08%	23.66%	17.89%	19.20%	12.33%	6.36%	18.60%	5.06%	13.97%	7.32%	15.02%	0.53%	1.54%	3.65%	0.89%	0.62%	0.24%	1.18%

3 Empirical Results

The results of the estimation values are presented in table 2. From this table it is visible an inverted U-shaped relationship between the number of eco-innovation strategies and turnover growth, except for the G sector (although not significant), but only significant for the entire sample and the Transportation and Storage sector (H). It is reasonable to state that our R^2 values are low, which is also common in other previous related literature (Jové-Llopis and Segarra-Blasco, 2018), inducing the need to include more variables into estimations to explain turnover growth besides those related to eco-innovations.

3 After removing the 4 outliers, the average of turnover growth became 0.2271 and its standard deviation 1.7993. Thus, after the treatment, EcoBreath turned out to be the variable with higher mean and volatility within the sample.

There are clear differences with respect to eco-innovations able to influence TG in Portuguese sectors. For now, and considering all firms in the survey, it can be observed that only facilitated recycling of product after use seems to exert a negative influence over TG. All the other environmental benefits obtained within the enterprise or by the end user (EcoBreath) have a positive influence over TG. When significant, the environmental benefits associated to marketing innovations (ecomkt) seem to negatively impact TG (for the entire sample, as well as in sections D+E, G and H). Size has also showed to have a clear positive impact over TG, despite not always being significant. For all firms and in sections C, H and K there is evidence to state that the higher the firm size, the higher the impact in TG. Employees education (percentage of employees with a tertiary degree: Empud1 and Empud2) only seems to have positive influence over TG in sections F and G, while negative in J and K, leading us to conclude that experience from employees maybe more important than education to TG.

With respect to environmental benefits obtained within the enterprise (EBWE) and considering the economic activity sectors, it is observable that the reduced air, water, noise or soil pollution (ECOPOL) has a negative and statistically significant impact over TG in the manufacturing sector (C) and in the wholesale and retail trade (G), but a positive one in Transportation and storage. Replacement shares of fossil energy by renewable energy sources have a positive and significant impact in G and in financial and insurance activities (K). Recycled waste, water, or materials for own use or sale (ECOREC) only reveals to be negative and statistically significant in transportation and storage (H), which may be related to the type of sector we are analysing. The same coefficient sign is present in the professional, scientific and technical activities and in the human health and social work activities sectors (M+Q). In all the other economic activity sectors and for the entire sample the coefficient is positive, although not significant, meaning that this type of eco-innovation improves TG.

Table 2
Regression results: Dependent variable Turnover Growth (TG - period 2012-2014)

Independents	All sample: Coeff.		Section C: Coeff.		Section D+E: Coeff.		Section F: Coeff.		Section G: Coeff.		Section H: Coeff.		Section J: Coeff.		Section K: Coeff.		Section M+Q: Coeff.	
EcoBreath		**0.0705***		0.0223		0.5123		0.0567		-0.0021		**0.2756*****		0.1419		0.0238		0.0714
EcoBreath2		**-0.0069***		-0.0040		-0.0462		-0.0061		0.0017		**-0.0281*****		-0.0121		-0.0039		-0.0048
ecomat	-0.0648		-0.0859		0.0054		-0.0548		-0.0400		-0.1098		0.1161		0.0287		-0.1730	
ecoeno	0.0312		-0.0176		0.3965		-0.0223		0.0447		0.1250		-0.3196		-0.1191		0.2704	
ecopol	-0.0062		**-0.1174***		0.0967		0.0896		**-0.0819*****		**0.5233****		0.6156		0.0607		0.2104	
ecosub	-0.0151		-0.0377		**0.2844***		0.1046		-0.0143		**-0.4451****		-0.2455		0.0768		-0.2511	
ecorep	0.1834		0.4096		-0.4561		-0.0144		**0.1145****		0.0502		-0.2444		**0.2269***		-0.2541	
ecorec	0.0466		0.0664		0.4772		0.1316		0.0936		**-0.3496***		0.0579		0.0537		-0.0392	
ecoenu	0.0637		0.3031		-0.0128		-0.4052		**-0.2467*****		0.0414		-0.8151		-0.1319		-0.3299	
ecopos	-0.0309		-0.2609		-0.0374		0.3234		**0.2878****		-0.0434		**0.6143****		**-0.1559****		**0.5228****	
ecorea	**-0.2044****		-0.2100		-0.1185		-0.4154		**-0.2018****		-0.0688		-0.1185		-0.2386		-0.3444	
ecoext	-0.0228		-0.0363		-0.0455		-0.0895		**0.1996*****		**-0.3005***		-0.4723		-0.0486		**0.3236***	
EBWE	0.0623	0.0341	**0.3127***	0.2776	-0.1129	**0.2276****	-0.0228	0.0391	**-0.3961****	**-0.4107****	0.5735	0.2655	-0.2428	0.0497	**0.1149****	0.1128	0.0182	-0.1361
EBEU	0.2015	0.0587	0.2260	0.1199	0.0647	-0.2711	0.4376	0.1272	0.0396	-0.0467	0.4341	0.1634	0.3448	-0.2063	0.3373	**0.1147****	0.1328	0.0928
ecoprd	0.1030	0.1223	0.0556	0.0829	0.1410	0.1684	-0.0125	-0.0399	**0.1741****	**0.2230****	0.7065	0.6520	0.0986	-0.2236	**-0.1150****	**-0.0845***	-0.0611	-0.0012
ecoprc	-0.0017	-0.0147	-0.0065	-0.0208	-0.2291	-0.3244	-0.0774	-0.1064	**0.2734***	**0.2240****	**-0.1691****	**-0.1192****	0.2326	0.1451	-0.0418	-0.0593	0.0176	0.0011
ecorg	-0.0535	-0.0559	-0.0309	-0.0323	-0.1888	-0.1520	-0.0001	-0.0240	**-0.2115****	**-0.1842****	-0.1358	-0.2094	-0.1735	0.0868	-0.0642	-0.0316	0.1368	0.1255
ecomkt	**-0.1206*****	**-0.1243*****	-0.0711	-0.0611	**-0.1311*****	**-0.2704****	0.0154	-0.0420	**-0.1859***	**-0.2287***	**-0.3947****	-0.2867	-0.1479	-0.2048	0.0130	-0.0156	-0.2424	-0.2756
Empud1	-0.1645	-0.1860	-0.5002	-0.5352	0.2139	0.0683	-0.0465	**0.0010****	**0.1608****	**0.1543****	omitted	omitted	omitted	**-0.3160****	-0.0697	**-0.1137***	0.0027	-0.0004
Empud2	-0.0540	-0.0592	omitted	omitted	omitted	omitted	omitted	omitted	omitted	omitted	-0.0497	-0.1028	0.1668	omitted	omitted	omitted	0.0000	0.0000
Size1	**0.3049*****	**0.2742*****	**0.3772*****	**0.3269*****	0.2810	0.1247	0.0729	0.0942	0.2260	**0.2099***	**0.6406*****	**0.5770***	0.4875	0.4278	0.0885	0.1174	0.0335	-0.0551
Size2	**0.1377*****	**0.1174*****	**0.1774*****	**0.1559*****	0.0657	-0.0405	-0.0156	0.0050	0.0900	0.0636	0.1488	0.1703	0.2573	0.1325	**0.2336*****	**0.2776****	0.0535	0.0148
R^2	0.0319	0.0282	0.0259	0.0129	0.0593	0.0527	0.0773	0.0138	0.0715	0.0476	0.1016	0.0671	0.1619	0.0432	0.2658	0.1927	0.1313	0.0328

Both G and H sectors have more coefficients revealing statistical significance. With respect to the wholesale and retail trade sector (G) and considering environmental benefits obtained during the consumption or use of a good or service by the end user (EBEU), it is noticed that reduced air, water,

noise or soil pollution (ECOPOS[4]) positively and significantly affects TG, as does extended product life through longer-lasting, more durable products (ECOEXT). ECOEXT also has a positive impact in TG in M+Q, but a negative one in transportation and storage (H). Considering the environmental benefits obtained within the enterprise (EBWE), section G is negatively influenced, which is not the case in K, C and D+E (Electricity, gas, steam and air conditioning supply + water supply, sewerage, waste management and remediation activities).

Finally, environmental benefits derived from product innovations have a positive influence in TG in G, but negative in K. Those derived from process innovations positively influence TG only in G section, while exerting negative pressure in TG in section H. Although not being statistically significant, except in the G section, the coefficient associated to environmental benefits due to organisational innovations seems to have a negative influence in turnover growth. From the four kinds of innovations (product, process, organisational and marketing) only product innovations seem to positively influence TG (even if not statistically significant overall, coefficient signs are positive for most sectors and the overall sample), except in the construction sector (section F), in sections J, K and M+Q. Our results are similar and contrast some of other authors' previous results for the entire sample, but provide useful thought about the need to consider sectors in an independent way while analysing the relationship between turnover growth and eco-innovations, leaving room for other future research avenues.

4 Conclusions

This work analyses the relationship between turnover growth (TG) and eco-innovation strategies for a sample of 7083 Portuguese 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. Although a lot more remains to be done within the field, we have considered different economic activity sectors in order 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 the influence turnover growth and because we had to restrict the analysis to a cross section regression. Nevertheless, results suggest that different eco-innovation strategies have different influence over different sectors. Replacement shares of fossil energy by renewable energy sources have a positive and significant impact in two sectors. This may induce that replacement of fossil fuels increases TG, an important result for firms, which have to accomplish with the European rules – increase of renewables share in total energy consumption. This result thus evidences that firms may gain from this replacement in terms of turnover growth, while contributing to overall European policies. Recycled waste, water, or materials for own use or sale (ECOREC) only reveals to be negative and statistically significant in transportation and storage (H), but it may be related

4 Also, it has a positive impact in TG in section J (Information and Communication sector), in section M+Q, but a negative and significant effect in section K.

to the specific activity in this sector. We find the same coefficient sign in the professional, scientific and technical activities and in the human health and social work activities sectors (M+Q). In all the other economic activity sectors and for the entire sample the coefficient is positive, although not significant, meaning that this type of eco-innovation improves TG, leaving room for a higher bet in recycling that seems to increase firms turnover growth. Finally, and contrarily to Jové-Llopis and Segarra-Blasco (2018), we may conclude that, in general, for all the sectors involved, the undertaking of an eco-strategy, in order to be more resource efficient, is associated with increased growth in turnover. Furthermore, there seems to exist an inverted U-shaped relationship between the number of eco-innovation strategies implemented and the turnover growth.

Acknowledgements

This paper is based on data from Eurostat, Community Innovation Survey (CIS), 2014. The responsibility for all conclusions drawn from the data lies entirely on the author(s). This work has been in part financially supported by the Research Unit on Governance, Competitiveness and Public Policy - GOVCOPP (project POCI-01-0145-FEDER-008540), funded by FEDER funds through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) – and by national funds through FCT - Fundação para a Ciência e a Tecnologia. Any persistent error or missings are the authors' entire responsibility.

References

Albertini, E. (2013). Does Environmental Management Improve Financial Performance? A Meta-Analytical Review. *Organization & Environment*, 26, 431–457.

Antonioli, D., Borghesi, S., and Mazzanti, M. (2016). Are regional systems greening the economy? Local spillovers, green innovations and firms' economic performances. *Economics of Innovation and New Technology*, 25, 692–713.

Aragón-Correa, J.A., Hurtado-Torres, N., Sharma, S., García-Morales, V.J. (2008). Environmental strategy and performance in small firms: A resource-based perspective. Journal of Environmental Management, 86, 88–103.

Barbieri, N., Ghisetti, C., Gilli, M., Marin, G., and Nicolli, F. (2016). A Survey of the Literature on Environmental Innovation Based on Main Path Analysis. *Journal of Economic Surveys*, 30, 596–623.

Cainelli, G., Mazzanti, M., and Zoboli, R. (2011). Environmentally oriented innovative strategies and firm performance in services. Micro-evidence from Italy. *International Review of Applied Economics*, 25, 61–85.

Colombelli, A., Krafft, J. and Quatraro, F. (2015). Eco-Innovation and Firm Growth: Do Green Gazelles Run Faster? Microeconometric Evidence from a Sample of European Firms; EconStor: Hamburg, Germany, 2015; Volume 12.

Dixon-Fowler, H.R., Slater, D.J., Johnson, J.L., Ellstrand, A.E., and Romi, A.M. (2013). Beyond "Does it Pay to be Green?" A Meta-Analysis of Moderators of the CEP-CFP Relationship. *Journal of Business Ethics*, 112, 353–366.

Doran, J. and Ryan, G. (2012). Regulation and firm perception, eco-innovation and firm performance. *European Journal of Innovation Management*, 15, 421–441.

Doran, J., and Ryan, G. (2016). The Importance of the Diverse Drivers and Types of Environmental Innovation for Firm Performance. *Business Strategy and the Environment,* 25, 102–119.

Earnhart, D., and Lizal, L. (2007). Effect of Pollution Control on Corporate Financial Performance in a Transition Economy. *European Environmental Journal*, 266, 247–266.

Ghisetti, C., and Rennings, K. (2014). Environmental innovations and profitability: How does it pay to be green? An empirical analysis on the German innovation survey. *Journal of Cleaner Production*, 75, 106–117.

Ghisetti, C., Mancinelli, S., Mazzanti, M., and Zoli, M. (2016). Financial barriers and environmental innovations: Evidence from EU manufacturing firms. *Climate Policy*, 3062, 1–17.

Hojnik, J. and Ruzzier, M. (2016). The driving forces of process eco-innovation and its impact on performance: Insights from Slovenia. *Journal of Cleaner Production*, 133, 812–825.

Jo, J.H., Roh, T.W., Kim, S., Youn, Y.C., Park, M.S., Han, K.J., and Jang, E.K. (2015). Eco-Innovation for sustainability: Evidence from 49 countries in Asia and Europe. *Sustainability*, 7, 16820–16835.

Jové-Llopis, E. and Segarra-Blasco, A. (2018). Eco-Efficiency Actions and Firm Growth in European SMEs. *Sustainability*, 10, 281, 1-26.

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

Mavi, R.K., Saen, R.F., and Goh, M. (2018). Joint analysis of eco-efficiency and eco-innovation with common weights in two-stage network DEA: A big data approach. *Technological Forecasting and Social Change*, in press, https://doi.org/10.1016/j.techfore.2018.01.035.

Miroshnychenko, I., Barontini, R., and Testa, F. (2017). Green practices and financial performance: A global outlook. *Journal of Cleaner Production*, 147, 340–351.

Palmer, K., Oates, W.E., and Portney, P.R. (1995). Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm? *Journal of Economic Perspectives*, 9, 119–132.

Porter, M.E., and Linde, C. van der (1995). Toward a New Conception of the Environment Competitiveness Relationship. *Journal of Economic Perspectives*, 9, 97–118.

Przychodzen, J., and Przychodzen, W. (2015). Relationships between eco-innovation and financial performance - evidence from publicly traded companies in Poland and Hungary. *Journal of Cleaner Production*, 90, 253–263.

Rexhäuser, S., and Rammer, C. (2014). Environmental Innovations and Firm Profitability: Unmasking the Porter Hypothesis. *Environmental and Resource Economics*, 57, 145–167.

Riillo, C.A.F. (2017). Beyond the question "Does it pay to be green?": How much green? and when? *Journal of Cleaner Production*, 2017, 141, 626–640.

Soltmann, C., Stucki, T., and Woerter, M. (2015). The Impact of Environmentally Friendly Innovations on Value Added. *Environmental and Resource Economics*, 62, 457–479.

Trumpp, C., and Guenther, T. (2017). Too Little or too much? Exploring U-shaped Relationships between Corporate Environmental Performance and Corporate Financial Performance. *Business Strategy and the Environment*, 26, 49–68.

Van Leeuwen, G., and Mohnen, P. (2017). Revisiting the Porter Hypothesis: An empirical analysis of green innovation for the Netherlands. *Economics of Innovation and New Technology*, 26, 63–77.

Wagner, M., Van Phu, N., Azomahou, T., and Wehrmeyer, W. (2002). The relationship between the environmental and economic performance of firms: An empirical analysis of the European paper industry. *Corporate Social Responsible Environmental Management*, 146, 133–146.