Eco-strategies and firm growth in SMEs: EU15 and new EU members

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Abstract:

This study investigates the effects of eco-strategies on firm performance in terms of sales growth in an extensive sample of 11,336 small and medium-sized enterprises (SMEs) located in 28 European countries. Our empirical results suggest that not all eco-strategies are positively related to better performance, at least not in the short term. We find that European firms using renewable energies, recycling or designing products that are easier to maintain, repair or reuse perform better. Those that aim to reduce water or energy pollution, however, seem to show a negative correlation to firm growth. Our results, also, indicate that high investment in eco-strategies improves firm growth, particularly in new members that joined the EU from 2004 onwards. Finally, we observe a U-shaped relationship between eco-strategies and firm growth, which indicates that a greater breadth of eco-strategies is associated with better firm performance. However, few European SMEs are able to either invest heavily or undertake multiple eco-strategies, thus leaving room for policy interventions.

Highlights:

- The relationship between different types of eco-strategy and firm growth in a sample of SMEs located in 28 European countries is analysed.
- Not all eco-strategies are positively related to better performance, at least not in the short term.
- The intensity and breadth of eco-strategies improve firm growth, but few firms are able to reach such intensity or breadth.
- Market incentives alone are not enough, so public policies should be implemented to improve firms' eco-strategy adoption and investment.
- The conjecture of firm growth varies across country groups. Environmental concerns are more important for EU-15 countries whereas new EU members seem to rely more on external finance for growth.

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1. INTRODUCTION

Although in existing research there seems to be a robust understanding of the factors that determine which innovations positively impact the environment,[1] exactly how these eco-strategies to reduce environmental impacts affect firm performance is still widely debated.

Traditional economic arguments claim that eco-strategies generate costs but no profits for firms. Some years later, Porter (1991) and Porter and Linde (1995) proposed a new green perspective emphasizing that both the environment and the firm can benefit, since stricter regulations may trigger innovation and lead to higher profitability and competitiveness in the long run.

Ambec et al., (2013), Dixon-Fowler et al., (2013), Albertini (2013), and Barbieri et al., (2016) provide recent reviews and meta-studies summarizing the empirical work on the economic effects of eco-strategies. These studies reveal the presence of considerable diversity in the empirical results, ranging from negative through non-significant to moderately (or even strongly) positive links between eco-innovation and firm performance. Such mixed results suggest that the relationship between eco-innovation strategies and firm performance is complex and poorly understood, indicating a need for a greater effort in investigating this link. This could provide a conclusive argument to help managers bring about a win-win situation in which both firms and society can benefit from eco-innovation practices. In addition, a better evaluation of this relationship would be useful to take into account, should it be necessary, when designing effective eco-innovation policies in the future.

In this study we therefore focus on the role played by eco-strategies, and we ask whether firms are creating economic opportunities (in terms of firm growth) by improving their eco-performance or missing out on a sustainable competitive advantage in today's turbulent environment. To do this we use the European Commission's Eurobarometer Survey 426 which provides a valuable opportunity to examine the role of eco-strategies in firm growth in SMEs in European countries.

Applying an ordered logistic model for 11,336 European SMEs, our empirical developments offer some interesting results. First, not all eco-strategies are positively related to better performance. We find that European firms using renewable energies perform better. In addition, undertaking eco-strategies aimed at recycling or designing

[1] The existing literature has mainly classified the determinants of eco-innovation into four groups: supply-side factors, demand-side factors, firm specific factors and environmental policy (Cuerva et al., 2014; Doran and Ryan, 2016; Horbach, 2008; Horbach et al., 2013; Triguero et al., 2013). Environmental policies seem to be the most important drivers for triggering eco-innovations. However, relying on external knowledge sources and cooperation are also more important for eco-innovators than general innovators (Cainelli et al., 2015; De Marchi, 2012).

products that are easier to maintain, repair or use increase firm growth in EU-15 members of the EU. Firms seeking to reduce water or energy pollution, on the other hand, seem to show a negative correlation with firm growth patterns. Second, our results indicate that high investment in eco-strategies improves firm growth, particularly in new member states that joined the EU from 2004 onwards. Finally, we observe a U-shaped relationship between eco-strategies and firm growth, meaning that a greater breadth of eco-strategies is associated with higher firm performance. However, few SMEs are able to either invest large amounts or undertake multiple eco-strategies.

This paper contributes to the previous literature in several ways. First, despite the important role that SMEs play in advanced economies, the impacts of eco-strategies on their firm performance have received less attention in the literature compared to large firms (Aragón-Correa et al., 2008). Nowadays SMEs are the economic backbone of the European Union, representing 99% of European business and accounting for more than two thirds of employment. We therefore contribute to the existing debate with a detailed investigation of SMEs.

Second, cross-country analyses of eco-strategies at firm level are still scarce (Colombelli et al., 2015; Lanoie et al., 2011). In general, empirical studies are performed focusing on either a single country or a specific sector.[2] However, this study enhances previous research by giving more clarity to the relationship between eco-innovation strategies and firm performance across 28 European countries taking into account both sector and country differences.

Finally, to compare how far eco-strategies vary across countries, we classify the EU28 countries into two clusters. The distinction between European Union-15 and new EU members (the group of more recent member that joined the EU from 2004 onward) is of great interest to day, bearing in mind that in a considerable number of Central and Eastern European countries have become part of the European project in recent years. 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, the evidence is virtually non-existent for new members (Hojnik and Ruzzier, 2016; Przychodzen and Przychodzen, 2015).

The remainder of the paper is structured as follows. Section 2 consists of a discussion of literature review and hypotheses. Section 3 presents the database, some descriptive statistics, the variables and the econometric methodology. Section 4 shows our main

[2] Examples of specific country analyses include: Italy (Marin and Lotti, 2017; Riillo, 2017), Germany (Ghisetti and Rennings, 2014; Rexhäuser and Rammer, 2014), Ireland (Doran and Ryan, 2012), the Netherlands (Leeuwen and Mohnen, 2017) and, Slovenia (Hojnik and Ruzzier, 2016). Analyses of specific sectors we include: automotive sector (Aragón-Correa et al., 2008) and the paper industry (Wagner et al., 2002), among others.

findings. The final section presents our conclusions and the consequent policy implications.

2. ECO-INNOVATION STRATEGIES AND FIRM PERFORMANCE: DISCUSSION OF THE LITERATURE AND HYPHOTHESES

While eco-innovation is expected to have a beneficial effect on the environment, its effect on firms' performance is less straightforward. Historically, the conventional economic approach held that investing in environmental activities to reduce an externality like pollution involved an additional cost to a firm with no resulting benefits, which in turn eroded a firm's overall competitiveness (Palmer et al., 1995; Walley and Whitehead, 1994). However, two decades ago a new green perspective emerged that considered that investments in eco-innovation activities would offset operational costs and increase firm performance in the long term (Porter and Linde, 1995).

Recently, scholars have increasingly emphasized the win-win idea (improving the environment with no reduction in firm profits). Relying primarily on case studies, Porter and Linde (1995) argue that more stringent but well-designed eco-regulation (mainly in the form of market-based instruments such as pollution taxes and tradable permits) can stimulate innovation which by enhancing productivity, increases firm benefits. This is generally known in the literature as the Porter Hypothesis (henceforth PH), according to which eco-regulation is a means whereby a firm can benefit from environmental and economic performance. It has, therefore, attracted much attention among researchers and policy-makers because it goes against the conventional wisdom that environmental protection always has a negative effect on economic growth.

2.1 Review of existing empirical studies

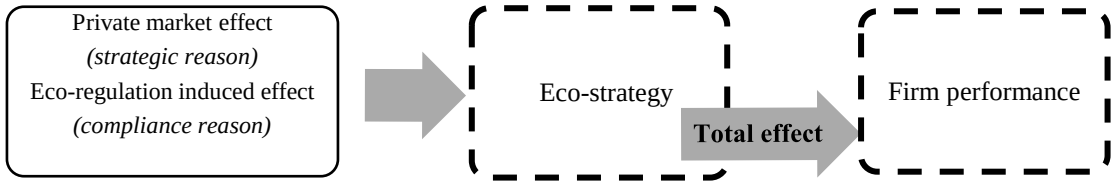
Given the PH framework, a range of empirical studies have set out to analyse the relationship between eco-strategies and performance at firm-level. Despite the accumulation of empirical work on this topic over the last decade, there is no general consensus on the direction and magnitude of the relationship. The emergence of heterogeneous results can be explained in the light of several dimensions such as the scope of analysis (firm or aggregate level, small or large sample), the variety of performance measures (productivity, growth, profitability), the hybrid indicators to measure eco-strategies (clean technologies, end-of-pipe techniques, pollution prevention, resource efficiency measures, etc.), the empirical approaches adopted and the availability of data.[3]

[3] See Barbieri et al., (2016) for a recent literature review on the economic effects of eco-innovations and also some examples: Ambec and Lanoie (2008); Aragón-Correa et al., (2008); Cainelli et al., (2011); Doran

Figure 1 provides a synthetic overview of the framework used in our empirical analysis. Note that our empirical investigation does not examine the full chain of causality from eco-policies to eco-innovation and firm performance, since we cannot disentangle the effects driven by eco-policies and private market (strategic reasoning). Because of data limitation, this analysis focuses on the relationship between eco-innovation strategies and SME performance, and we therefore measure the total effect of eco-strategy (the direct effect stemming from private eco-investment and the indirect effect stemming from policy). Nevertheless, the present study is still relevant for policy-makers, as it indicates whether current eco-policies are sufficient to make eco-strategies profitable or whether policy adjustments are needed.

Figure 1.

Framework of analysis



Source: own elaboration.

In the following, a summary is made of the recent empirical literature on the economic effects of eco-strategies on firm performance.[4] Different concepts are used to measure firm performance, such as productivity (including for example valued added, gross output and turnover per employee), growth (in terms of sales) and financial measures (e.g. operating margins, return on sales, Tobin's Q ratio). Table 1 summarizes the relevant literature described in this section according to which dimension of firm performance is considered.

In the European context, Doran and Ryan (2012), using a cross-sectional Irish sample, find that firms that engage in eco-innovation in general have higher levels of turnover per employee than firms that do not. Similarly, Hojnik and Ruzzier (2016), exploring Slovenian firms, and Przychodzen and Przychodzen (2015), examining a sample of Polish and Hungarian firms, suggest that process eco-innovation practices have no adverse effect

and Ryan (2012); Elsayed and Paton (2005); Ghisetti and Rennings (2014); Hojnik and Ruzzier (2016); Horváthová (2010); Lee and Min (2015); Riillo (2017).

[4] Note that in the literature there is also a stream of research focusing on eco-strategies and employment effects. This falls outside the scope of the present paper. For an overview of the subject see for example: Gagliardi et al., (2016); Horbach and Rennings, (2013); Kunapatarawong and Martínez-Ros (2016).

on firm performance (in terms of profitability and growth) and conclude that it pays to be an eco-innovator. Meanwhile the study by Antonioli et al., (2016), which also analyses the general effect of eco-innovation on firm performance for a group of firms in the Emilia-Romagna region in Italy, finds that some firms' productivity performances (such us revenues over total labour cost) are positively related to eco-innovations.

Table 1
Summary of the related literature

Research themes	Studies	Sample	Main findings
Eco-strategies and productivity	(Riillo, 2017) *Turnover per employee* (Soltmann et al., 2015) *Valued added*	890 Italian firms 2007 survey of SMEs Observatory 12 OECD countries Sector level (patents)	Green practices are U-shape related to performance
	(Marin and Lotti, 2017) *Real value added per employee*	11,938 Italian manufacturing firm (Survey on Manufacturing Firm Unicredit) (patents)	Eco-innovations exhibit a lower return relative to other innovations
	(Leeuwen and Mohnen, 2017) *Gross output per employee*	5,989 Dutch firms The Survey on ECF, CIS and The Production Statistics Survey (PS)	Resource-saving eco-innovations increase TFP, whereas end-of-pipe eco-innovations tend to reduce TFP
	(Doran and Ryan, 2012) *Turnover per employee*	2,181 Irish firms CIS 2008	Positive and significant effect of eco-innovation and firm performance
	(Antonioli et al., 2016) *Value added per employee* *Total labour cost*	555 Italian firms (questionnaire)	Some firms' productivity performances are positively related to eco-innovation +: revenue over total labour cost n.s.: value added per employee
	(Doran and Ryan, 2016) Turnover per employee	2,181 Irish firms CIS 2008	Only two of the nine types of eco-innovation positively impact firm performance (reduced CO 'footprint' and recycled waste, water or materials)
Eco-strategies and growth	(Cainelli et al., 2011) *Turnover growth*	773 Italian service firms CIS II and SEA	Negative effect of eco-innovation and growth in turnover and not significant or even negative effect on labour productivity growth
	(Colombelli et al., 2015) *Turnover growth*	456,240 firms 6 European countries ORBIS and OECD RegPat Database (patents)	Firms producing eco-innovations are characterized by higher growth rates than those generating generic innovations
	(Hojnik and Ruzzier, 2016) *Turnover growth*	223 Slovenian firms (questionnaire)	Positive and significant effect of eco-innovation and firm growth
Eco-strategies and finance performance	(Miroshnychenko et al., 2017) *Tobin's q and ROE*	3490 publicly-traded companies from 58 countries Thomson Reuters Dataset	Internal green practices (pollution prevention and green supply chain management) are the major eco-drivers of financial performance
	(Przychodzen and Przychodzen, 2015) ROE, ROA	439 Polish and Hungarian publicly traded firms	Green research and development is positively related to financial performance
	(Ghisetti and Rennings, 2014) *Operating margins*	1,063 German firms Mannheim Innovation Panel	Reduction in the use of energy or materials per unit of output positively affect firms' competitiveness. Contrarily, externality reducing innovations hamper firms' competitiveness
	(Rexhäuser and Rammer, 2014) *Operating margins*	3,618 German firms Mannheim Innovation Panel	
	(Wagner et al., 2002) *ROCE, ROS, ROE*	Germany, Italy, The Netherlands and United Kingdom – 37 firms questionnaire	Negative or not significant relationship
	(Earnhart and Lizal, 2007) *Profit based rate of return and operating profits based*	436 Czech Republic firms Private data vendor Aspekt	Better pollution control neither improves nor undermines financial success
	(Trumpp and Guenther, 2017) *ROA and TSR*	696 manufacturing and services firms CDP Global 500, S&P 500 or FTSE 350	U-shaped, relationship between carbon and waste intensity performance and profitability

Note: CIS (Community Innovation Survey), ROA (Return on assets), ROCE (Return on capital employed), ROE (Return on equity), ROS (Return on sales), TPF (Total factor productivity effects), TSR (Total shareholder return).

However, contrary to this positive evidence of the impact of eco-innovation strategies on firm performance, some research indicates that not only is there no correlation between the two variables, there is not even a trade-off. Cainelli et al. (2011), for instance, using a sample of Italian services firms show a negative link between eco-motivations and growth in employment and turnover in the short term. Wagner et al. (2002), focusing on one particular industry (paper) in four European countries (Germany, Italy, the Netherlands and the United Kingdom), also provide evidence of a negative relationship- On the basis of patent analysis, Marin and Lotti (2017) more recently used a sample of Italian manufacturing firms and observed that eco-innovations exhibit a lower return relative to other innovations, at least in the short run. This differential effect seems to be especially true for polluting firms facing higher compliance costs for eco-regulations than other firms. In the context of transition economies, there is some evidence that better pollution prevention strategies, generated by improved production processes neither improve nor undermine financial success in the Czech Republic (Earnhart and Lizal, 2007).

Beyond the extensive literature that looks at the link between eco-strategies in general and firm performance, some researchers have recently started to claim that most of the empirical studies analysing the relationship between eco-innovation practices and firm competitiveness should go further, distinguishing between different types of eco-strategy, rather than just focusing on the question "whether it pays to be green" (Ghisetti and Rennings, 2014; Riillo, 2017).

Using a complementary approach on a German sample, Ghisetti and Rennings (2014) consider two typologies of eco-innovation: one aimed at reducing externalities and the other aimed at increasing energy and resource efficiency. Their econometric analysis, based on two waves of the Mannheim Innovation Panel, suggests that innovations leading to a reduction in the use of energy or materials per unit of output have a positive effect on firm competitiveness in terms of higher profits. However, innovations aimed at reducing externalities such as air, water, noise pollution, and harmful materials have the opposite effect. Using the same German data for 2009, Rexhäuser and Rammer, (2014) find similar results, as do Miroshnychenko et al., (2017) using over 3,000 publicly-traded firms across 58 countries. These findings suggest that the question as to whether it pays to be green should be reformulated and better qualified, in terms of the typologies of eco-innovation orientation.

It is surprising that, despite the great importance of the current policy debate on green and sustainable growth in the European Union, the number of studies that examine the role of eco-innovation orientation in promoting firm growth is relatively small, especially when compared to the number of studies focusing on the growth effects of general innovations. Although technological innovations are generally recognised as contributing to firms' growth (for a review see Coad (2009)), the effect of eco-strategies are still little researched and unclear (Cainelli et al., 2011; Colombelli et al., 2015).

Cainelli et al., (2011) using the CIS sample of Italian firms, find a negative link between environmental motivations in general and growth in both employment and turnover in the

short term. Colombelli et al., (2015), however, analysing a sample of over 400,000 firms located in Germany, France, Italy, Spain and Sweden during the period 2002-2011, show that those oriented towards eco-innovation (identified based on green patents) are characterized by higher growth rates than those carrying out only generic innovations.

On the basis of all this and with the aim of understanding and explaining the mixed results of the empirical research into the relationship between eco-strategies and firm performance across European countries, we formulate the following overarching research question: do eco-strategies have a positive link on firm performance? To help us arrive at an answer, we coherently test three hypotheses.

The first of these, following the existing literature mentioned above, looks at the different nature of eco-strategies and their effects on firm performance.

H1: The economic effects of eco-strategies on firm growth patterns are heterogeneous and conditioned by the type of eco-strategy considered.

The second is in line with more recent studies that suggest there is a need to investigate the intensity of eco-strategies rather than the fact of their adoption.[5] Antonioli and Mazzanti (2009), using a sample of Italian firms, show that the level of eco-innovation investment plays a role in determining firms' productivity, whereas a non-significant effect is found it for the adoption. The negative or nonsignificant effect of the adoption might be explained by the fact that eco-strategies need time for their effects to be felt or because a minimum level of intensity is needed to cause a change in production efficiency or demand before any return on these strategies can be reaped (Cainelli et al., 2011). This leads us to the second hypothesis:

H2: The intensity of investments in eco-strategies triggers better firm performance.

As mentioned above, firms investing in eco-strategies have high risks and costs in the short term before they start to reap any benefit, because eco-strategies are characterized by a high level of uncertainty, novelty and the need to go beyond firms's core competencies. These characteristics are especially important for SMEs, which face major difficulties in obtaining credit for their eco-investments compared to larger firms, which often have better access to equity and long-term loans (Ghisetti et al., 2016). As known from general innovation theory, given the inherent risk of innovation, firms have the incentive to diversify or develop multiple number of external linkages and strategies in order to maximize their chances of success (Leiponen and Helfat, 2010; Quintana-García and Benavides-Velasco, 2008; Tavassoli and Karlsson, 2016). However, diversification comes at a price. A firm needs additional training for its employees, new equipment and time to integrate and assimilate new strategies.

[5] Nevertheless, eco-innovation intensity as a variable has scarcely been analysed since it is absent from most survey data (for instance, some waves of the CIS survey include an eco-module but do not deal with intensities).

The empirical results generally suggest that wider horizons as regards innovation objectives and knowledge sources are associated with better performance. However, studies into the effect of a greater breadth of eco-strategies on firm performance is still missing.

Using industry-level data from 12 OECD countries, Soltmann et al., (2015) show that the general relationship between the intensity of green inventions and performance is a U shape related to performance. They conclude that the turning point is quite high and consequently only relevant for a few industries. For most industries, therefore, an increasing level of green inventions has a negative effect on firm performance. The same empirical evidence of a U-shaped relationship between environmental performance and profitability for firms in the manufacturing and service industries was recently provided by Trumpp and Guenther (2017).

Our third hypothesis is therefore:

H3. Firms with a greater breadth of eco-strategies experience better firm performance.

3. DATA AND EMPIRICAL STRATEGY

3.1 Database and descriptive statistics

The source of the data used in this paper is the Flash Eurobarometer Survey 426 (FLE426) on *"Small and Medium Enterprises, Resources Efficiency and Green Markets, wave 3"*, conducted between 1 and 18 September 2015. The database includes the 28 member states of the European Union plus Albania, the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey, Iceland, Moldova, Norway and the US, and covers large companies and SMEs.

In the FLE426 a total of 15,020 managers (13,114 from the EU28) were selected using a stratification procedure according to the dimensions of firm size and sector (four categories: manufacturing, retail, services, and industry).

One of the main advantages of the FLE426 is that it is an extensive survey that includes three dimensions, namely country, sector and firm size. However, the main drawback is that it is a cross-sectional dataset, and so the problem of simultaneity is somewhat unavoidable (Hoogendoorn et al., 2015; Marin et al., 2015).

Due to the focus of our analysis and the data cleaning procedure (discarding observations with missing values for the relevant variables), the final sample includes 11,336 firms.

To examine the differences between EU countries in some depth, we also classify the EU28 countries into two clusters: the European Union-15 and new members of EU. Internal differences in eco-performance in these two clusters are found to be important, especially for the new EU members, which operate further from their respective eco-technological frontiers (Beltrán-Esteve and Picazo-Tadeo, 2017; Horbach, 2016). Table 2 gives an overview of the final sample while Table 3 displays the characteristics of the sample by country group.

Table 2
Distribution of the sample by clusters, sectors and firm size

EU15 members			New EU members		
Country	**Firms**	**Percent**	**Country**	**Freq.**	**Percent**
FR - France	463	4.08	CY - Cyprus	184	1.62
BE - Belgium	407	3.59	CZ - Czech Republic	436	3.85
NE - The Netherlands	428	3.78	EE - Estonia	452	3.99
DE - Germany	358	3.16	HU - Hungary	423	3.73
IT - Italy	397	3.50	LV - Latvia	481	4.24
LU - Luxembourg	176	1.55	LT - Lithuania	466	4.11
DK - Denmark	413	3.64	MT - Malta	164	1.45
IE - Ireland	429	3.78	PL - Poland	456	4.02
GB - United Kingdom	375	3.31	SK - Slovakia	429	3.78
GR - Greece	452	3.99	SI - Slovenia	471	4.15
ES - Spain	441	3.89	BG - Bulgaria	411	3.63
PT - Portugal	461	4.07	RO - Romania	426	3.76
FI - Finland	452	3.99	HR - Croatia	433	3.82
SE - Sweden	457	4.03			
AT - Austria	395	3.48			
Total EU15	***6,104***	***53.85***	***Total new EU***	***5,232***	***46.15***
		Firms by sectors			
Manufacturing (NACE C)	1,274	20.87	Manufacturing	1,286	24.58
Retail (NACE G)	1,921	31.47	Retail	1,701	32.51
Services (NACE H/I/J/K/L/M/N)	2,134	34.96	Services	1,488	28.44
Industry (NACE B/D/E/F)	775	12.70	Industry	757	14.47
		Firms by employees			
1 to 9	2,681	43.92	1 to 9	2,345	44.84
10 to 49	2,228	36.50	10 to 49	1,864	35.63
50 to 249	1,195	19.57	50 to 249	1,022	19.54

Source: FLE426, European Commission.

The EU-15 members group includes 6,104 firms and the new members group 5,232. The sample is dominated by the services and retail sectors and by very small firms with 1 to 9 employees in both country groups. Most of the SMEs (86% of the sample) are taking action to become more resource efficient. The most common resource efficiency actions taken by the EU-28 are those aimed at saving energy (63%), minimising waste (57%) and saving materials (56%). In contrast, SMEs are less likely to be taking actions to use predominantly renewable energy (13%).

In short, the values reflected in the two cluster of countries together with the substantial significance of the t-test, suggest that the profile of SMEs from former EU member countries differs slightly from those in new member countries. The first group presents greater sensitivity to the undertaking of resource efficiency practices to be greener and invests slightly larger amounts of money in foster them thanks to their own technical expertise and greater external finance.

Table 3
Descriptive statistics by country clusters (mean values)

	Total sample	EU15 members	New EU members	Mean differences
Dependent variable: Turnover growth (% firms)				
Decrease	0.2694	0.2622	0.2779	0.0156
	(0.4437)	(0.4399)	(0.4480)	(0.0083)
Remain	0.3167	0.3078	0.3272	0.0193***
	(0.4652)	(0.4616)	(0.4692)	(0.0087)
Increase	0.4137	0.4298	0.3948	-0.0350***
	(0.4925)	(0.4950)	(0.4888)	(0.0092)
Independent variables				
Resource efficiency eco-strategies (% firms)	0.8594	0.8969	0.8157	-0.0812***
	(0.3475)	(0.3040)	(0.3877)	(0.0065)
Water reduction	0.4408	0.4441	0.4369	-0.0072
	(0.4965)	(0.4969)	(0.4960)	(0.0093)
Energy reduction	0.6289	0.6584	0.5946	-0.0638***
	(0.4831)	(0.4742)	(0.4910)	(0.0090)
Predominant use of renewable energy	0.1293	0.1671	0.0852	-0.0818***
	(0.3355)	(0.3730)	(0.2792)	(0.0062)
Material reduction	0.5578	0.5865	0.5244	-0.0620***
	(0.4966)	(0.4925)	(0.4994)	(0.0093)
Waste reduction	0.5671	0.6317	0.4917	-0.1399***
	(0.4954)	(0.4823)	(0.4999)	(0.0092)
Sale of scrap to other firms	0.3071	0.3247	0.2866	-0.0380***
	(0.4613)	(0.4683)	(0.4522)	(0.0086)
Recycling	0.3782	0.4580	0.2851	-0.1728***
	(0.4849)	(0.4982)	(0.4515)	(0.0089)
Design products easier to maintain, repair or use	0.2238	0.2644	0.1764	-0.0882***
	(0.4168)	(0.4410)	(0.3812)	(0.0078)
Breadth of strategies (number of strategies)	3.2332	3.5350	2.8813	-0.6537***
	(2.1706)	(2.1431)	2.1484)	(0.0404)
Resource efficient investment (% firms)				
Less than 1% of turnover	0.4959	0.4792	0.5175	-0.0076
	(0.4522)	(0.4517)	(0.4528)	(0.0093)
1-5% of turnover	0.4008	0.4193	0.3769	-0.0423***
	(0.4900)	(0.4934)	(0.4846)	(0.0999)
6-10% of turnover	0.0696	0.0697	0.0695	-0.0001
	(0.2546)	(0.2547)	(0.2544)	(0.00519)
11-30% of turnover	0.0238	0.0233	0.0243	0.0009
	(0.1524)	(0.1511)	(0.1542)	(0.0031)
More than 30% of turnover	0.0096	0.0082	0.0114	0.0032
	(0.0977)	(0.0902)	(0.1065)	(0.0019)
Control variables				
Size (% firms)				
1-9 employees	0.4434	0.4392	0.4483	0.0091
	(0.4968)	(0.4963)	(0.4973)	(0.0093)
10-49 employees	0.3609	0.3650	0.3562	-0.00873
	(0.4803)	(0.4814)	(0.4789)	(0.0090)
50-249 employees	0.1955	0.1957	0.1953	-0.0004
	(0.3966)	(0.3968)	(0.3964)	(0.0074)
Young	0.0926	0.0817	0.1047	0.0229***
	(0.2895)	(0.2740)	(0.3062)	(0.0054)
Own technical expertise	0.4972	0.5160	0.4753	-0.0407***
	(0.5000)	(0.4997)	(0.4994)	(0.0094)
Own finance	0.5832	0.5647	0.6049	0.0402***
	(0.4930)	(0.4958)	(0.4889)	(0.0092)
External finance	0.1826	0.2362	0.1202	-0.1160***
	(0.3864)	(0.4248)	(0.3252)	(0.0071)
Greenness	0.3517	0.3668	0.3340	-0.0321***
	(0.4775)	(0.4819)	(0.4717)	(0.0089)

Business opportunities	0.2027	0.2239	0.1779	-0.0460***
	(0.4020)	(0.4169)	(0.3825)	(0.0075)
Sector dummies (% firms)				
Manufacturing	0.2258	0.2087	0.2457	0.0370***
	(0.4181)	(0.4064)	(0.4305)	(0.0078)
Retail	0.3195	0.3147	0.3251	0.1043
	(0.4663)	(0.4644)	(0.4684)	(0.0087)
Services	0.3195	0.3496	0.2844	-0.0652***
	(0.4663)	(0.4768)	(0.4511)	(0.0087)
Industry	0.1351	0.1269	0.1446	0.0177
	(0.3418)	(0.3329)	(0.3518)	(0.0064)
Observations	11,336	6,104	5,232	

Source: FLE426, European Commission

Note: Stander deviation parenthesis. Comparison of the two samples by the statistical t-test. *** Significant at 1%.

3.2 Empirical strategy

We estimate an ordered logit model, where we compare the impact of the various eco-innovation strategies on different exclusive categories of turnover growth: increased, unchanged and decreased (which is the base case).[6] The models for ordinal outcomes can be described in terms of a latent variable. The structural model is:

$$y^*_{i,c} = X_{i,c}\beta + \varepsilon_i \qquad \text{Eq.[1]}$$

where $y^*_{i,c}$ is the latent variable (annual turnover growth of firm *i* in country *c)*, X, is a vector of explanatory and control variables and ε_i is the idiosyncratic error term. The latent variable can be divided into M ordinal categories, so the observed variable is:

$$y_{i,c} = j \text{ if } \alpha_j < y^*_{i,c} \leq \alpha_{j+1}, \text{ for } j = 1 \; to \; M$$

and the probabilities of observing $y^*_{i,c} = j$ are given by:

$$P(y_{i,c} = j | X_{i,c}) = F(\alpha_{j+1} - X_{i,c}\beta) - F(\alpha_j - X_{i,c}\beta)$$

where F denotes the logistic cumulative distribution function. The three categories for our growth variable $y^*$are: decreased (j = 1), unchanged (j = 2) and increased (j = 3).

To test our first hypothesis, we include a dummy variable indicating whether or not a firm is undertaking any eco-strategy to be more resource efficient (Eq. [2]). Then, following the argument that a distinction needs to be made between different typologies of eco-strategy to assess the effects of those innovations on firm growth, we specified Eq. [3] where we include a vector of eight different types of eco-strategy: water reduction, energy reduction, using renewable energy, saving materials, minimizing waste, selling scrap material to another company, recycling, and designing products that are easier to maintain, repair or use. To examine whether the intensity is more important than the adoption, we then introduce a dummy variable into Eq. [4] to account for the intensity of

[6] It is a limitation of our dependent variable that we do not have continuous data and therefore cannot use classic linear models.

the eco-strategy investment.[7] This variable takes the value one whether the firm spends more than five percent of its yearly turnover on measures to improve resource efficiency.

$$Growth_{i,c} = eco - strategy_{i,c}\beta_1 + CL_{i,c}\beta_2 + \delta sector_{i,c} + \rho country_i + \varepsilon_i \quad \text{Eq.[2]}$$

$$\begin{aligned} Growth_{i,c} = {} & strategy1_{i,c}\beta_1 + strategy2_{i,c}\beta_2 + strategy3_{i,c}\beta_3 + strategy4_{i,c}\beta_4 \\ & + strategy5_{i,c}\beta_5 + strategy6_{i,c}\beta_6 + strategy7_{i,c}\beta_7 + strategy8_{i,c}\beta_8 \\ & + CL_{i,c}\beta_9 + \delta sector_{i,c} + \rho country_i + \varepsilon_i \end{aligned} \quad \text{Eq.[3]}$$

$$Growth_{i,c} = high\_invesment_{i,c}\beta_1 + +CL_{i,c}\beta_{10} + \delta sector_{i,c} + \rho country_i + \varepsilon_i \quad \text{Eq.[4]}$$

Moving on to the empirical test if breadth of eco-strategies is associated with positive firm performance we estimate the models in Equations [5] - [6]. First introducing the breadth variable that refers to the number of eco-strategies implemented by each firm. Then, to identify any nonlinear relationship, if any, we also introduce the quadratic form of breadth.

$$Growth_{i,c} = breadth_{i,c}\beta_1 + CL_{i,c}\beta_2 + \delta sector_{i,c} + \rho country_i + \varepsilon_i \quad \text{Eq.[5]}$$

$$Growth_{i,c} = breadth_{i,c}\beta_1 + breadth_{i,c}^2\beta_2 + CL_{i,c}\beta_3 + \delta sector_{i,c} + \rho country_i + \varepsilon_i \quad \text{Eq.[6]}$$

To minimise any estimation bias due to an omitted variable, we have included in all the equations a series of control variables in line with previous work on the determinants of firm growth (see Coad (2009) for a survey), as well as being restricted by the variables available to us in our dataset. As regards the set of control variables, to take into account relevant observable firm-level characteristics, we introduce the following variables: firm size –micro (*1-9 employees*), small (*10–49 employees*) and medium sized (*50–249 employees*) – age (*young*), the role of technological and management capabilities within the firm (*own technical expertise*) and, the importance of internal and external financial support respectively in implementing resource efficiency activities *(own finance and external resources).*

To prevent any potential omitted variable bias, we include two dummy variables that take into account the influence of firm eco-orientation by considering whether the environment is one of the top priorities *(greenness)* and whether the firm is aiming to create a competitive advantage or business opportunity by taking actions to be more resource efficient *(business opportunities).* Finally, we include sector dummies (manufacturing, retail, services and industry), and country dummies.[8]

Due to the non-linear form of the ordered logit estimation the size of the coefficients should not be directly interpreted. The focus should be on the sign and significance of the

[7] Unfortunately, we do not have continuous data for investment intensity. These data are collected through categorical values that are self-reported by firms on an interval scale. The questionnaire asks firms how much they invested to become more resource efficient in general, and so, the intensity is not available for each separate eco-strategy.

[8] Appendix 1 summarizes the list of variables and their definition, Appendix 2 shows the correlation matrix.

estimates. Clustered standard errors by country are reported to avoid an underestimation of standard errors due to intra-group error correlation.

Before turning to the regression results, we first address potential concerns about the presence of multicollinearity. Table A.2 shows the correlations between the independent and control variables. The correlation coefficients and variance inflation factors raise no concerns regarding multicollinearity. The only noteworthy correlation is between the eight eco-strategies and breadth (from 0.37 to 0.70) which will be included in separate model specifications later on.

4. DISCUSSION OF RESULTS

The results of the ordered logit model for the whole database and for both country groups considered in this paper are displayed in Tables 4-6.[9]

We find for all the countries involved that undertaking an eco-strategy in general to be more resource efficient is associated with reduced growth in terms of turnover. When we split the sample by clusters, the eco-strategy coefficient remains negative, but is non-significant. At first sight our main finding would be the negative relationship between eco-innovation strategies and firm growth, meaning that it does not pay to be green. However, going a step further and distinguishing between different types of eco-strategy, we instead find clear confirmation that not all measures to improve resource efficiency have the same effect on growth, and therefore it would be best to decompose them.

Of the eight forms of eco-strategy considered, only three have a significantly positive effect on firm performance. Using predominantly renewable energy (e.g. including own production through solar panels, etc.), recycling by reusing material or waste within the company, and designing products that are easier to maintain, repair or reuse are eco-strategies that relate to positive firms' growth. However, firms that aim to reduce water or energy experience a negative and strongly significant effect on firms' growth. The other eco-strategies under consideration show no significant effect on firm growth. In line with previous literature, this suggests that the effect of eco-strategies on firm performance varies depending on the specific sub-type of resource efficient strategy considered (Doran and Ryan, 2016; Ghisetti and Rennings, 2014).

Regarding the two country groups, the results for EU-15 countries show that firms that undertake an energy reduction eco-strategy see a decrease in firm performance, whereas two resource efficiency practices – the use of renewable energies and the design of products that are easier to maintain, repair or reuse – seem to play a more important role

[9] We must stress that the cross-sectional nature of the dataset we are using constitutes a limitation to the scope of the present analysis and only allows us to comment on correlations between variables rather than proper causations. In addition, the formulation of some questions does not allow an exact time structure to be identified.

in firm growth. As for the new member group, only one of the eight eco-strategies – the predominant use of renewable energy– exerts a positive and strongly significant effect on firms' growth. In addition, firms in these countries that implement water and energy reduction activities show the worst performance.

Other reasons for the negative relationship between eco-strategy in general and firm performance may be that firms might find it difficult to reap the returns on the resource-efficiency practices since they need time before they exert their full effects, or that the intensity of the strategies (which we do not observe in specifications I and II) is not sufficiently high to modify the production process or stimulate the demand through environmental innovation dynamics. Regarding the latter, when we include the investment in eco-strategy (specification III), it seems that greater investment in resource efficiency strategies triggers an improvement in overall firm performance. However, only a few firms in the sample invest intensely in eco-strategies and turn them out to be profitable in terms of firm growth. In contrast, when we split the analysis into former and new members, the large amounts of money spent on resource efficiency strategies are only positive and significant for countries that have recently been incorporated into the EU project.

Regarding our third hypothesis, when breadth is introduced in specification IV a negative relationship is found, although this relationship is not significant. In specification V, however, when we also incorporate the quadratic term, the breadth variable becomes negative and significant and the quadratic term positive and significant, which suggests that the wider array of eco-strategies influences firm performance more than proportionality. The relationship between firm growth and eco-strategy is U-shaped, in line with the findings of Soltmann et al., (2015) using industry-level data. This implies that when the number of eco-strategies undertaken is low, this has a negative impact on firm performance. Conversely, when the number of eco-strategies is high, this triggers firm growth. However, again only a few firms in the sample undertake a large number of eco-strategies. These results are still robust when we split the sample into our two clusters of countries – the breadth variables and their quadratic forms have the same sign but are not significant.

As for the effect of the control the variables employed in our econometric specification, the results reveal that firms that value either the environment as a core priority activity or resource efficient practices as the means to create competitive advantage show better firm performance. In particular we note that SMEs in EU-15 countries rely more heavily on better eco-management than countries that have more recently joined the EU.

In addition, having good own technical capabilities and expertise and good access to financial resources (both internal and, external) significantly helps European SMEs to improve their firm performance. Our result clearly confirms the conjecture that firm growth is different across country groups. External finance significantly increases firm growth in new member states, although, this variable seems not to be relevant for long-standing members of the EU. Own technical expertise and own financial resources also show a significant positive influence on growth in the EU15 countries. These results are

in line with Hölzl (2009), finding that technological capabilities seem to be more important in high-growth SMEs in countries that are closer to the technological frontier.

As far as firm characteristics are concerned, age and size are found to be important determinants of a firm's growth, with a large body of evidence showing that younger and smaller firms are more dynamic and thus more effective in spurring growth (Barba Navaretti et al., 2014; Coad, 2009). As regards age, our results are in line with the previous literature, with young firms seeming to perform better. Firm size, meanwhile, is positively correlated to firm performance in both country groups in our sample.

Table 4
Ordered logit regression: whole sample

	(I)	(II)	(III)	(IV)	(V)
Eco-strategy	-0.171*				
	(0.0803)				
Types					
Water reduction		-0.171**			
		(0.0545)			
Energy reduction		-0.198***			
		(0.0484)			
Predominant use of renewable energy		0.221***			
		(0.0440)			
Material reduction		0.0155			
		(0.0468)			
Waste reduction		0.0228			
		(0.0410)			
Sale of scrap to other firms		-0.0108			
		(0.0525)			
Recycling		0.0810*			
		(0.0321)			
Design products easier to maintain, repair,		0.148***			
use		(0.0334)			
High investment			0.194**		
			(0.0680)		
Breadth				-0.0133	-0.116*
				(0.0150)	(0.0480)
$Breadth^2$					0.0143*
					(0.0057)
Control variables					
Size: ref. size 1_9					
size_10_49	0.525***	0.532***	0.522***	0.524***	0.525***
	(0.0444)	(0.0416)	(0.0440)	(0.0445)	(0.0440)
size_50_249	0.872***	0.887***	0.872***	0.874***	0.870***
	(0.0594)	(0.0574)	(0.0587)	(0.0601)	(0.0590)
Young	0.965***	0.962***	0.967***	0.965***	0.964***
	(0.0658)	(0.0673)	(0.0654)	(0.0662)	(0.0662)
Own technical expertise	0.0866*	0.0717*	0.0464	0.0645	0.0899*
	(0.0361)	(0.0320)	(0.0326)	(0.0333)	(0.0355)
Own finance	0.139**	0.135***	0.0824*	0.104**	0.146***
	(0.0439)	(0.0366)	(0.0375)	(0.0366)	(0.0429)

External finance	0.205***	0.198***	0.171**	0.192***	0.207***
	(0.0556)	(0.0574)	(0.0537)	(0.0582)	(0.0591)
Greenness priority	0.148***	0.146***	0.126***	0.141***	0.156***
	(0.0337)	(0.0354)	(0.0323)	(0.0362)	(0.0371)
Business opportunity	0.218***	0.199***	0.199***	0.213***	0.223***
	(0.0432)	(0.0468)	(0.0420)	(0.0453)	(0.0470)
Sector: ref. Industry					
Manufacturing	0.161*	0.178**	0.161*	0.163*	0.163*
	(0.0679)	(0.0686)	(0.0675)	(0.0683)	(0.0684)
Retail	0.192**	0.236***	0.202***	0.192**	0.194**
	(0.0605)	(0.0609)	(0.0605)	(0.0608)	(0.0603)
Services	0.300***	0.343***	0.308***	0.303***	0.304***
	(0.0651)	(0.0645)	(0.0652)	(0.0654)	(0.0655)
Constant cut1	-0.0982	-0.0524	-0.00637	-0.0301	-0.105
	(0.0845)	(0.0804)	(0.0799)	(0.0813)	(0.0861)
Constant cut2	1.355***	1.408***	1.447***	1.423***	1.349***
	(0.0801)	(0.0795)	(0.0813)	(0.0819)	(0.0829)
Country dummies	YES	YES	YES	YES	YES
Wald test country dummies	10478***	20840***	8894***	9222***	9454***
Pseudo R^2	0.0447	0.0475	0.0449	0.0446	0.0445
Observations	11,336	11,336	11,336	11,336	11,336

Clustered standard errors by country (28 clusters). *, ** and *** correspond to significance levels of 1, 5 and 10 %. Dependent variable: annual turnover growth (1) Decreased; (2) Remained unchanged, (3) Increased.

Table 5
Ordered logit regression: EU-15 members

	(I)	**(II)**	**(III)**	**(IV)**	**(V)**
Eco-strategy	-0.158				
	(0.110)				
Types					
Water reduction		-0.0968			
		(0.0737)			
Energy reduction		-0.152**			
		(0.0537)			
Predominant use of renewable energy		0.166**			
		(0.0520)			
Material reduction		0.0177			
		(0.0583)			
Waste reduction		0.0349			
		(0.0529)			
Sale of scrap to other firms		-0.0162			
		(0.0734)			
Recycling		0.0908			
		(0.0500)			
Design products easier to maintain, repair,		0.170***			
use		(0.0341)	0.100		
High investment			(0.0956)		
				0.0095	-0.0905
Breadth				(0.0121)	(0.0611)
					0.0137
$Breadth^2$					(0.0078)
					(0.0057)
Control variables					
Size: ref. size 1_9					
size_10_49	0.546***	0.549***	0.546***	0.542***	0.543***

	(0.0655)	(0.0612)	(0.0654)	(0.0653)	(0.0649)
size_50_249	0.774***	0.783***	0.774***	0.770***	0.765***
	(0.0899)	(0.0824)	(0.0900)	(0.0900)	(0.0883)
Young	1.032***	1.037***	1.032***	1.033***	1.034***
	(0.0910)	(0.0921)	(0.0906)	(0.0901)	(0.0909)
Own technical expertise	0.134*	0.0960*	0.104*	0.0989	0.121*
	(0.0549)	(0.0478)	(0.0463)	(0.0506)	(0.0547)
Own finance	0.149*	0.124*	0.113*	0.107	0.137*
	(0.0624)	(0.0573)	(0.0543)	(0.0567)	(0.0648)
External finance	0.129	0.106	0.104	0.100	0.114
	(0.0690)	(0.0662)	(0.0682)	(0.0680)	(0.0688)
Greenness priority	0.184***	0.159***	0.166***	0.158***	0.168***
	(0.0336)	(0.0324)	(0.0342)	(0.0327)	(0.0327)
Business opportunity	0.207***	0.174**	0.192**	0.188**	0.198**
	(0.0602)	(0.0635)	(0.0588)	(0.0608)	(0.0623)
Sector: ref. Industry					
Manufacturing	0.148	0.154	0.149	0.146	0.147
	(0.101)	(0.0991)	(0.101)	(0.101)	(0.102)
Retail	0.240**	0.273***	0.247**	0.244**	0.250**
	(0.0785)	(0.0804)	(0.0792)	(0.0793)	(0.0780)
Services	0.362***	0.397***	0.370***	0.373***	0.376***
	(0.0818)	(0.0821)	(0.0806)	(0.0827)	(0.0817)
Constant cut1	-0.509***	-0.390***	-0.404***	-0.391***	-0.481***
	(0.126)	(0.114)	(0.115)	(0.114)	(0.113)
Constant cut2	0.922***	1.046***	1.027***	1.040***	0.950***
	(0.105)	(0.108)	(0.106)	(0.105)	(0.101)
Country dummies	YES	YES	YES	YES	YES
Wald test country dummies	41910***	33690***	1.4e+05***	1.0e+05***	24925.20***
Pseudo R^2	0.0486	0.0504	0.0485	0.0484	0.0489
Observations	6,104	6,104	6,104	6,104	6,104

Clustered standard errors by country (15 clusters). *, ** and *** correspond to significance levels of 1, 5 and 10 %. Dependent variable: annual turnover growth (1) Decreased; (2) Remained unchanged, (3) Increased.

Table 6
Ordered logit regression: new EU members

	(I)	**(II)**	**(III)**	**(IV)**	**(V)**
Eco-strategy	-0.170				
	(0.117)				
Types					
Water reduction		-0.271***			
		(0.0744)			
Energy reduction		-0.236**			
		(0.0799)			
Predominant use of renewable energy		0.323***			
		(0.0763)			
Material reduction		0.0111			
		(0.0777)			
Waste reduction		0.00940			
		(0.0614)			
Sale of scrap to other firms		-0.00211			
		(0.0789)			
Recycling		0.0501			
		(0.0378)			

Design products easier to maintain, repair, use		0.110 (0.0680)	0.305** (0.0929)		
High investment				-0.0433 (0.0292)	-0.140* (0.0708)
Breadth					0.0136 (0.0079)
Breadth^2					
Control variables					
Size: ref. size 1_9					
size_10_49	0.499*** (0.0620)	0.514*** (0.0557)	0.491*** (0.0598)	0.507*** (0.0625)	0.507*** (0.0613)
size_50_249	0.968*** (0.0726)	0.997*** (0.0752)	0.968*** (0.0705)	0.991*** (0.0735)	0.986*** (0.0718)
Young	0.911*** (0.0860)	0.898*** (0.0892)	0.916*** (0.0846)	0.912*** (0.0884)	0.910*** (0.0876)
Own technical expertise	0.0307 (0.0386)	0.0495 (0.0415)	-0.0171 (0.0416)	0.0300 (0.0412)	0.0566 (0.0394)
Own finance	0.125* (0.0581)	0.163*** (0.0418)	0.0471 (0.0488)	0.117** (0.0443)	0.166*** (0.0473)
External finance	0.358*** (0.0827)	0.381*** (0.0874)	0.314*** (0.0758)	0.367*** (0.0901)	0.383*** (0.0927)
Greenness priority	0.0975 (0.0599)	0.124 (0.0678)	0.0752 (0.0536)	0.116 (0.0691)	0.133 (0.0726)
Business opportunity	0.232*** (0.0613)	0.235** (0.0729)	0.208*** (0.0597)	0.250*** (0.0713)	0.258*** (0.0737)
Sector: ref. Industry					
Manufacturing	0.499*** (0.0620)	0.514*** (0.0557)	0.491*** (0.0598)	0.507*** (0.0625)	0.507*** (0.0613)
Retail	0.968*** (0.0726)	0.997*** (0.0752)	0.968*** (0.0705)	0.991*** (0.0735)	0.986*** (0.0718)
Services	0.911*** (0.0860)	0.898*** (0.0892)	0.916*** (0.0846)	0.912*** (0.0884)	0.910*** (0.0876)
Constant cut1	-0.202 (0.107)	-0.159 (0.0924)	-0.125 (0.0958)	-0.174 (0.0935)	-0.229 (0.117)
Constant cut2	1.281*** (0.113)	1.335*** (0.102)	1.359*** (0.112)	1.309*** (0.107)	1.255*** (0.119)
Country dummies	YES	YES	YES	YES	YES
Wald test country dummies	3656***	35196***	5345***	9303***	9685***
Pseudo R^2	0.0409	0.0457	0.0415	0.0413	0.0417
Observations	5,232	5,232	5,232	5,232	5,232

Clustered standard errors by country (13 clusters). *, ** and *** correspond to significance levels of 1, 5 and 10 %. Dependent variable: annual turnover growth (1) Decreased; (2) Remained unchanged, (3) Increased.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The aim of this paper was to shed light on how eco-innovation strategies impact on SME growth across European countries. Previous empirical studies on the relationship between eco-strategies and firm performance have often been based on relatively small samples and are usually confined to a single country. Our paper expands this stream of research by using an extensive dataset covering a large sample of SMEs in 28 European countries. In addition, we classify the EU28 countries into two clusters. This distinction between EU15 and new EU members allows us to better understand the differences between the two groups of countries.

Through the application of an ordered logistic model our empirical results suggest that there is a need to distinguish between different eco-strategies and, in line with previous literature, draw attention to the fact that the correct question is not whether 'it pays to be eco', but rather 'when' and 'for whom' it pays to be eco. Firm growth varies greatly according to eco-strategy, and thus, not all eco-strategies are positively related to better performance, at least not in the short term. It would appear that in a European SME context certain measures in eco-strategies can result in a win-win situation for both the firm and society, while others result in a better environmental situation but at the expense of firm performance in terms of growth. In particular we find that European firms using renewable energies perform better. Undertaking eco-strategies aimed at recycling or designing products that are easier to maintain, repair or reuse also increases firm growth in former members of the EU. However, those firms that aim to reduce water or energy pollution seem to show a negative correlation with firm growth. Consequently, our results also shed light on the idea that the analysis and classification of different types of eco-strategy does matter.

Furthermore, our results indicate that higher investment in eco-strategies improves firm growth, particularly in the new member states. In other words, it seems important to be eco-efficient but it must also happen in a big way. Finally, we observe a U-shaped relationship between eco-strategies and firm growth meaning that a greater breadth of eco-strategies is associated with better firm performance. However, few SMEs are able to either invest large amounts or undertake large numbers of eco-strategies.

At the same time, we also observe that the conjecture of firm growth is different across country groups. Valuing the environment as a core activity of the firm is more important for EU15 countries whereas new EU members seems to rely more on external finance for growth.

To sum up, our empirical evidence suggests both a negative and a positive relationship between eco-strategy and firm performance that depends, on the one hand, on the types of eco-strategy, and on the other, on the level and intensity of those eco-strategies. Hence the association between eco-strategies and firm performance may be more complex than simply positive, negative or neutral. This would suggest that the theoretical framework should encompass at the same time both perspectives: a positive and negative relationship between eco-strategy and firm performance.

In terms of implications, we find that most European SMEs do undertake eco-strategies but at a low investment intensity. Since the impact of eco-strategies is negative when investment intensity is not taken into account, this suggests that there is room for policy interventions aimed at raising awareness among SMEs of the advantages of making a minimum level of investment in eco-strategies. The eco-strategies whereby European firms add value vary slightly across different countries. Policy-makers should therefore consider the economic and technological specifications of each group of EU countries so as to choose the best possible instruments for increasing investments in eco-strategies. Furthermore, a greater breadth of eco-strategies is associated with better firm performance, and therefore managers should evaluate not only the benefit of each

particular eco-strategy, but also the possible synergies and interactions between different strategies.

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APPENDIX

Appendix 1. Variable definitions

Table A.1

Variable definitions

Dependent variables	
Sales growth rate	Categorical variable which takes the value 1 = firm turnover decreased; 2 = firm turnover unchanged; and 3 = firm turnover increased
Independent variables	
Eco-strategies	8 dummy variables that take the value 1 if the firm states to undertake the following actions to be more resource efficient; 0 if not Water reduction Energy reduction Predominant use of renewable energy Material reduction Waste reduction Sale of scrap to other firms Recycling Design products easier to maintain, repair or reuse Breadth: number of eco-strategies undertaken by the firm (range from 0 to 8) High investment: Dummy variable that takes the value 1 if the firm investment in eco-strategies is higher than 5% of annual turnover; 0 if not
Control variables	
Size	Categorical variable 1–9 employees 9–49 employees 50–249 employees
Young	Dummy variable that takes a value equal to 1 if firm is less than 6-years-old; 0 if not
Own technical expertise	Dummy variable that takes a value equal to 1 if firm reports internal technical expertise to implement resource efficiency practices; 0 if not
Own finance	Dummy variable that takes a value equal to 1 if firm reports self-financed resource efficiency measures; 0 if not
External finance	Dummy variable that takes a value equal to 1 if firm reports external support to implement resource efficiency practices; 0 if not
Firm's greenness	Dummy variable which takes the value 1 if firm reports that the environment is a core priority for the firm, going beyond regulatory requirements; 0 if not
Profit motivation	Dummy variable that takes a value equal to 1 if firm reports internal technical expertise to implement resource efficiency practices; 0 if not
Sector	Sector-specific dummy variables. This indicates the main activity of the company: manufacturing, retail, services and industry

Appendix 2. Correlation matrix

Table A.2
Correlation matrix

1	1.00																					
2	0.48*	1.00																				
3	0.13*	0.17*	1.00																			
4	0.39*	0.42*	0.13*	1.00																		
5	0.39*	0.40*	0.17*	0.42*	1.00																	
6	0.18*	0.19*	0.10*	0.23*	0.26*	1.00																
7	0.20*	0.20*	0.14*	0.23*	0.29*	0.19*	1.00															
8	0.17*	0.19*	0.14*	0.25*	0.23*	0.18*	0.21*	1.00														
9	0.07*	0.09*	0.09*	0.07*	0.06*	0.05*	0.06*	0.09*	1.00													
10	0.65*	0.67*	0.37*	0.68*	0.70*	0.50*	0.54*	0.49*	0.12*	1.00												
11	-0.06*	-0.13*	-0.06*	-0.08*	-0.09*	-0.20*	-0.06*	-0.05*	-0.02*	-0.16*	1.00											
12	0.01	0.04*	0.01	0.01	0.02*	0.07*	0.02*	0.01*	0.012	0.04*	-0.67*	1.00										
13	0.07*	0.10*	0.05*	0.08*	0.09*	0.16*	0.04*	0.04*	0.015	0.14*	-0.44*	-0.37*	1.00									
14	-0.02*	-0.05*	-0.02*	-0.02*	-0.03*	-0.04*	-0.01	-0.02*	-0.01	-0.04*	0.10*	-0.04*	-0.07*	1.00								
15	0.18*	0.27*	0.07*	0.27*	0.26*	0.15*	0.17*	0.19*	0.07*	0.34*	-0.07*	0.01*	0.06*	-0.03*	1.00							
16	0.24*	0.31*	0.07*	0.27*	0.25*	0.17*	0.17*	0.12*	0.08*	0.35*	-0.08*	0.02*	0.07*	-0.02*	0.15*	1.00						
17	0.11*	0.14*	0.11*	0.12*	0.15*	0.13*	0.10*	0.08*	0.07*	0.20*	-0.12*	0.02*	0.11*	-0.01	0.01*	-0.02*	1.00					
18	0.21*	0.24*	0.13*	0.20*	0.25*	0.11*	0.21*	0.11*	0.04*	0.32*	-0.06*	0.01	0.06*	-0.01	0.16*	0.17*	0.06*	1.00				
19	0.10*	0.15*	0.07*	0.18*	0.14*	0.14*	0.10*	0.15*	0.06*	0.22*	-0.10*	0.02*	0.08*	-0.01	0.15*	0.11*	0.09*	-0.02*	1.00			
20	-0.02*	-0.04*	0.03*	0.02*	0.02	0.03*	-0.01	0.02*	0.03*	0.01	-0.02*	0.03*	-0.01	0.03*	0.04*	-0.01	0.01	0.01	0.05	1.00		
21	0.05*	0.06*	0.01	0.11*	0.10*	0.20*	0.06*	0.12*	0.04*	0.15*	-0.15*	0.02*	0.16*	-0.04*	0.10*	0.09*	0.04*	0.01	0.08*	-0.21*	1.00	
22	0.05	-0.01	-0.04*	-0.08*	-0.03*	-0.03*	-0.01	-0.06*	-0.07*	-0.05*	0.11*	-0.03*	-0.10*	-0.03	-0.07*	-0.02*	-0.04*	-0.01	-0.04*	-0.27*	-0.37*	1.00
23	-0.03*	-0.01	-0.01	-0.03*	-0.05*	-0.17*	-0.04*	-0.06*	0.01	-0.09*	0.03*	-0.01	-0.02*	0.01*	-0.04*	-0.05*	0.01	-0.01	-0.03*	-0.27*	-0.37*	-0.46*

*Significant at 5%.

1. Water reduction; 2. Energy reduction; 3. Predominant use of renewable energy; 4. Material reduction; 5. Waste reduction; 6.Sale of scrap to other firms; 7.Recycling; 8.Design products easier to maintain, repair or use; 9.High investment in eco-strategy; 10. Breadth; 11. Size: 1-9 employees; 12. Size 10-49 employees; 13. Size 50-249 employees; 14. Young; 15. Own technical expertise; 16. Own finance; 17. External finance; 18. Greenness; 19. Business opportunity; 20. Industry; 21. Manufacturing; 22.Retail; 23.Services.