How past decisions affect future behaviour on eco-innovation: An empirical study.

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Abstract

The environment is increasingly gaining importance for citizens and society and, therefore, for consumers. Eco-innovation is a direct path for reducing the impact of production while providing companies with a source of competitive advantage. The automotive industry and its supply chain have a great impact on the environment, but no research has been developed on how the orientation towards the environment is evolving for the automotive industry and how future performance may be affected by current decisions. The aim of this paper is to bridge this gap by analysing the eco-innovative dynamism of the automobile industry. To do this, we deploy a panel analysis to see the point at which past behaviour influences future decisions. The Partial Least Square (PLS) method is used to analyse the eco-innovative dynamism of the automobile industry. We analyse a data set based on 159 responses of Spanish companies that belong to the automobile sector. Results show that environmental orientation drivers do not evolve over a short period of time while in the longer term there is an evolution. We prove that carryover effects have a great impact on the future behaviour of the firms, showing that the evolution of organizations' environmental behaviour is a long-range matter. Managerial implications arise from this paper's conclusions, as the decision-making process is clarified.

Keywords: *automobile industry, dynamism, eco-innovation, predicting green behaviour*

1. Introduction

Innovations that contribute to the sustainability are usually called green innovations, sustainable innovations, or eco-innovations. Previous studies of these concepts have found a relationship between them andconfirmation that the company performs better (Lin et al., 2013) in different areas such as profitability (Aguilera-Caracuel and Ortiz-de-Mandojana, 2013), operational capability (Zhu and Sarkis, 2004, Dangelico, 2016), innovativeness (Dangelico and Pujari, 2017),and marketing capability (Chen, 2008) and have pointed to eco-innovations as a source of competitive advantage (Porter and Van der Linde, 1995, Hall and Vredenburg, 2004).
These benefits, mainly tested for companies and organizations, are also increasingly gaining importance for citizens and society and, therefore, for consumers. The view of sustainable innovation is changing from "doing more with less" to "doing good by doing new things" with an increased engagement with the key stakeholders of the firm and a shift in focus from intra-firm linkages to collaboration (Adams et al., 2016, Bhattacharya, 2016). In this line, some authors have deepened their analysis of firms' environmental strategy, finding that those companies that detect a high environmental market demand tend to adopt a proactive environmental strategy to improve eco-innovation, while government subsidy is also a positive driver (Tsai and Liao, 2017a).

Eco-innovation is a direct path for favouring the shift to a low-carbon sustainable economy, and it is also important for reducing the impact of production in the sectors where the company operates (Van den Bergh, et al.,2011, Cubas-Díaz and Martínez Sedano, 2017). It also has an impact on other sectors via external linkages (Costantini et al., 2017), as suppliers, clients and related stakeholders, especially among those taking part in the supply chain (Darnall et al., 2008). The impact of the automobile industry's environmental policies on broader auxiliary industries is a key issue that makes this type of sectoral analysis even more interesting.

The automotive industry together with its supply chain constitute the largest industry in the world (Zailani et al, 2015), and thus it has a great impact on the environment, not only in the productions of parts and vehicles, but also because of the use over time of the final products. More efficient and non-polluting new materials and technologies have a great importance for this industry (Sierzchula et al., 2012).

The automobile industry is facing strong environmental pressures for several reasons: it is considered to be a pollutant sector; it has high public visibility (Geels, 2014); and it is characterized by being large and politically powerful, having scale-intensive firms.

According to Howes et al. (2013), large and multinationals companies are those that 1) can command the managerial resources required to put environmental management systems in place and 2) can address the environment with a "compliance plus" approach. This proactive focus anticipates new regulations; companies adopt practices and strategies that position them one-step away from further requirements (Howes et al., 2013, Edgeman and Eskildsen, 2014).
Among the benefits of adopting this new industry perspective would be a reduction in conflicts with stakeholders; at the same time, it would reduce the risk of unacceptable environmental practices and consequent consumer rejection would be minimized (see e.g. the Volkswagen's emissions scandal explained by Rhodes, 2016).
Research emphasis on the automobile industry and its impact on the environment is not new. Several authors have applied their knowledge and research to this sector with the objective of finding benefits for both, the companies and the environment. Understanding the characteristics

and particularities of the eco-innovation process is key for meeting the requirements of today's markets and society (Xavier et al., 2017). Several authors have made efforts to achieve a better understanding of the structure, patterns and dynamics of eco-innovation in the automobile industry (Zailani et al., 2015, De Stefano et al., 2016, Kushwaha and Sharma, 2016) and how the orientation towards the environment is evolving for the automotive industry (Damert and Baumgartner, 2017, Ansari and Kant, 2017). Yet there is still a gap in research regarding how future performance may be affected by current decisions.

2. Background theory and hypothesis development

Eco-innovation appears nowadays as a strong research area in which interest is increasing. However, academics have not reached consensus about its definition, as it is a field still under construction, although from the policy side there is a clear aim at supporting and increasing its visibility and performance. Indeed, eco-innovation is defined as *"any innovation that makes progress towards the goal of sustainable development by reducing impacts on the environment, increasing resilience to environmental pressures or using natural resources more efficiently and responsibly*[1]*"* (European Commission, 2011).

In a recent study developed by Xavier et al. (2017), eco-innovation models were classified according to an in depth literature review, as well as research gaps and future lines of study for a better understanding of the construct. The authors identified 45 different eco-innovations models. After classifying their approach (diagram, framework, flowchart, process model, systemic model and conceptual model and or method); research area (supply chain management, industrial ecology, business strategy, innovation process, management and strategy, environmental strategy, and product design and innovation); research method; application (segment, industry, and analysis unit); and geographical area of study, the authors reached several conclusions. They concluded that 1) eco-innovation models should be tested in segments not yet studied, such as the automotive industry; 2) European companies are leading the green change (the highest environmental performance can be seen in Europe); and 3) there is a lack of models that focus on the sustainable innovation potential of the organization and that identify relations between different elements affecting eco-innovation. We agree with this identification of needs, and our paper aims to cover this gap.

There are also different open lines of study regarding eco-innovation and its business implications. One of them links it with a higher business performance (e.g., Doran and Ryan, 2012, 2014, 2016), concluding that business performance is affected by eco-innovation activities in both direct and indirect ways (Cheng et al., 2014) and that eco-innovative companies usually reflect better financial performance (Przychodzen and Przychodzen, 2015). More specifically, other authors such as Kushwaha and Sharma (2016) have studied the automobile providers industry, finding that those firms with the most proactive environmental practices had better economic performance.

Another area of study is related to the eco-innovation drivers, for which different authors have advanced knowledge significantly in the last decade. Among the identified variables that favour and guide eco-innovation are: firms' technological trajectory (Sáez-Martínez et al., 2016), collaboration with research institutions (Triguero et al., 2013), demand factors (Cai and Zhou, 2014), and environmental regulations and firms' internal organizational capabilities (Kesidoe and Demirel, 2012, Bossle et al., 2016). Smith and Crotty (2008) named environmental regulations as driving eco-innovation in the UK automobile sector, while regulatory and internal pressures have also been identified by Zhu et al., (2007) and Lin et al (2013) as causative variables for greening the automobile supply-chain.

[1] Decision N° 1639/2006/EC establishing a Competitiveness and Innovation Framework Programme

Considering these previous studies, one could conclude that promoting eco-innovation activities from exogenous factors, such as the impact that companies' stakeholders can have on regulations or the demand stimulus, is important to achieve a higher level of innovation that considers the environment. But endogenous aspects such as firms' capabilities, technological trajectory, or internal pressures are the variables that companies can influence and act on if they are seeking to increase their eco-innovative position; these will lead, according to the academic literature, to better business performance.

Although previous studies have provided interesting insights, managers can still ask themselves how to change their companies' eco-innovative capabilities, as this is a vibrant topic. For example, Díaz-García, et al. (2015) identified the need to adopt a longitudinal approach by identifying drivers that influence the further growth and development of eco-innovative firms. For the automobile industry, process and product innovation and closeness to market information sources were identified as variables influencing companies' eco-innovation orientation (Peiró-Signes et al., 2014, Segarra-Oña et al., 2014).

This highly innovative industry has been facing strong environmental regulations to which not all the companies have reacted in the same way. Mondéjar-Jiménez et al. (2015) found that, within the automotive industry, there are three different groups, named the eco-blinds, the eco-marketers and eco-balanced. The last group of companies looks for finding an equilibrium between opening new markets and launching new products and services to cover the green demand and cutting down the operational costs through reducing the consumption of natural resources' consumption. The second group orients their efforts mainly to cover the eco-demand, being highly influenced by the market information sources and their suppliers' and clients' networks. The eco-blind group is still reacting to the environmental challenges instead of taking advantage of the opportunities that have arisen regarding sustainability in recent years.

Although the relations among the different variables that affect and impact on the eco-innovative behaviour in the automobile industry have been pointed out as a research gap, few authors to date have deepened in this field and, from our point of view, the way that previous behaviour can affect companies' future decisions is still a knot to disentangle. The impact that previous decisions may have on the future is an active academic area in other knowledge fields, such as the study of consumer behaviour, where it has been applied, for example, in predicting green product consumptions (Paul, et al., 2016, Yadav and Pathak, 2016 or Chen and Hung, 2016). These authors based their hypotheses on the theory of reasoned action (TRA), first developed by Ajzen and Fishbein (1977), which examines the attitude-behaviour relationship. The findings of Ajzen and Fishbein supported the application of TRA for predicting green product consumption and stated that a positive attitude and concern towards the environment increases the effort that individuals make to reduce their environmental impact (Singh and Gupta, 2013).

The TRA also affirms that the frequency with which a behaviour has been performed in the past is found to account for the variance in later behaviour independent of intentions, as past behaviour, is the best predictor of future behaviour (Ajzen, 2002).

Several authors have proved that companies' behaviour is difficult to change and that we should expect a long period in order to change companies' culture (Benn and Bolton, 2011, Boons et al., 2013). In this regard, the literature supports that employees' behaviour is among the keys that support change towards a greener attitude (Tariq et al., 2014).

Therefore, on the basis of this theoretical development, we state two hypotheses:

Hypothesis 1: Environmental orientation drivers are not dynamic in the short term.

Considering this, and proposing a new cross-seeding study, we want to analyse to what extent

previous behaviour influences future decisions. In other words, we wish to investigate how much companies' previous decisions and behaviour regarding eco-innovation influence on the companies' actual activities.
Moreover, eco-innovation is a strategic decision that forces companies to adapt their actions in a reactive or a proactive way, and in both cases internal processes and products, as well as companies' relations with their market, need a fairly long time to adapt. In this line, we argue that past behaviour is a significant driver for present behaviour.

Hypothesis 2: Past behaviour will significantly affect present behaviour in companies' environmental orientation drivers and in eco-innovation itself.

With these hypotheses we will explore, on the one hand, if the drivers of eco-innovation (which have been proved to affect companies' environmental orientation) are good predictors for eco-innovation decisions (what we have called dynamism) and, on the other hand, we will evaluate the impact of carryover (past) effects on companies' behaviour. We will test our hypotheses on the automobile industry.

Therefore, the aim of this paper is to bridge this gap by breaking down the eco-innovative dynamism of the automobile industry. To do this, we deploy a panel analysis in order to see the point at which past behaviour influences future decisions. We follow the line of research that has been disentangling eco-innovation and for which different authors have pointed to research gaps. These gaps include the need for 1) an in-depth level of detail (Tsai and Liao, 2017b, Xavier et al., 2017); 2) a better understanding of the impact of previous trajectories (Sáez-Martínez et al., 2016); and 3) the automobile industry-specific studies (Xavier et al., 2017).

3. Research method.

3.1. Sample

This study uses a sample of 159 automotive companies (NACE code 29) from the 2012 Spanish Technological Innovation Panel (PITEC). The PITEC questionnaire is built by the Spanish Statistical Office and has monitored the innovation activities of Spanish companies since 2003. This allows us to see the evolution of the environmental orientation drivers. From the original sample in 2012 (191 companies) that have consistent data on the drivers of the environmental orientation of the firm, we disregarded those companies that were missing data for the period of the study (2008-2012), ending up with the final sample.

We used industry-specific data in this study as a first approach. Industries are subject to different competitive and regulatory environments, which might be affecting companies' behaviour towards environmental and innovation-related aspects.

3.2. Measures

To perform the analysis we considered te model of Segarra-Oña et al. (2014) model of the drivers affecting the environmental orientation of the firm while innovating. This model takes into account the observations at one point in time and has been consistently checked within the automotive industry and in other industries by Segarra-Oña et al. (2011a, 2011b).
The model uses measures in PITEC related to the types of innovation according to the OECD's Oslo Manual (Mortensen and Bloch, 2005). The manual concentrates on new and significantly improved products (goods and services) and processes, which are reflected in PITEC through

the orientation to product or processes in the innovation activities of the companies. Additionally, the survey and the model offer insight about how important it is for the company's innovation activities to arise from information coming from the market (suppliers, customers, and competitors), which has been proved to be important in the orientation of the companies towards product or process innovation. Finally, we also considered variables related to the environmental orientation of the firm, which are the main target of this study.

Annex1 describes the variables used in the model (items) as they appear in the PITEC database, including their scale, descriptions, and latent variables associated in the model, which have been used and supported by the Community Innovation Survey and PITEC for years.

3.3. Conceptual model

According to PITEC[2], process-oriented companies are defined as those companies that are oriented to cost reduction and to increased capacity and flexibility. Process-oriented companies focus on savings in materials, energy, and water, as this reduces product costs. Moreover, they are usually focused on increasing the efficiency of their processes, which is also cost-related. Product-oriented companies are those companies that focus on increasing the quality or number of their products, on penetrating new markets, or on increasing market share. We also considered in the analysis companies' dependence on market information sources, that is, clients, suppliers, and competitors, as information sources for innovation.

The original model posits that Market Information Sources (MIS) have a positive impact on Product and Process Orientation (PtO and PsO, respectively) and that the latter build on the Environmental Orientation (EO) of the companies.

In our model we include an additional relation between the market information sources and the environmental orientation. We believe that information from suppliers, competitors, and clients is becoming more important in the environmental orientation of firms and, therefore, in how companies approach environmental innovation. Thus, a direct effect has been added to discern whether this effect exists.

We used Partial Least Square (PLS) and SmartPLS software (Ringle et al. 2013) to test our hypotheses.

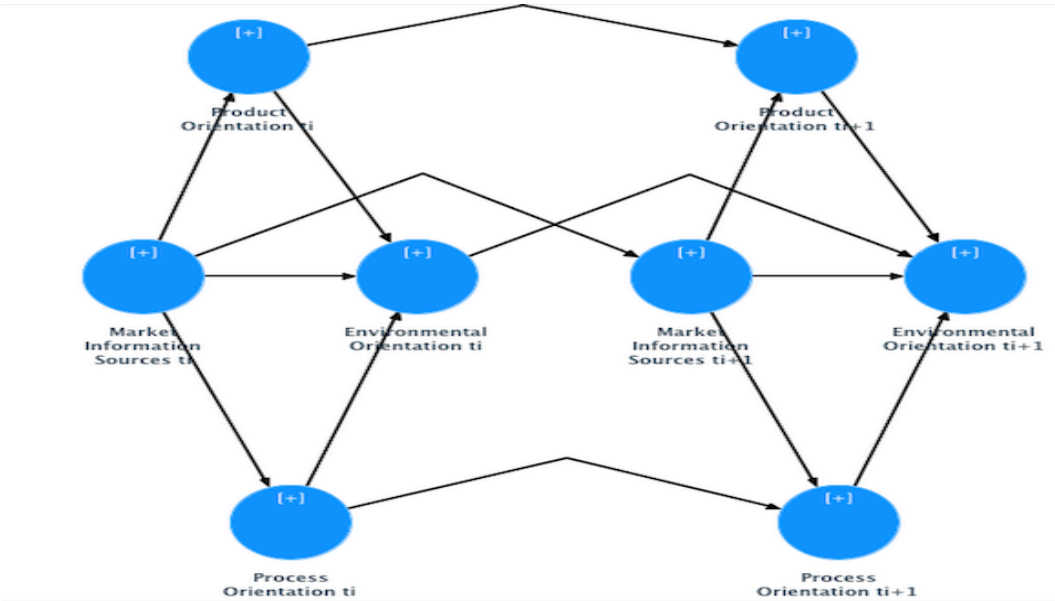
The overriding question in this study is whether environmental orientation drivers are dynamic or not. In other words, do the drivers evolve through time?

Our first approach was to evaluate the models for each year and later make a comparison of the path models. However, one important aspect to consider when answering this question and modelling the evolution is to consider the carryover effects. That is, a company's behavioural patterns are a strategic issue, difficult to change and to manage. Therefore, we can expect that past behaviours are going to have a big impact on future behaviours, and we cannot dismiss them in a dynamic context.

To address these issues, we took into account the temporal effects to better understand the evolution of the orientations over the time. We followed Johnson et al. (2006) to model the temporal effects on a PLS framework. Essentially, we considered that each latent variable in period t_i is going to affect the same latent variable in period t_{i+1}. For example, environmental orientation in 2010 will be affected by process and product-orientation in 2010, by the market information sources in 2010, and also by the environmental orientation of the firm in the previous year 2009. Our conceptual model is shown in Figure 1.

Figure 1. Environmental Orientation Conceptual model

[2] http://icono.fecyt.es/PITEC/Documents/2014/PITECdatabase%20%28May%202014%29.pdf, http://icono.fecyt.es/PITEC/Paginas/por_que.aspx



We evaluated the model for years 2008 (t_0) to 2012 (t_4).

4. Analysis and results

4.1. Measurement model evaluation

In a PLS context we evaluated first the measurement model (outer model). All the estimates in the outer model meet the suggested criteria for item reliability, internal consistency, and convergent and discriminant validity (see Table 1). Respectively, item loadings are higher than 0.707 (available from the authors); the construct's composite reliability (CR) values are over 0.7 (Nunnally and Bernstein, 1994); and average variance extracted (AVE) values are above 0.5, (Fornell and Larcker, 1981) and they are greater than the squared correlations with the other constructs (Fornell and Larcker, 1981). Therefore, we can conclude that the measurement model is reliable and valid.

Table 1. Reliability measurement and matrix of correlation between latent variables.

	AVE	**CR**	**EO 08**	**EO 09**	**EO 10**	**EO 11**	**EO 12**	**MIS 08**	**MIS 09**	**MIS 10**	**MIS 11**	**MIS 12**	**PsO 08**	**PsO 09**	**PsO 10**	**PsO 11**	**PsO 12**	**PtO 08**	**PtO 09**	**PtO 10**	**PtO 11**	**PtO 12**
EO 08	0.809	0.927	**0.899**																			
EO 09	0.654	0.85	0.435	**0.809**																		
EO 10	0.828	0.935	0.492	0.481	**0.91**																	
EO 11	0.844	0.942	0.491	0.469	0.615	**0.919**																
EO 12	0.887	0.959	0.371	0.57	0.591	0.727	**0.942**															
MIS 08	0.595	0.812	0.277	0.146	0.242	0.238	0.297	**0.771**														
MIS 09	0.571	0.797	0.302	0.368	0.26	0.273	0.299	0.573	**0.756**													
MIS 10	0.634	0.839	0.247	0.28	0.416	0.331	0.337	0.499	0.676	**0.796**												
MIS 11	0.653	0.849	0.256	0.249	0.235	0.49	0.455	0.517	0.534	0.728	**0.808**											
MIS 12	0.682	0.865	0.221	0.362	0.333	0.503	0.609	0.41	0.488	0.643	0.801	**0.826**										
PsO 08	0.644	0.9	0.533	0.356	0.306	0.259	0.331	0.216	0.245	0.162	0.119	0.151	**0.802**									
PsO 09	0.670	0.91	0.334	0.54	0.337	0.257	0.355	0.093	0.343	0.178	0.015	0.153	0.602	**0.819**								
PsO 10	0.684	0.915	0.344	0.39	0.582	0.385	0.442	0.16	0.205	0.303	0.119	0.258	0.496	0.721	**0.827**							
PsO 11	0.744	0.935	0.359	0.311	0.311	0.575	0.472	0.174	0.196	0.221	0.365	0.336	0.462	0.474	0.555	**0.862**						
PsO 12	0.753	0.938	0.313	0.434	0.371	0.491	0.659	0.224	0.191	0.298	0.395	0.53	0.456	0.466	0.513	0.741	**0.868**					
PtO 08	0.572	0.869	0.466	0.312	0.265	0.241	0.354	0.337	0.255	0.3	0.306	0.358	0.431	0.247	0.308	0.303	0.401	**0.756**				
PtO 09	0.578	0.872	0.304	0.455	0.345	0.302	0.456	0.304	0.429	0.39	0.301	0.415	0.302	0.462	0.413	0.295	0.419	0.582	**0.76**			
PtO 10	0.598	0.88	0.344	0.328	0.448	0.333	0.323	0.222	0.27	0.481	0.363	0.374	0.27	0.298	0.495	0.372	0.424	0.535	0.682	**0.773**		
PtO 11	0.641	0.899	0.252	0.304	0.227	0.483	0.395	0.206	0.217	0.421	0.523	0.45	0.167	0.192	0.323	0.461	0.47	0.437	0.609	0.715	**0.8**	
PtO 12	0.683	0.915	0.23	0.361	0.245	0.411	0.549	0.248	0.23	0.383	0.506	0.591	0.196	0.268	0.354	0.379	0.563	0.457	0.62	0.604	0.685	**0.827**

Note: Square root of AVE on diagonals in bold.

4.2. Structural model evaluation

Secondly, we assessed the inner model (structural model). To do so, we evaluated the sign, magnitude, and significance of the path coefficients using a bootstrapping procedure with 5000 resamples, the coefficients of determination (R^2 values), and the predictive relevance of the model by a blindfolding procedure (Q^2 value).

Path coefficient signs are consistent (positive) with the expectations, giving partial support to the directionality of the relations (see Figure 2). Most of the t-values are statistically significant, providing empirical support to the proposed relations in the model (see Table 2). The R^2 values of the endogenous latent variables show that the model has a moderate capability to explain the variables (Chin, 1998) . In addition, we included f^2 effect size (Table 2), which is a measure of the impact of a specific predictor construct on an endogenous construct. According to Cohen (1988), effect size can be classified as small ($f^2 = 0.02$), medium ($f^2 = 0.15$), or large ($f^2 = 0.35$). Finally, all Q^2 values are greater than zero, indicating that the model has predictive relevance (Henseler et al., 2009).

Once we validated the model, we proved the results to gain some interesting insights.

Figure 2. Structural model

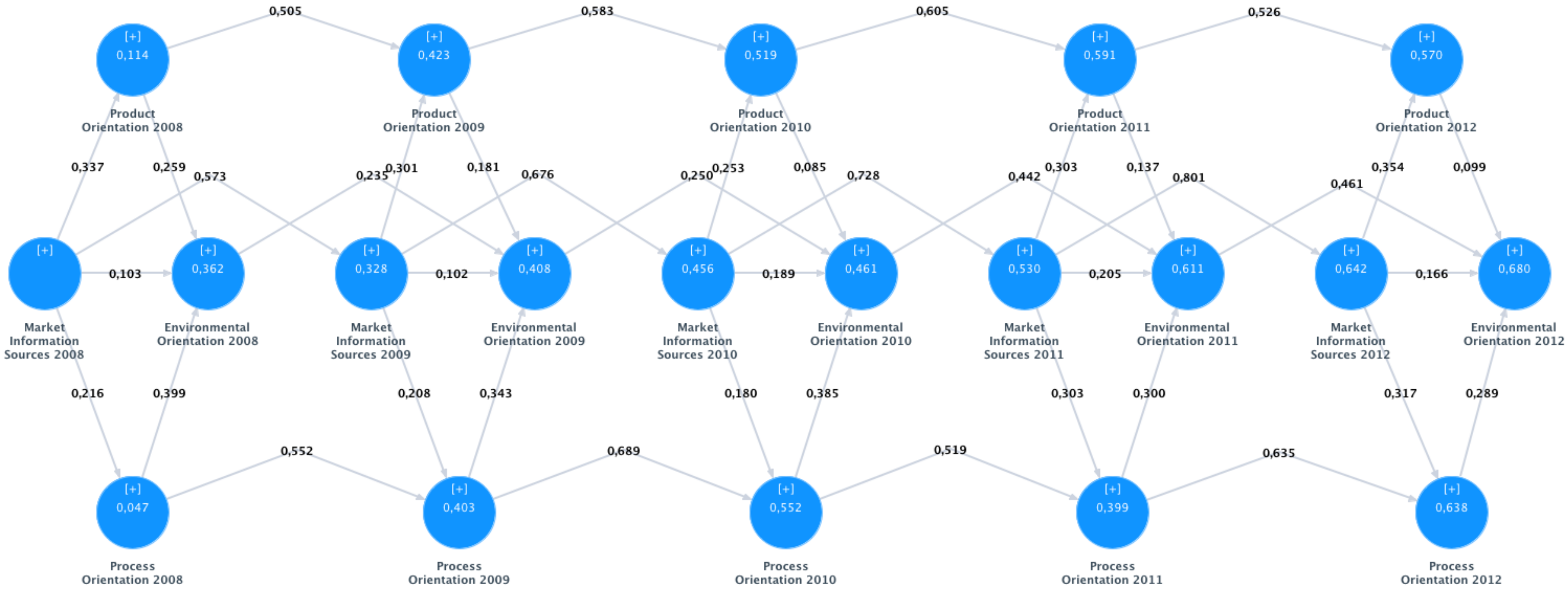


Table 2. Direct effects, f^2, variance explained by antecedent variables, R^2 and Q^2 test for the endogenous variables

Effects on endogenous variables	Direct effects t value (bootstrap)	R^2	Variance explained	Q^2	f^2
Environmental Orientation 2008		0.362		0.287	
Market Information Sources 2008	0.103 n.s. (1.344)		0.029		0.015
Process Orientation 2008	0.399 *** (4.910)		0.213		0.202
Product Orientation 2008	0.259 ** (2.966)		0.121		0.079
Environmental Orientation 2009		0.408		0.227	
Environmental Orientation 2008	0.235 ** (2.909)		0.102		0.078
Market Information Sources 2009	0.102 n.s. (1.362)		0.038		0.013
Process Orientation 2009	0.343 *** (4.964)		0.185		0.145
Product Orientation 2009	0.181 * (2.285)		0.082		0.039
Environmental Orientation 2010		0.461		0.374	
Environmental Orientation 2009	0.25 *** (3.355)		0.12		0.094
Market Information Sources 2010	0.189 ** (2.493)		0.079		0.050
Process Orientation 2010	0.385 *** (4.661)		0.224		0.191
Product Orientation 2010	0.085 n.s. (0.969)		0.038		0.008
Environmental Orientation 2011		0.611		0.504	
Environmental Orientation 2010	0.442 *** (6.858)		0.272		0.445
Market Information Sources 2011	0.205 ** (2.836)		0.1		0.075
Process Orientation 2011	0.3 *** (4.389)		0.173		0.169
Product Orientation 2011	0.137 * (1.883)		0.066		0.031
Environmental Orientation 2012		0.68		0.593	
Environmental Orientation 2011	0.461 *** (5.995)		0.335		0.449
Market Information Sources 2012	0.166 * (2.211)		0.101		0.047
Process Orientation 2012	0.289 *** (3.737)		0.19		0.151
Product Orientation 2012	0.099 n.s. (1.206)		0.054		0.017
Market Information Sources 2009		0.328		0.182	
Market Information Sources 2008	0.573 *** (7.980)		0.328		0.489
Market Information Sources 2010		0.456		0.286	
Market Information Sources 2009	0.676 *** (12.320)		0.456		0.840
Market Information Sources 2011		0.53		0.346	
Market Information Sources 2010	0.728 *** (14.182)		0.53		1.129
Market Information Sources 2012		0.642		0.435	
Market Information Sources 2011	0.801 *** (19.731)		0.642		1.792
Process Orientation 2008		0.047		0.028	
Market Information Sources 2008	0.216 ** (2.503)		0.047		0.049
Process Orientation 2009		0.403		0.262	
Market Information Sources 2009	0.208 ** (2.451)		0.071		0.068
Process Orientation 2008	0.552 *** (7.111)		0.332		0.480
Process Orientation 2010		0.552		0.372	
Market Information Sources 2010	0.18 ** (2.592)		0.055		0.070
Process Orientation 2009	0.689 *** (10.388)		0.497		1.026
Process Orientation 2011		0.399		0.290	
Market Information Sources 2011	0.303 *** (3.854)		0.111		0.151
Process Orientation 2010	0.519 *** (6.552)		0.288		0.442
Process Orientation 2012		0.638		0.475	
Market Information Sources 2012	0.317 *** (4.404)		0.168		0.246
Process Orientation 2011	0.635 *** (8.858)		0.471		0.989
Product Orientation 2008		0.114		0.061	
Market Information Sources 2008	0.337 *** (4.336)		0.114		0.129
Product Orientation 2009		0.423		0.238	
Market Information Sources 2009	0.301 *** (3.916)		0.129		0.146

Product Orientation 2008	0.505 *** (6.609)		0.294		0.413
Product Orientation 2010		0.519		0.302	
Market Information Sources 2010	0.253 *** (4.304)		0.122		0.113
Product Orientation 2009	0.583 *** (7.454)		0.398		0.599
Product Orientation 2011		0.591		0.371	
Market Information Sources 2011	0.303 *** (3.999)		0.158		0.195
Product Orientation 2010	0.605 *** (8.399)		0.433		0.777
Product Orientation 2012		0.57		0.387	
Market Information Sources 2012	0.354 *** (3.918)		0.209		0.232
Product Orientation 2011	0.526 *** (5.562)		0.36		0.512

4.3. Hypothesis tests and results

Our first analysis on path coefficients reveals that, generally, PsO explains a greater variance of the EO than PtO (i.e., 17.3% and 6.6%, respectively in 2011), and MIS similarly affect both PsO and PtO (path coefficients are similar). However, we see an evolution of the MIS'impact on EO, discussed below.

The magnitude of the path coefficients indicates the strength of the relation between the latent variables as beta coefficients in a regression. A change in the magnitude of the path coefficients over time will indicate a variation in the patterns that drive the environmental orientation of the companies. Therefore, to test our first hypothesis, we looked for an evolution on the path coefficients over time and if this change is significant.

We tested these changes using a nonparametrical confidence interval approach, which is consistent with PLS methodology. Thus, we checked if the path coefficient in t_i is in the 95% confidence interval of the same path coefficient in period t_{i+1}. We can assume that if the path coefficient in t_i is within the confidence interval of t_{i+1} there are no significant differences between the two paths, and vice versa. Additionally, to test the dynamics in a longer run we made this comparison between t_i and t_{i+2}, t_{i+3} and so forth.

Note that we disregarded for this comparison for the year 2008 (t_0). For this year, we do not have carryover effects, and its inclusion affects path coefficients in that year.

Table 3 shows the path coefficients and the bias corrected and accelerated (BCa) 95% confidence intervals obtained in a bootstrapping procedure with 5000 resamples. The numbers in parentheses refer to the related years; i.e., (2) is the path from 2009 to 2010. Then, if there is a significant difference at $p<0.05$ between the path coefficient in group year i and the path coefficient in year $i \pm j$, where j varies from 1 to 3 depending on the reference year i, j will appear in parentheses below the path coefficient i. For example, the path value on the upper left side of the table ($MIS_{2008} \rightarrow MIS_{2009}$ 0.573) is significantly different from the paths of groups 2, 3, and 4 (values inside the parentheses below the path 0.573), that is, from the paths $MIS_{2009} \rightarrow MIS_{2010}$ (0.676), $MIS_{2010} \rightarrow MIS_{2011}$ (0.728), $MIS_{2011} \rightarrow MIS_{2012}$ (0.801). Similarly, the path $MIS_{2010} \rightarrow MIS_{2011}$ (0.728), group 3, differs significantly only from groups 1 and 4, that is $MIS_{2008} \rightarrow MIS_{2009}$ (0.573), $MIS_{2011} \rightarrow MIS_{2012}$ (0.801), but not from group 3 (path 0.676). Consequently, if there are no groups referred below the path, no significant differences have been found between that path and the other paths on the same row.

We can see significant differences in the MIS carryover effects from 2009 to 2012. Regarding the EO carryover effect, there is a significant increase on the path from the period 2009-2010 to 2011-2012. In the overall period, PsO and PtO showed no significant differences. Finally, there is a significant difference in the relation of MIS on PsO in the period. An increase in the carryover path coefficients values indicates an evolution of the relative importance of the previous behaviour on determining the future behaviour in the model. Therefore, results support our first hypothesis; in the short term there are no dynamics in the drivers of the EO of the firms.

Table 3. Test on the difference between the path coefficients using Bias Corrected and accelerated 95% confidence intervals (BCa CI).

Group year →	Path 08/09 (1)	BCa CI	Path 09/10 (2)	BCa CI	Path 10/11 (3)	BCa CI	Path 11/12 (4)	BCa CI
MISti-1 -> MISti	0.573 (2, 3, 4)	[0.456 ; 0.693]	0.676 (1, 4)	[0.585 ; 0.765]	0.728 (1, 4)	[0.641 ; 0.811]	0.801 (1, 2, 3)	[0.731 ; 0.864]
PsOti-1 -> PsOti	0.552 (2)	[0.42 ; 0.673]	0.689 (1, 3)	[0.578 ; 0.796]	0.519 (2)	[0.389 ; 0.65]	0.635	[0.519 ; 0.754]
PtOti-1 -> PtOti	0.505	[0.384 ; 0.637]	0.583	[0.45 ; 0.708]	0.605	[0.488 ; 0.725]	0.526	[0.377 ; 0.688]
EOti-1 -> EOti	0.235 (3, 4)	[0.105 ; 0.368]	0.25 (3, 4)	[0.134 ; 0.377]	0.442 (1, 2)	[0.341 ; 0.552]	0.461 (1, 2)	[0.336 ; 0.589]
MIS -> PsO	0.208	[0.066 ; 0.346]	0.18 (4)	[0.07 ; 0.297]	0.303 (2)	[0.171 ; 0.428]	0.317 (2)	[0.194 ; 0.429]
MIS -> PtO	0.301	[0.171 ; 0.421]	0.253	[0.155 ; 0.35]	0.303	[0.176 ; 0.425]	0.354	[0.197 ; 0.494]
MIS -> EO	0.102	[-0.02 ; 0.225]	0.189	[0.058 ; 0.309]	0.205	[0.082 ; 0.319]	0.166	[0.037 ; 0.283]
PsO -> EO	0.343	[0.226 ; 0.449]	0.385	[0.244 ; 0.519]	0.3	[0.187 ; 0.411]	0.289	[0.164 ; 0.419]
PtO -> EO	0.181	[0.051 ; 0.314]	0.085	[-0.059 ; 0.228]	0.137	[0.019 ; 0.255]	0.099	[-0.036 ; 0.232]

Note: Numbers in parentheses indicate the path group year from which this path was significantly different at p-0.05 level according to non parametric confidence interval procedure.

Moreover, the analysis of the significance of the relations shows that the path MIS on EO is not significant in 2008 and 2009 and PO on EO in 2010 and 2012, suggesting a turn in the patterns that drive environmental innovation. We can clearly see a switch on the impact of MIS on EO from a mediating to a direct effect. That is, initially, the importance of the information from the market players, such as competitors, clients, and suppliers, in the innovation process is affecting the EO through the PO. Subsequently, the importance of the information from the market is directly affecting the EO, suggesting that companies are taking into account the increasing awareness of the market players about environmental issues. In other words, environmental issues are no longer collateral, and the market is significantly driving companies' EO while innovating.

Regarding our second hypothesis, we similarly tested the differences on the explained variance (R^2 values) by the model. (Note that Table 4 follows the same patterns as Table 3 for interpretation purposes). We can observe an evolution on the variance explained by the model from around 40% to 68% (EO construct). Generally speaking, the variance explained by the model in the overall period has increased for all the latent variables. These results are consistent with the previous finding on the path analysis that indicates an increase of the importance on the carryover effects paths while the relation paths show no significant differences.

Additionally, we note almost no evolution over time on the R^2 (Table 4). The carryover effects (see explanation of variance in Table 4), the large effects of the carryover variables in producing the R^2 (f2 values on Table 2), and the predictive relevance of the model (Q^2 values) increases over time, reinforcing the argument that past behaviours are fundamental in predicting future behaviour.

Table 4. Test on the differences between the R^2 values using Bias Corrected and accelerated 95% confidence intervals (BCa CI).

Group year →	R^2_{2009} (1)	BCa CI	R^2_{2010} (2)	BCa CI	R^2_{2011} (3)	BCa CI	R^2_{2012} (4)	BCa CI

Environmental Orientation	0.408 (3, 4)	[0.293 ; 0.488]	0.461 (3, 4)	[0.345 ; 0.542]	0.611 (1, 2)	[0.494 ; 0.691]	0.680 (1, 2)	[0.551 ; 0.757]
Market Information Sources	0.328 (2, 3, 4)	[0.188 ; 0.459]	0.456 (4)	[0.332 ; 0.573]	0.530 (1)	[0.397 ; 0.643]	0.642 (1, 2)	[0.524 ; 0.736]
Process Orientation	0.403 (2, 4)	[0.272 ; 0.515]	0.552 (1,3)	[0.414 ; 0.662]	0.399 (2, 4)	[0.260 ; 0.513]	0.638 (1, 3)	[0.499 ; 0.734]
Product Orientation	0.423 (3, 4)	[0.299 ; 0.520]	0.519	[0.355 ; 0.643]	0.591 (1)	[0.461 ; 0.685]	0.570 (1)	[0.449 ; 0.658]

Note: Numbers in parentheses indicate the R^2 year from which this R^2 was significantly different at p-0.05 level according to non parametric confidence interval procedure.

7. Conclusions, limitations and further research

The objective of this research was to understand the EO dynamics. As environmental innovation is pointed out as a source of competitive advantage (Esty and Winston, 2006), the understanding of its evolution becomes crucial to determine which attitudes and behaviours managers and policy makers should push in order to achieve or encourage it. Eco-innovation improvement and enhancement would help governments, industries, and companies to better comply with stakeholders' demands and therefore to satisfy the market and final consumers.

In this line, there is a latent need to disentangle how eco-innovation drivers work and what variables affect companies' decisions.This paper helps to clarify the topic of why and how the orientation towards the environment is evolving within industry and how future performance may be affected by current decisions.

This study was designed primarily to study the evolution over time of three main EO drivers: product orientation, process orientation, and market information sources.

The results show that the driver patterns do not evolve over a short period of time. However, in the longer term we can see an evolution, which points to an increase of the direct effect of information from suppliers, competitors, and clients (the market) on the EO of companies. This allowed us to evaluate the dynamics on the drivers and the impact of past behaviour on subsequent years (carryover effects). To do so, EO has been analysed as a behavioural matter in an innovative approach that puts together the fields of management and psychology. This theoretical framework, the theory of reasoned action (TRA) (Ajzen and Fishbein, 1977), has been used in numerous studies in an attempt to explain human behaviour but has been scarcely used in the management field of study.

The TRA depends on the belief that performing a specific behaviour will lead to a specific outcome. The TRA also affirms that the frequency with which a behaviour has been performed in the past is found to account for variance in later behaviour; independent of intentions, past behaviour is the best predictor of future behaviour. We deployed an empirical study of the automotive industry, finding that the environmental awareness and an eco-innovation orientation in the past predicts a high environmental company involvement in the future.

These findings would also reinforce the positive externalities that the companies are obtaining when being green, as they are building their environmental responsibility by repeating the decisions and creating a green culture.

Moreover, we proved that carryover effects have a great impact on the future behaviour of the firms, which reinforces that the evolution of organizations' environmental behaviour is a long-range matter.

Managerial implications of this analysis clearly arise. On the one hand, results clarify how the drivers of the eco-innovative orientation within this industry remain the same, so acting and investing on their enhancement becomes crucial. On the other hand, the weight of the carryover effects on eco-innovation orientation is identified, so as soon as managerial decisions and the company's whole strategy aligns and clarify their long term objectives regarding sustainability, the better results companies will attain.

Limitations of the study are mainly caused by differences in companies represented by the wide spectrum of the automotive industry. Car manufacturers and tier-one suppliers may have a more proactive environmental orientation than suppliers at lower levels. Car manufactures link the industry with the final consumer and, therefore, usually set up stricter environmental regulations that go downstream within the industry.

Regarding the future lines of research that this study opens, on the one hand, the limitation mentioned above should be considered, so that future researchers might segment the industry by levels of relationship with manufacturers (tier one, tier two, etc.). On the other hand, as we have shown that studying environmental orientation dynamics can be a worthwhile exercise for understanding companies' behavioural evolution, and because industries are under specific environmental legislation and common regulations have relatively different impacts on each industry, similar studies on other industries and/or countries should be undertaken to expand the knowledge on these dynamics.

References

Adams R, Jeanrenaud S, Bessant J, Denyer D, Overy P. 2016. Sustainability-oriented innovation: a systematic review. *International Journal of Management Reviews* **18**: 180-205. DOI: 10.1111/ijmr.12068

Aguilera-Caracuel J, Ortiz-de-Mandojana N. 2013. Green innovation and financial performance: An institutional approach. *Organization & Environment* **26**: 365-385. DOI: 10.1177/1086026613507931

Ajzen I, Fishbein M. 1977. Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological bulletin* **84***:* 888-918. DOI: 10.1037/0033-2909.84.5.888

Ajzen I. 2002. Residual effects of past on later behavior: Habituation and reasoned action perspectives. *Personality and social psychology review* **6**: 107-122. DOI:10.1207/S15327957PSPR0602_02

Ansari ZN, Kant R. 2017. Exploring the framework development status for sustainability in supply chain management: a systematic literature synthesis and future research directions. *Business Strategy and the Environment* **26**: 873-892. DOI: 10.1002/bse.1945

Bhattacharya CB. 2016. Responsible Marketing: Doing Well by Doing Good. *GfK Marketing Intelligence Review* **8**: 8-17. DOI: 10.1515/gfkmir-2016-0002

Benn S, Bolton D. 2011. *Key concepts in corporate social responsibility*. Sage, London.

Boons F, Lüdeke-Freund F. 2013. Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. *Journal of Cleaner Production* **45**: 9-19. DOI:10.1016/j.jclepro.2012.07.007

Bossle MB, de Barcellos MD, Vieira LM, Sauvée L. 2016. The drivers for adoption of eco-innovation. *Journal of Cleaner Production* **113***:* 861-872. DOI: 10.1016/j.jclepro.2015.11.033

Cai WG, Zhou XL. 2014. On the drivers of eco-innovation: empirical evidence from China. *Journal of Cleaner Production* **79**: 239-248. DOI: 10.1016/j.jclepro.2014.05.035

Chen YS. 2008. The driver of green innovation and green image–green core competence. *Journal of business ethics* **81**: 531-543. DOI: 10.1007/s10551-007-9522-1

Cheng CC, Yang CL, Sheu C. 2014. The link between eco-innovation and business performance: a Taiwanese industry context. *Journal of Cleaner Production* **64**: 81-90. DOI: 10.1016/j.jclepro.2013.09.050

Chen SC, Hung CW. 2016. Elucidating the factors influencing the acceptance of green products: An extension of theory of planned behavior. *Technological Forecasting and Social Change* **112**: 155-163. DOI: 10.1016/j.techfore.2016.08.022

Chin WW. 1998. The partial least squares approach to structural equation modeling In: *Modern methods for business research*, Marcoulides GA (eds.). Psychology Press. New Jersey.

Costantini V, Crespi F, Marin G, Paglialunga E. 2017. Eco-innovation, sustainable supply chains and environmental performance in European industries. *Journal of Cleaner Production* **155**: 141-154. DOI: 10.1016/j.jclepro.2016.09.038

Cubas-Díaz M, Martínez Sedano MA. 2017. Measures for Sustainable Investment Decisions and Business Strategy–A Triple Bottom Line Approach. *Business Strategy and the Environment* **27**:, 16-38. DOI: 10.1002/bse.1980

Damert M, Baumgartner RJ. 2017. Intra-Sectoral Differences in Climate Change Strategies: Evidence from the Global Automotive Industry. *Business Strategy and the Environment*. DOI: 10.1002/bse.1968

Dangelico RM. 2016. Green product innovation: where we are and where we are going. *Business Strategy and the Environment*, **2**: 560-576. DOI: 10.1002/bse.1886

Dangelico RM, Pujari D, Pontrandolfo P. 2017. Green Product Innovation in Manufacturing Firms: A Sustainability-Oriented Dynamic Capability Perspective. *Business Strategy and the Environment* **26**: 490-506. DOI: 10.1002/bse.1932

Darnall N, Jolley GJ, Handfield R. 2008. Environmental management systems and green supply chain management: complements for sustainability? *Business Strategy and the Environment* **17**: 30-45. DOI: 10.1002/bse.557
De Stefano MC, Montes-Sancho MJ, Busch T. 2016. A natural resource-based view of climate change: Innovation challenges in the automobile industry. *Journal of Cleaner Production*.**139**: 1436-1448. DOI: 10.1016/j.jclepro.2016.08.023
Díaz-García C, González-Moreno A, Sáez-Martínez FJ. 2015. Eco-innovation: insights from a literature review. *Innovation* **17**: 6-23. DOI: 10.1080/14479338.2015.1011060
Doran J, Ryan G. 2012. Regulation and firm perception, eco-innovation and firm performance. *European Journal of Innovation Management* **15**: 421-441. DOI: 10.1108/14601061211272367
Doran J, Ryan G. 2014. Eco-Innovation–does additional engagement lead to additional rewards? *International Journal of Social Economics* **41**: 1110-1130. DOI: 10.1108/IJSE-07-2013-0169
Doran J, 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. DOI: DOI: 10.1002/bse.1860
Edgeman R, Eskildsen J. 2014. Modeling and assessing sustainable enterprise excellence. *Business Strategy and the Environment* **23**: 173-187. DOI: 10.1002/bse.1779
Esty D, Winston A. 2009. *Green to gold: How smart companies use environmental strategy to innovate, create value, and build competitive advantage*. John Wiley & Sons, New Jersey.
European Commission. 2011. *Communication from the Commission to the European parliament, the council, the European economic and social committee and the committee of the regions Innovation for a sustainable Future* - The Eco-innovation Action Plan (Eco-AP), http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0899, accessed on June 2017.
Fornell C, Larcker DF. 1981. Evaluating structural equation models with unobservable variables and measurement error. J*ournal of marketing research* **18**: 39-50. DOI: 10.2307/3151312
Forrester, JW. 1961. *Industry dynamics*. Cambridge, Massachusetts.
Geels, FW. 2014. Reconceptualising the co-evolution of firms-in-industries and their environments: Developing an inter-disciplinary Triple Embeddedness Framework. Research Policy, **43**: 261-277. DOI: 10.1016/j.respol.2013.10.006
Hall J, Vredenburg H. 2004. Sustainable development innovation and competitive advantage: implications for business, policy and management education. *Innovation* **6**: 129-140. DOI: 10.5172/impp.2004.6.2.129
Henseler J, Ringle CM, Sinkovics RR. 2009. The use of partial least squares path modeling in international marketing. *Advances in International Marketing* **20**: 277-320. DOI: 10.1108/S1474-7979(2009)0000020014
Howes R, Skea J, Whelan B. 2013. *Clean and competitive: motivating environmental performance in industry*. Routledge.
Johnson MD, Herrmann A, Huber F. 2006. The evolution of loyalty intentions. *Journal of marketing* **70**: 122-132. DOI: 10.1509/jmkg.70.2.122
Kesidou E, Demirel P. 2012. On the drivers of eco-innovations: Empirical evidence from the UK. Research Policy **41**: 862-870. DOI: 10.1016/j.respol.2012.01.005
Kushwaha GS, Sharma NK. 2016. Green initiatives: a step towards sustainable development and firm's performance in the automobile industry. *Journal of Cleaner production* **121**: 116-129. DOI: 10.1016/j.jclepro.2015.07.072
Lin RJ, Tan KH, Geng Y. 2013. Market demand, green product innovation, and firm performance: evidence from Vietnam motorcycle industry. *Journal of Cleaner Production* **40**: 101-107. DOI: 10.1016/j.jclepro.2012.01.001

Mondéjar-Jiménez J, Segarra-Oña M, Peiró-Signes A, Payá-Martínez A, Sáez-Martínez FJ. 2015. Segmentation of the Spanish automotive industry with respect to the environmental orientation of firms: Towards an ad-hoc vertical policy to promote eco-innovation. *Journal of Cleaner Production* **86**: 238-244. DOI: 10.1016/j.jclepro.2014.08.034
Mortensen PS, Bloch CW. 2005. *Oslo Manual-Guidelines for Collecting and Interpreting Innovation Data: Proposed Guidelines for Collecting and Interpreting Innovation Data*. Organisation for Economic Cooporation and Development. OECD.
Nunnally JC, Bernstein I. 1994. *Psychometric Theory*. MacGraw-Hill, New York.
Paul J, Modi A, Patel J. 2016. Predicting green product consumption using theory of planned behavior and reasoned action. Journal of Retailing and Consumer Services **29**: 123-134. DOI: 10.1016/j.jretconser.2015.11.006
Peiró-Signes A, Payá-Martínez A, de-Miguel-Molina M. 2014. What is Influencing the Sustainable Attitude of the Automobile Industry? In *Environmental Issues in Automotive Industry*. Springer Berlin.
Porter ME, Van der Linde C. 1995. Toward a new conception of the environment-competitiveness relationship. *Journal of economic perspectives*, **9**: 97-118. DOI: 10.1257/jep.9.4.97
Przychodzen J, 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. DOI: 10.1016/j.jclepro.2014.11.034
Rhodes C. 2016. Democratic business ethics: Volkswagen's emissions scandal and the disruption of corporate sovereignty. *Organization Studies* **37**: 1501-1518. DOI: 10.1177/0170840616641984
Ringle CM, Wende S, Becker JM. 2014. *Smartpls 3.0.* Hamburg: SmartPLS. Retrieved from http://www.smartpls.com
Sáez-Martínez FJ, Díaz-García C, Gonzalez-Moreno A. 2016. Firm technological trajectory as a driver of eco-innovation in young small and medium-sized enterprises. *Journal of Cleaner Production* **138**: 28-37. DOI: 10.1016/j.jclepro.2016.04.108
Segarra-Oña M, Peiró-Signes A, Miret-Pastor L, Albors-Garrigós J. 2011a. Uncovering non-obvious relationship between environmental certification and economic performance at the food industry. In *Information Technologies in Environmental Engineering*. Springer Berlin.
Segarra-Oña M, Peiró-Signes A, Miret-Pastor L, Albors-Garrigós J. 2011b. Eco-innovation, an evolution of innovation? Empirical analysis of the Spanish tile industry. *Boletín de la Sociedad Española de Cerámica y Vidrio* **50**: 219-228.
Segarra-Oña M, Peiró-Signes A, Payá-Martínez A. 2014. Factors Influencing Automobile Firms' Eco-Innovation Orientation. *Engineering Management Journal* **26**: 31-38. DOI: 10.1080/10429247.2014.11432002
Singh N, Gupta K. 2013. Environmental attitude and ecological behaviour of Indian consumers. *Social Responsibility Journal*, **9**: 4-18. DOI: 10.1108/17471111311307787
Sierzchula W, Bakker S, Maat K, van Wee B. 2012. Technological diversity of emerging eco-innovations: a case study of the automobile industry. *Journal of Cleaner Production* **37**: 211-220. DOI: 10.1016/j.jclepro.2012.07.011
Smith M, Crotty J. 2008. Environmental regulation and innovation driving ecological design in the UK automotive industry. *Business Strategy and the Environment* **17**: 341-349.
Tariq S, Jan FA, Ahmad MS. 2014. Green employee empowerment: a systematic literature review on state-of-art in green human resource management. Quality & Quantity **50**: 237-269. DOI: 10.1007/s11135-014-0146-0

Tsai KH, Liao YC. 2017a. Sustainability Strategy and Eco-Innovation: A Moderation Model. *Business Strategy and the Environment* **26**: 426-437. DOI: 10.1002/bse.1926

Tsai KH, Liao YC. 2017b. Innovation Capacity and the Implementation of Eco-innovation: Toward a Contingency Perspective. *Business Strategy and the Environment* **26**: 1000-1013 DOI: 10.1002/bse.1963

Triguero A, Moreno-Mondéjar L, Davia MA. 2013. Drivers of different types of eco-innovation in European SMEs. *Ecological economics* **92**: 25-33. DOI: 10.1016/j.ecolecon.2013.04.009

Van den Bergh JC, Truffer B, Kallis G. 2011. Environmental innovation and societal transitions: Introduction and overview. *Environmental innovation and societal transitions* **1**: 1-23. DOI: 10.1016/j.eist.2011.04.010

Xavier AF, Naveiro RM, Aoussat A, Reyes T. 2017. Systematic literature review of eco-innovation models: Opportunities and recommendations for future research. *Journal of Cleaner Production* **149**: 1278-1302. DOI: 10.1016/j.jclepro.2017.02.145

Yadav R, Pathak GS. 2016. Young consumers' intention towards buying green products in a developing nation: Extending the theory of planned behavior. *Journal of Cleaner Production* **135**: 732-739. DOI: 10.1016/j.jclepro.2016.06.120

Zailani S, Govindan K, Iranmanesh M, Shaharudin MR, Chong YS. 2015. Green innovation adoption in automotive supply chain: the Malaysian case. *Journal of Cleaner Production* **108**: 1115-1122. DOI: 10.1016/j.jclepro.2015.06.039

Zhu Q, Sarkis J. 2004. Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal Oper. Manag., **22**: 265-289. DOI: 10.1016/j.jom.2004.01.005

Zhu Q, Sarkis J, Lai KH. 2007. Green supply chain management: pressures, practices and performance within the Chinese automobile industry. *Journal of Cleaner Production* **15**: 1041-1052. DOI: 10.1016/j.jclepro.2006.05.021

Annex 1. Item description, scales and latent variables.

ITEMS	SCALE	EXPLANATION	LATENT VARIABLE
FUENTE0	Cat.	Importance of information from suppliers in the innovation activities	Market Information Sources
FUENTE1	Cat.	Importance of information from clients or customers in the innovation activities	
FUENTE2	Cat.	Importance of information from competitors in the innovation activities	
OBJET1	Cat.	Importance of the objective Increase range of goods or services in firm's innovation activities	Product Orientation
OBJET2	Cat.	Importance of the objective Replace outdated products or processes in firm's innovation activities	
OBJET3	Cat.	Importance of the objective Enter new markets in firm's innovation activities	
OBJET4	Cat.	Importance of the objective Increase market share in firm's innovation activities	
OBJET5	Cat.	Importance of the objective Improve quality of goods or services in firm's innovation activities	
OBJET6	Cat.	Importance of the objective Improve flexibility for producing goods or services in firm's innovation activities	Process Orientation
OBJET7	Cat.	Importance of the objective Increase capacity for producing goods or services in firm's innovation activities	
OBJET8	Cat.	Importance of the objective Reduce labour costs per unit output in firm's innovation activities	
OBJET9	Cat.	Importance of the objective Reduce material costs per unit output in firm's innovation activities	
OBJET10	Cat.	Importance of the objective Reduce energy costs per unit output in firm's innovation activities	
OBJET11	Cat.	Importance of the objective Reduce environmental impacts in firm's innovation activities	Environmental Orientation
OBJET12	Cat.	Importance of the objective Improve health or safety of your employees in firm's innovation activities	
OBJET13	Cat.	Importance of the objective Meet environmental, health or safety regulations in firm's innovation activities	

Cat, Categorical variables: 1=High; 2=Medium 3=Low 4=Not considered or not important.