Portillo-Tarragona, P.; Scarpellini, S.; Marín-Vinuesa, L.M. (2019). Drivers for eco-innovation in firms: an exploratory study in Spain. International Journal of Business and Globalisation, 22 (4), 618-637, DOI: 10.1504/IJBG.2019.100253

Drivers for eco-innovation: an exploratory study in Spain

Abstract: The authors study the determinants of the behaviour of protection of the innovations through green patents, as an approximation of eco-innovative profile in firms. To this end, a large sample of firms from three regions in Spain is analysed through a binomial logit model. The authors find that age, size and financial performance significantly affect the choice of having green patents as eco-innovative conduct in firms. They also find that the sector of activity and the legal structure of firms are related with the choice of having, or not having, green patents to protect the innovations. Implications are explored for policy makers promoting the green patents registration and for practitioners introducing environmental improvement in the innovation processes.

Keywords: Eco-innovation, Green Patents, Economic-Financial Characteristics, Binomial Logit Model, Corporate finance.

1 Introduction

Technological innovation is unquestionably the most promising road to sustainability (Ehrenfeld, 2005). In terms of industrial practice, improvements in processes, products and services have gradually moved towards greater efficiency in the use of resources and reducing environmental impact on innovation investments – hence the increase in eco-innovative progress, which is defined here as the process of developing new ideas, conduct, products and processes that help to reduce burdens or attain environmental objectives (Rennings, 2000).

Nevertheless, in the innovation management field, the number of scholars who conduct research dedicated to new products/services or the development of green innovations is still limited (Schiederig et al., 2012).

The literature contains definitions of eco-innovation that differ but have a common basis, emphasising the various aspects of the term. Carrillo-Hermosilla et al. (2010) and Andersen (2010) define eco-innovation as innovation that is capable of attracting green returns. In contrast, according to Kemp and Pearson (2008), eco-innovation is the production, assimilation or exploitation of a product, production process, service or business method that is novel for that organisation, the result of which is a reduction in environmental risk, pollution and other negative effects caused by the intensive use of resources. In other words, these innovations pursue an environmental benefit as opposed to other goals (Horbach et al., 2012) and are based on and pursue eco-efficiency (Scarpellini et al., 2012); the term "innovation" is applied in a broad sense, as defined by the Oslo Manual (OECD, 2005).

The implementation of eco-innovation in firms and the selection of optimal investment alternatives nonetheless require different criteria and perspectives to be considered, according to the needs of those involved in the process. Stakeholder theory emphasises the importance of stakeholders for a firm's environmental performance (Henriques and Sadorsky, 1999; Sharma and Henriques, 2005). The stakeholder's influence on the organisation's activities is related to proactivity (local community) (Cousar and Huff, 2011) or channelling resources towards investments with a lower degree of uncertainty (suppliers of financial resources). On the other hand, agency theory (Jensen and Meckling, 1976) hypothesises that the risk associated with these types of investment can affect the type of resources chosen to finance them (O´Brien, 2003), because if the risk and

effort associated with such investments is not rewarded, managers will allocate resources to alternatives with less uncertainty, thus sacrificing better long-term results.

Therefore, firms are still interested in proposals that aim for the "three dimensions of returns" (ecological security, security in resource provision and socioeconomic security) proposed by Fussler and James (1999), and are also interested in finding the balance between economic efficiency and social welfare considered by Kenji-Kondo (2001), analysing environmental factors that are external to the process (De Burgos and Cespedes, 2001) and searching for "triple bottom line accounting" equilibrium (Elkington, 1998), which includes ecologic and social data in traditional financial accounting provided by firms.

Over the last ten years there has been a shift in the paradigm in favour of sustainable growth based on innovation and more efficient resource administration. In 2010, the European Commission itself adopted the Europe 2020 Strategy, the initiatives of which include the effective use of resources and innovation-based growth (European Commission, 2010). These initiatives recognise the important function of eco-innovation in helping firms attain environmental targets through innovation. However, in the EU, the problems associated with financial constraints represent a barrier to the rapid internal or external, public or private development of eco-innovation (European Commission, 2011).

Spain holds 9th position on the EU Eco-innovation Scoreboard, according to the EU Eco-innovation observatory (Léger, 2015), close behind countries such as UK and Italy, and above the European average (EU-28). Concerning eco-innovation in firms, however, Spain's score is substantially lower, which indicates a low R&D intensity (Valero-Gil et al., 2017). In facts, at present, Spain remains labelled as only 'moderately innovative' within the framework of the EU (European Commission, 2016). Thus, the study of the issue of eco-innovation drivers for Spanish business is interesting to foment national and international patents, which is regarded as a crucial factor if firms are to improve their resources for eco-innovation (Aragón-Correa and Leyva-de la Hiz, 2015).

In Spain, the debate on the utilisation of innovation, and how it strengthens firms' competitiveness, has been promoted over the last few years by processes such as market internationalisation, consumption fragmentation, the growth of emerging economies and the international financial crisis. However, there are still barriers that limit the development of innovative products, processes and services in firms, particularly in small- and medium-sized enterprises (SMEs). Furthermore, the benefit provided by eco-innovation is not always evident in the analysis of investment projects.

Different works have stressed the relationship between innovation, eco-innovation and patents (Arundel and Kabla, 1998; Kemp and Oltra, 2011; Kemp and Pearson, 2008; Lanjouw and Schankerman, 2004) and, therefore, environmental patents can be considered a good proxy for eco-innovation, which is traditionally found in developed countries, especially the USA, Germany and Japan (Dechezleprêtre et al., 2013; Durán-Romero and Urraca-Ruiz, 2015). However, other European countries, such as Spain, in which the number of patents per capita (EPO, 2015) is traditionally low, constitute an interesting aspect in the study of environmental patents (OECD, 2013).

The use of green patents as a proxy for eco-innovation is an objective criterion for selecting firms which have generated environmental innovations. This is a preferable alternative to subjective criteria that are based on a detailed examination of eco-innovative investment. With our criterion, we can isolate registered and accredited innovations which aim to improve the environment and which fall within the definition of eco-innovation used for this study.

The objective of this study is therefore to learn more about the characteristics of the firms that implement eco-innovation, as identified through the environmental patents – that is, those firms which have been defined as "green or sustainable" by the International Classification of Patents (ICP) – in order to define the factors related to eco-innovative habits in firms from three regions in Spain.

In particular, this study provides an economic-financial analysis of firms in the sectors that have more opportunities for eco-innovation and the most important explanatory factors in firms involved in patented eco-innovation.

The main aim of this analysis is to understand the reasons behind the commitment to eco-innovation, as measured by company possession of "green patents". The results obtained provide a basis for local or national policy markets; these results also provide tools that can be used in the implementation of policies aimed at fostering the development of patents and the dissemination of a green innovation/invention culture among those firms which have to date not been greatly involved in this activity, if at all, and to encourage those that have even further.

With this objective in mind, the following section will analyse previous literature and the state of the question, while the third section will describe our methodology, the sample and the variables. The fourth section defines the profile of the firms included in the sample, discusses the results and presents the main conclusions.

2 Literature Review

Prior studies have confirmed the close relationship between innovation and eco-innovation. Kemp and Pearson (2008) highlight innovation as the step prior to eco-innovation, and Segarra-Oña et al. (2011) also posit that innovation itself is a factor that affects eco-innovation in firms; eco-innovation is measured here by the number of registered green patents, as there is previous empirical evidence that patents are a reliable measure of innovative activity (Crosby, 2007; Johnstone et al., 2010; Marin, 2014). We may therefore assume that the most innovative sectors would also be the most willing to make progress in environmental innovation.

The competitive advantage generated by environmental proactivity in firms (Porter, 1991; Porter and Van der Linde, 1995) can be promoted by environmental legislation encouraging companies to become involved in environmental innovation. Indeed, Ghisetti and Rennings (2014), Kammerer (2009) and Kesidou and Demirel (2012) identify legislation as a factor of environmental innovation. In this respect, the regulatory framework of sectors such as motor vehicles has been found to be one of the main factors in favour of eco-innovation (Mondéjar-Jiménez et al., 2015). Horbach et al. (2012) also mention other factors such as the specific characteristics of firms, as well as technology and the market.

Murillo-Luna et al. (2008) identify four types of strategic environmental conduct in firms: passive, compliant with legislation, attention to stakeholders and total environmental quality. Stakeholder pressure is thus mentioned as a driver for environmental proactivity (Paramanathan 2004).

On the other hand, some industrial sectors can have a significant impact on the environment owing to the technologies that they use, and therefore provide greater opportunities for eco-innovative solutions, as mentioned by Przychodzen and Przychodzen (2015), who also maintain that firm size is a factor to be considered, as the largest firms perform better than the smallest.

The firms' potential access to R&D grows with greater access to resources, and thus small firms are handicapped when it comes to green innovations. In this regard, size may be regarded as a structural factor (Ariño et al., 2008; Arundel and Kabla, 1998; Sáez-Martínez et al., 2015; González-Benito et al., 2016). Small firms, therefore, face more obstacles when incorporating green concerns into their economic practices, and have more difficulty gaining competitive advantages, and, it follows, find it harder to make a profit from environmentally-friendly investments (Revell and Rutherfoord, 2003). Despite this, there is evidence of small firms pushing forward green initiatives (Revell and Rutherfoord, 2010).

The assessment of firms' access to resources must also take into account financial resources. The financing problem is linked to the innovation process (Ayyagari et al., 2007), and by extension to eco-innovation, and thus firms with greater financing facilities will be more proactive in innovation and, if applicable, eco-innovation. In this respect, Aragon-Correa and Leyva-de la Hiz (2015) posit that there is a positive relationship between the number of green patents and other patents registered by firms, as they are subject to the influence of similar factors.

Financial resource providers want to compensate for the risk associated with environmental investment, as they otherwise prefer alternatives with less uncertainty, despite their legitimacy (Gómez-Mejía, 2009). However, there is evidence that the socially responsible profile of investment does not have to be perceived as an important sacrifice in terms of returns (Ortas et al., 2014), as it contributes to the generation of value either through share prices or financial performance (Moneva, 2007).

The age of firms may be the factor that tilts the balance in favour of innovation, especially environmental innovation. Older firms have more public exposure, and their corporate image is more vulnerable to reputational risk, which makes them more prone to eco-innovation (Jensen and Roy, 2008). Conversely, young firms may be more inclined to innovate in as far as they have more potential to offer solutions to new challenges (Díaz-García et al., 2015; Jensen and Roy, 2008). Aragon-Correa and Leyva-de la Hiz (2015), for their part, have found no evidence that this variable affects the attitude of towards environmental innovation of firms.

Legislation and regional tax incentives can also aim to favour certain types of environmental conduct by creating public financial incentives such as grants, fiscal and/or financial advantages, as well as favouring innovation. Also, instruments that may reduce financial risks, which would favour certain socially beneficial investments, also exist, and if they solely depend on private financing, this could lead to lower than desirable investment levels. As Johnstone and Labonne (2006) and Kammerer (2009) point out, the application of environmental regulations also has a significant effect on a firm's eco-innovation initiatives.

Some evidence noted in previous studies which examine public grants as favouring innovation (Ghisetti and Rennings, 2014), has corroborated the importance of reducing fees and taxes, as this fosters the adoption of more sustainable conduct, such as in the energy field or the motor vehicle sector (Sierzchula et al., 2014).

The causal relationships between financial variables and environmental innovation activities in firms have focused on financial performance, basically measured by share prices or a firm's profits, as evidenced by its financial statements (Cohen et al., 1995). Although the results are not conclusive, there are studies that indicate a positive impact (Aragon-Correa et al., 2008; Hart and Ahuja, 1995; Waddock and Graves, 1997; Montabon et al., 2007), others that support a negative relationship (Busch and Hoffmann, 2011; Wagner et al., 2002; Wagner, 2005) and others which demonstrate that the impact on a firm's economic performance depends on whether the purpose of legislation is to eliminate or reduce negative externalities or to improve the efficiency of production processes (Horbach et al., 2012).

When analysing financial performance, the results are not conclusive, partly due to the use of different environmental and financial indicators (Derwall et al., 2005) and the possible interference of variables such as sector, leverage or size (Przychodzen and Przychodzen, 2015).

The relationship between eco-innovative conduct and financial performance is still the subject of debate, particularly regarding investment possibilities in settings with high returns, good results and the ability to generate surpluses. Potocan et al. (2016) point that economic results affects positively on enterprise's environmental responsiveness. In line with Waddock and Graves (1997), better financial performance provides more freedom to invest in more socially responsible projects, such as innovation initiatives in products and processes in favour of the environment. According a one revision of previous studies, Sadat et al. (2016) point the return on investment as an assessment criteria of technological innovation capabilities. In this respect, we should highlight the uncertainty associated with the analysis of cash flows generated by investment in innovation in general, and particularly in environmental innovation, as this has an impact on risk structure, financing and, finally, financial costs.

Concerning patents and the geographical scope of our analysis, the Spanish Office of Patents and Trademarks (Oficina Española de Patentes y Marcas) plays an active role in promoting the use of Industrial Property Rights by Spanish firms – a tool for accessing international markets. National subsidies were regulated in Orden IET/940/2013, de 24 de mayo, which aims to foster patents and utility models as a tool to ensure that technological property rights at international levels are protected, the competitiveness of those organisations in the private sector which are currently seeking markets outside Spain is improved, and finally that the protection of the national investments made by SMEs and individual persons, also through patents and utility models, is promoted.

The grants are awarded to patent or utility model applications presented to a patent office abroad or the regional offices, within the framework of national or regional-patent or utility-model registration processes. The grants also involve the provision of subventions for activities carried out within the framework of international and the Spanish protocols (registration and/or search).

In general, the programme is targeted at facilitating the recovery of the initial costs incurred by official registration fees established by the European regulation of the internal market and the de minimis limits – see Commission Regulation (EC) nº 1998/2006 of 15 December, on the application of articles 87 and 88 of the Treaty to de minimis aid (Official Journal of the European Union, L379, 28-12-2006).

Specifically, it is worth mentioning that these grants are awarded to SMEs in Spain as a response to the need to protect innovation through national and international patents, which is regarded as a crucial factor if firms are to be competitive in an increasingly globalised context[1]. However, it is also worth stressing that no specific initiative for creating specific grants for green innovations has yet been launched in Spain. Therefore, patent-grant policies do not take environmental regulations into consideration, following the criterion that the support of green patents belongs to other initiatives for the promotion of green technologies. As a result, all firms, regardless of their environmental orientation, can benefit from the grants.

The analysis of the literature and patent-incentive policies is a firm basis from which to examine some factors that are still under discussion in the scholarly debate, such as the size, age and financial performance of green-patenting firms. On this basis, our main research question is: how does the age, size and financial performance of firms contribute to explain their behaviour in terms of eco-innovation, as reflected by their possession of green-patents?

[1] The grants are regulated by article 17 of Ley 38/2003, de 17 de noviembre, General de Subvenciones, and the associated regulations (passed as Real Decreto 887/2006, de 21 de julio), Ley 30/1992, de 26 de noviembre, de Régimen Jurídico de las Administraciones Públicas y del Procedimiento Administrativo Común, Ley 47/2003, de 26 de noviembre, General Presupuestaria, Ley 11/2007, de 22 de junio, de acceso electrónico de los ciudadanos a los Servicios Públicos, Real Decreto 1671/2009, de 6 de noviembre, por el que se desarrolla parcialmente la Ley 11/2007, de 22 de junio and Commission Regulation (EC) nº 1998/2006 of 15 December, on the application of articles 87 and 88 of the Treaty to de minimis aid.

For the reasons explained above and taking into account the results reached in the previous studies, we posit the following research hypotheses:

Hypothesis 1 (H1): The higher the company size, the more likely it is that, ceteris paribus, the ‘‘eco-innovate (green patents)" option will be chosen.

Hypothesis 2 (H2): The higher the age of company, the more likely it is that, ceteris paribus, the ‘‘eco-innovate (green patents)" option will be chosen.

Hypothesis 3 (H3): The higher the business financial performance, the more likely it is that, ceteris paribus, the ‘‘eco-innovate (green patents)" option will be chosen.

In addition to these economic-financial characteristics, other factors that are also under discussion in the academic debate are: the Legal structure of firms (Gallego-Bono and Chaves-Avila, 2016), the sector of activity (Triguero et al., 2016) and the acces to financial resource Aragon-Correa and Leyva-de la Hiz (2015) and the location of firms (Polzin et al., 2016). As we explained below, these factors could contribute to explain the eco-innovative behaviour. Therefore our research proposal is directed to examine whether there is a relationship of these factors with the choice of having green patents as eco-innovative conduct in firms. To this end, four variables: legal structure, sector, listed and location are included as control variables in the empirical analysis.

The legal structure of firms may have an effect on their innovation strategy. Flexible legal structures – such as those found in cooperatives – are conducive to more innovation, turning these firms into proactive nexuses in the generation of innovation and its dissemination (Gallego-Bono and Chaves-Avila, 2016).

Those sectors that are more exposed to environmental risks have more incentives to foster environmental innovation as a means of managing reputational risk (Power, 2012; Waddock and Graves, 1997). A propensity for eco-innovation has also been noted in the most internationally competitive sectors (Aguilera-Caracuel et al., 2012; Brunnermeier and Cohen, 2003; Triguero et al., 2016). The third variable is related to the location of the firm (Polzin et al., 2016; Li et al., 2016; Triguero et al., 2016), as the decentralisation of initiatives in favour of eco-innovation has turned some regions into ‘lighthouses’ for eco-innovation (Cooke, 2011). In Spain, policies for the promotion of eco-innovation vary from region to region; those regions with a special tax regime, such as the Basque Country and Navarre, offer especially generous financial incentives (Miguel et al., 2015). Therefore, the location of firms may have a direct effect on their position concerning eco-innovation (Polzin et al., 2016).

The easy access to financial resources favours eco-innovation (Aragon-Correa and Leyva-de la Hiz (2015). The greater the ability to access financial markets, the more diverse the channels to access resources will be. Spanish firms are highly dependent on bank intermediation (Cardone et al., 2005), which limits their access to capital markets and, in consequence, to the number of potential investors, and this also creates barriers to financial resources and hampers eco-innovation (Polzin et al., 2016). Similarly, access to the financial markets demands much more information than the alternatives, which would leave the public image of these firms extremely exposed.

3 Methodology

3.1. Data

We combined different information sources to study the factors that, from an economic-financial perspective, characterise firms which implement eco-innovation.

The data have been obtained from two sources: the financial data come from the SABI database[1], and correspond to the last available full year (2013). By contrast, the determination of the eco-innovative nature of firms is based on patents related to environmental aspects registered in the Spanish Patent and Trademark Office (Oficina Española de Patentes y Marcas - OEPM) by the firms we studied, through the International Classification of Patents (ICP), with those corresponding to the codes defined by the United Nations Framework Convention on Climate Change (CMNUCC[2]) being classified as “green or sustainable”. Having patents of these characteristics allows us to classify the firms in our sample as innovative, as the firms have at least one innovative product or process, according to the sample analysed by Ketata et al. (2015); for the purposes of this article, they are unquestionably eco-innovative firms if they have at least one “green or sustainable” patent.

1 Sistema de Análisis de Balances Ibéricos (SABI) [online database]. 2014. Madrid.

2See http://unfccc.int/portal_espanol/informacion_basica/la_convencion/items/6196.php (consulted June 2015). [here and elsewhere – this is more commonly ‘Accessed on/in..’]

The sample comprises eco-innovative firms which are primarily located in Navarre and the Basque Country – two regions with high eco-innovation rates according to the Eco-Innovation Observatory report for Spain (EIO, 2013). In this study, Aragon was added to these two autonomous regions because the eco-innovative firms of the region have been subject to a previous study (Llera et al., 2013), which helped us to define the variables to be analysed in the current article and to narrow down the kind of green patents to be included in the sample.

Firms with 50 employees or more have been chosen, as smaller firms are considered not to have high potential in terms of using eco-innovation or eco-design solutions relevant for our analysis.

The firms selected were those operating in sectors with the greatest potential for eco-innovation, such as those sectors related to the technologies contemplated in "BREFs" or "Best Available Techniques"[1], specifically industry, transport and logistics and waste, the CNAE 09 codes of which correspond to mining (05-09), manufacturing industry (10-33), the supply of electric power, gas, steam and air-conditioning (35), the supply of water, drainage activities, waste management and decontamination (36-39), and transport and storage (49-53).

After combining the different data sources mentioned above, we obtained a final sample consisting of 883 observations. Table 1 summarises the final composition of the sample according to legal status, whether the firms are listed on a stock exchange, activity sector and location.

As Table 1 show, most of the firms in the sample are not listed on the Spanish Stock Exchange (98.2% of the sample). On the other hand, many of them are public limited companies and private limited companies, 60.7% and 34.4%, respectively. There are very few cooperatives and limited partnerships (4.6% and 0.2%). Regarding sector, the largest percentage (81.8%) was made up of firms (identified with Spanish CNAE 09 codes) that correspond to the manufacturing industry, followed by those industries involved in transport and storage (11.7%), power, gas, steam and air-conditioning supply (4.1%), water-supply, drainage, waste management and decontamination (1.6%), and mining (0.9%). Regarding location, most of the firms, 56.1% of the total, are located in the Basque Country, with firms from Aragon and Navarre representing 24.9% and 19%, respectively.

A description of the green patents is provided in Table 1. As is clear, of the 883 firms in the sample, those with green patents (GP) number 83 firms and represent 9.4% of the total, in contrast with the remaining 90.6% of firms without such patents (non-GP).

Table 1. Sampling process and sample composition

Panel A. Sampling process

	Initial	SABI
Sample	883	875

Panel B. Composition of the sample

Legal Structure	(%)	Total	GP	non-GP
Cooperative	4.64	41	18	23
Public Limited Company	60.70	536	41	495
Limited Partnership	0.23	2	0	2
Limited Company	34.43	304	24	280
Observations		883	83	800
Sector	**(%)**	**Total**	**GP**	**non-GP**
Mining	0.91	8	1	7
Manufacturing	81.77	722	68	654
Energy	4.08	36	11	25

1 See http://www.prtr-es.es/documentos/documentos-mejores-tecnicas-disponibles (accessed on June 2015).

Water supply	1.59	14	2	12
Transport and storage	11.66	103	1	102
Observations		883	83	800
Regions	(%)	Total	GP	non-GP
Aragon	24.92	220	9	211
Navarre	19.03	168	22	146
Basque Country	56.06	495	52	443
Observations		883	83	800
Shares	(%)	Total	GP	non-GP
Traded on stock exchange	1.81	16	1	15
Not traded	98.19	867	82	785

Note: GP= firms with green patents, non-GP= firms without green patents.

3.2. Method

The contrast model states, as a dependent variable, that "the existence of patents related to environmental technologies, or green patents (Eco-innovation)" is a dichotomous variable which takes value 1 when the firm has green patent and 0 when firm has not a green patent. As with the theoretical framework, in the empirical model we are going to deal with the propensity to eco-innovate with regard to the factors involved in the process.

Eco-innovation = f (age, size, financial performance, sector, legal structure, location, listed)

Bearing in mind the nature of the dependent variable, we specify a binomial logit model. This technique is appropriate for a dichotomous dependent variable such as Eco-innovation (Maddala, 1983). The basic structure of the proposed model, which tests the factors with Eco-innovation, then, is as follows:

$$P\left[Y_j = 1 \middle| X_j\right] = \frac{e^{\beta_o + \sum_{i=1}^{7} \beta_i X_{ij}}}{1 + e^{\beta_o + \sum_{i=1}^{7} \beta_i + \beta_i X_{ij}}} \quad (1)$$

where:

Yj =1 if the firm has green patents and Yj =0 otherwise

$X1j$ $X2j$ $X3j$ $X4j$ $X5j$ $X6j$, $X7j$ =Xj, stands for the seven factors described above for firm j and P [Yj=1Xj] is the likelihood of the jth firm having green patents.

Unlike traditional regression coefficients, logit coefficients cannot be interpreted directly as estimates of the magnitude of the marginal effects of changes in the explanatory variables on the expected value of the dependent variable. Therefore, to interpret the sensitivity of the likelihood of eco-innovation with respect to explanatory variables, we also report marginal effects.

The instantaneous rate of change of the likelihood of Eco-innovation with regards to a variable Xij is (John and Nelson, 1984):

$$\frac{\partial P\left[Y_j = 1 \middle| X_j\right]}{\partial X_{ij}} = \beta_i P\left[Y_j = 1 \middle| X_j\right]\left(1 - P\left[Y_j = 1 \middle| X_j\right]\right) \quad (2)$$

3.3. Measures

The variables were operationalized with a set of items from their conceptual definitions and the relevant literature.

Dependent or explained variable:

Eco-innovation is the variable that indicates if firm has or not has green patents (Teirlinck and Spithoven 2013). An objective way of measuring the eco-innovation variable would be by ascertaining the existence of environmental patents held by the firm (Oltra et al., 2009). As patents influence innovation (Segarra-Oña et al., 2011), environmental patents can also affect eco-innovative conduct. Along these lines, different studies such as those by Wagner (2007), Johnstone et al. (2010) and Marin (2014) use patent data to analyse environmental innovation; not all firms decide to use patents to protect their innovations, and these patents may not cover the entire process and their use can vary by sector.

Independent and control variables:

Age, variable measured with the number of years between the firm's establishment and 31 December, 2013.

Size, variable measured by the number of workers in the firm in 2013.

Financial performance. This variable has been quantified on the basis of the firm's financial returns in 2013, which are calculated as the ratio between the net income divided by common equity. Financial performance as a cause of innovative conduct is measured using financial returns, as in Wagner (2005) and Przychodzen and Przychodzen (2015).

Sector, is the sector to which the firm belongs. We have considered five sectors: mining, manufacturing, energy, water supply, transport and storage.

Legal Structure, we have considered: Cooperative, Public Limited Company, Limited Partnership and Limited Company.

Location, is the location of firm. We have considered: Aragon, Navarre and Basque Country.

Listed, is the variable that indicates if firm is listed on stock exchange or not listed on stock exchange.

4 Results

A preliminary analysis was conducted to determine the relationships between pairs of independent and dependent variables. Table 2 summarises the relationships between legal status, companies which are listed on the stock exchange, activity classification and autonomous region and the eco-innovation variable. The proportion of firms with green patents varies according to firms' legal status, location and CNAE 09 activity code. Except the variable for those listed on a stock exchange, for all analysed variables the differences found in the proportions between firms with and without green patents are statistically significant in Pearson's $\chi 2$ test.

Table 2. Relation between Green patents and legal structure/sector/regions

	Total	GP		non-GP			
	n	n	%	n	%		
Legal Structure							
Cooperative	41	18	43.90	23	56.10		
Public Limited Company	536	41	7.65	495	92.35	Dif. of proportions	
Limited Partnership	2	0	0.00	2	100.00	Pearson´s	*p*-value
Limited Company	304	24	7.89	280	92.11	60.256	0.000
Observations	883	83	9.40	800	90.60		
Sector	Total	n	%	n	%		
Mining	8	1	12.50	7	87.50		
Manufacturing	722	68	9.42	654	90.58		
Energy	36	11	30.56	25	69.44	Dif. proportions	
Water supply	14	2	14.29	12	85.71	Pearson´s	*p*-value
Transport and storage	103	1	0.97	102	99.03	27.995	0.000
Observations	883	83	9.40	800	90.60		

Regions	Total	n	%	n	%		
Aragon	220	9	4.09	211	95.91	Dif. proportions	
Navarre	168	22	13.10	146	86.90	Pearson´s	*p*-value
Basque Country	495	52	10.51	443	89.49	10.685	0.005
Observations	883	83	9.40	800	90.60		
Shares	Total	n	%	n	%		
Traded on stock exchange	16	1	6.25	15	93.75	Dif. proportions	
Not traded	867	82	9.46	785	90.54	Pearson´s	*p*-value
Observations	883	83	9.40	800	90.60	0.19	0.66

Note: GP= firms with green patents, non-GP= firms without green patents.

Regarding legal status, the results indicate greater interest in registering green patents in cooperatives: 43.9% of them have green patents, compared to public limited companies (7.65%), private limited companies (7.9%) or limited partnerships (0%). Regarding sector, the highest percentages of firms with green patents was made up of those firms that supply electricity, gas, steam and air-conditioning (30.56%), compared to firms involved in water supply, drainage, waste management and decontamination (14.3%), mining (12.5%), manufacture (9.42%) and transport and storage (1%). It is also significant that firms located in Navarre and the Basque Country have a greater interest in registering green patents. Indeed, 13% and 10% of the firms in Navarre and the Basque Country, respectively, have green patents, compared with Aragon (4.09%).

Regarding the listed on a stock exchange variable, the differences found in the proportions between firms with and without green patents were not statistically significant according to the Pearson's $\chi 2$ test.

Table 3 summarises the descriptive statistics of the variables: age, size, financial performance for the total sample (panel A) and presents the mean values for each of the two groups that define the eco-innovation-dependent variable[1], meaning the group of firms that have green patents and those that do not (panel B). In the group of firms with green patent (GP), the mean value of each independent variable is greater than that found in the group of firms without such patents (non-GP).

Table 3. Results of ANOVA

Panel A. Descriptive statistics for total sample					Panel B. Differences of the mean values			
	Total sample				GP	non-GP	GP *vs* non-GP	
	Minimun	Maximun	Mean	SD	Mean	Mean	F statistics	*p*-value
Age	1.00	115.13	30.73	19.49	35.74	30.21	6.090	0.014
Size	3.91	8.90	4.81	0.82	5.60	4.74	91.660	0.000
Financial Performance	-860	880.31	1.59	65.57	17.53	-0.08	5.440	0.020

Note: Mean values of the variables by groups of GP and non-GP companies. ANOVA test for differences of the means.

[1] Of the 883 firms in the sample, 83 have green patents and 800 do not. However, for the variables size, age and financial performance there are less available data. For size: n=882 (total), n=82 (GP) and n=800 (NGP), for age: n=883 (total), n=83 (GP) and n=800 (non-GP) and for financial performance: n=878 (total), n=83 (GP) and n=795 (non-GP). Considering the missing data, the logit analysis was performed with 875 valid data.

As was mentioned earlier, a binomial logit model is used to analyse the determinants of Eco-innovation. The results of estimating the logit model are summarised in Table 4.

Table 4. Results of logistic Regression

	Coefficient	Marginal effect
Age	0.017 **	0.001 **
Size	0.911 ***	0.044 ***
Financial Performance	0.003 **	0.001 **
Aragon	-0.690	-0.029
Navarre	0.381	0.021
Public Limited Company	-1.750 ***	-0.109 ***
Limited Company	-1.320 ***	-0.056 ***
Mining	-0.789	-0.027
Manufacturing	-1.390 ***	-0.104 ***
Water supply	-0.643	-0.023
Transport and storage	-3.460 ***	-0.072 ***
Traded on stock exchange	-2.487	-0.048
McFadden´s Adj R^2	29.00%	
Likelihood ratio Test	-208.97116	
Hosmer and Lemeshow Test	p=0.857	
Predicte capacity	91.89%	
Sensitivity	24.39%	
Specificity	98.87%	

Note: Marginal effects are computed at the sample means. Sensitivity: % of observations correctly predicted as 1; specificity: % of observations correctly predicted as 0.

The model present satisfactory indicators of overall significance, with chi-squared values corresponding to levels of significance lower than 0.001. The percentage of correctly classified cases by the estimated functions is 91.89%. The values of sensitivity (proportion of observations correctly predicted as 1) and specificity (proportion of observations correctly predicted as 0) statistics are acceptable. The model's good fit is also confirmed by the results of the Hosmer and Lemeshow test ($\chi 2(8)=4.00$ sig=0.8570), which demonstrates that there are no significant differences between the observed and predicted values. Thus, the model appears to have good predictive power. Likewise, these models have reasonably good explanatory power, as shown by their pseudo-adjusted R2 value (29.04%).

The findings in this model are consistent with the predictions about relationships between economic-financial characteristics and eco-innovation in firms. Table 4 shows that the results for the size, firm age and financial performance support the predictions given by H1, H2 and H3. The coefficients of the three explanatory variables: size, firm age and financial performance are positive and significant at signification level of 0.01, 0.05 and 0.05, respectively. Therefore, these variables are considered significant when estimating the behaviour of the eco-innovation-dependent variable, at the specified level of significance. The results show that the choice to register green patents is related to firm size, and it is also related to the firm's age. On the other hand, we also find in the analysed data that better financial performance has a positive effect on the choice to

register green patents. The rest of positive and significant coefficients indicate that the sector of activity and the legal structure of firms are related with the choice of having, or not having, green patents to protect the innovations.

5 Conclusions

The utilisation of eco-innovation and its contribution to growing competitiveness in firms means that there is increasing interest in learning about the processes involved in implementing eco-innovative conduct, as it is considered a factor associated with success in the near future for all firms.

The results obtained in this study tell us more about the characteristics of firms that implement eco-innovation in Spain regions, which is helpful if we are to define the factors related to eco-innovation in firms. In particular, this study provides an economic-financial analysis of firms belonging to the sectors with more opportunities for eco-innovation, and the main explanatory variables in sectors with patented eco-innovation.

The results indicate that age, size and financial performance variables are significant as determinants of eco-innovation, thus providing a description of the determinants of the most eco-innovative businesses in the studied regions. Moreover, the adoption of eco-innovative conduct in firms varies according to legal status, activity classification and autonomous region.

Although patents registered by firms cannot be used in general to determine their eco-innovative nature, as proactivity in eco-innovation may involve actions other than protecting industrial property, and it can vary by sector, this variable enables us to objectively classify firms that have developed eco-innovative measures.

The main contribution of this economic-financial analysis of eco-innovative firms is summarised in the use of a set of variables and the firms' classification using a specific analysis of their environmental patents. The results are of interest for both academics and practitioners, as well as for policy-makers, as we have identified the determinants of eco-innovative conduct in firms. Another potential implication for practitioners is related to the analysis of green patents registered by competitors.

The results obtained provide a basis for the development of environmental-sustainability strategies that guide business activities, as environmental sustainability is considered one of the main factors for the future success of firms.

This paper has also some policy implications. If green patents registration is related to the barriers still in place for eco-innovation in firms, we may suggest that possible grants and regional incentives that aim to encourage investment in sustainable innovation should be directed at reducing the difficulties involved in implementing eco-innovation that are related to age, legal status and financial performance, by establishing specific incentives.

Green patents are a clear-cut expression of eco-innovation, and it is therefore desirable to implement policies which help to overcome the main obstacles in the way of green patents at European and international levels. It seems also natural that green patents are given priority over generic patents.

Our analysis suggests that promotion programmes are a great opportunity for firms to protect their inventions according to the European laws of free competition and internationalisation. Firms face an additional difficulty concerning the competitive advantages offered by industrial property in general and the protection of their own inventions in particular: misinformation. This justifies the concession of grants to promote the protection of industrial property and to increase the number of firms registering their innovations.

These policies, however, should be reoriented in order to increase the total number of green patents throughout the regions, regardless of the size of the firms. This study highlights the fact that larger and older firms are more prone to registering green patents. The environmentally friendly nature of these patents, which defines the firms as eco-innovative, may be considered a good criterion for the assimilation of grants geared towards the protection of industrial property and also towards the promotion of eco-innovation, increasing both the number of patents and of firms involved in patenting.

Although this study has certain limitations, related to sample size and geographic location, it was possible to suggest various lines of research which are of interest; and we should delve deeper into our analysis by increasing both the study variables and the information linked to eco-innovative processes in firms and the environmental patents resulting from eco-innovation investment.

References

Aguilera-Caracuel, J., Hurtado-Torres, N. and Aragón-Correa J.A. (2012) 'Does international experience help firms to be green? A knowledge-based view of how international experience and organisational learning influence proactive environmental strategies', *International Business Review*, Vol. 21, No. 5, pp. 847–861.

Andersen, M.M. (2010) 'On the faces and phases of eco-innovation- on the dynamics of the greening of the Economy strategies', in *Druid Summer Conference 2010 on Opening Up Innovation: Strategy, Organization and Technology'* Imperial College London Business School, June, pp. 16–18.

Aragon-Correa, J.A., Hurtado-Torres, N., Sharma, S. and García-Morales, V.J. (2008) 'Environmental strategy and performance in small firms: a resource-based perspective', *Journal of Environmental Management,* No. 86, pp. 88–103.

Aragon-Correa, J.A., Leyva-de la Hiz, D.I. (2015) 'The Influence of Technology Differences on Corporate Environmental Patents: A Resource-Based Versus an Institutional View of Green Innovations', *Business Strategy and the Environment*, No. 25, pp. 421-434.

Arundel, A. and Kabla, I. (1998) 'What percentage of innovations are patented? Empirical estimates for European firms', *Research Policy,* No. 27, pp. 127–141.

Ariño, A., Ragozzino, R., and Reuer, J.J. (2008) 'Alliance dynamics for entrepreneurial firms', *Journal of Management Studies*, Vol. 45, No. 1, pp. 147–168.

Ayyagari, M., Demirgüç-Kunt, A. and Maksimovic, V. (2007) 'Firm Innovation in Emerging Markets', *World Bank Policy Research Working Paper* 4157, March.

Brunnermeier, S.B. and Cohen, M.A. (2003) 'Determinants of environmental innovation in US manufacturing industries', *Journal of Environmental Economics and Managemen*t, No. 45, pp. 278–293.

Busch, T. and Hoffmann, V. (2011) 'How Hot Is Your Bottom Line? Linking Carbon and Financial'´, *Performance. Business & Society*, No. 50, pp. 233–265.

Cardone, C., Casasola, M.J. and Samartín, M. (2005) 'Do banking relationships improve credit conditions for Spanish SMEs', *Business Economics Working Paper,* 05/28/.

Carrillo-Hermosilla, J. (2006) 'A Policy Approach to the Environmental Impacts of Technological Lock-In', *Ecological Economics*, Vol. 58, No. 4, pp. 717–742.

Carrillo-Hermosilla, J., del Río, P. and Könnölä, T. (2010) 'Diversity of eco-innovations: Reflections from selected case studies', *Journal of Cleaner Production*, No. 18, pp. 1073–1083.

Cohen M., Fenn S. and Naimon J. (1995) 'Environmental and financial performance: are they related?', *Working paper*. Vanderbilt University, Nashville.

Cooke, P. (2011) 'Transition regions: Regional–national eco-innovation systems and strategies', *Progress in Planning*, Vol. 76 No. 3, pp.105-146.

Comisión Europea 2010. Europa 2020 Una estrategia para un crecimiento inteligente, sostenible e integrador, COM (2010) *Comunicación de la*

Comisión, http://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=CELEX:52010DC2020&from=ES

Crosby, M. (2007) 'Patents, Innovation and Growth', *Economic Record*, Vol. 76, No. 234, pp. 255–262.

Cousar, W.T. and Huff, S. (2011) 'The value of sustainable practices: a climate of stakeholder engagement', Int*ernational Journal of Business and Globalisation,* Vol. 7, No. 4, pp. 459-470.De Burgos-Jiménez, J. and Céspedes-Lorente, J.J. (2001) 'Environmental performance as an operations objective', *International Journal of Operations & Production Management,* Vol. 21, No. 12, pp. 1553-1572.

Dechezleprêtre, A., Glachant, M. and Ménière, Y. (2013) 'What drives the international transfer of climate change mitigation technologies? Empirical Evidence from patent data', *Environmental Resources Economics,* No. 54, pp. 161–178.

Derwall, J., Guenster, N., Bauer, R. and Koedijk, K. (2005) 'The Eco-Efficiency Premium Puzzle', *Financial Analysts Journal*, Vol. 61, No. 2, pp. 51–63.

Díaz-García, C., González-Moreno, A. and Sáez-Martínez, F.J. (2015) 'Eco-innovation: insights from a literature review', *Innovation: Management, Policy & Practice*, Vol. 17, No. 1, pp. 6–23.

Durán-Romero, G. and Urraca-Ruiz, A. (2015) 'Climate change and eco-innovation. A patent data assessment of environmentally sound technologies', *Innovation: Management, Policy & Practice*, Vol. 17 No.1, pp. 115–138.

EIO (2013) European Eco-innovation Observatory, http://www.eco-innovation.eu/images/stories/Reports/EIO_Country_Brief_2013_Spain.pdf

Ehrenfeld, J. (2005) 'Eco-Efficiency: Philosophy, Theory, and Practice', *Journal of Industrial Ecology*, No. 9, pp. 6–8.

Elkington, J. (1998) 'Partnerships from cannibals with forks: The triple bottom line of 21st-century business', *Environmental Quality Management,* Vol.8, No.1, pp. 37–51.

EPO (2015) European Patent Office, http://www.epo.org/about-us/annual-reports-statistics/statistics.html

European Commission (2016) European SMEs and the Circular Economy. European Union, Luxembourg. Doi: 10.2779/397947.

Fussler, C. and James, P. (1999) *Eco-Innovación: Integrando El Medio Ambiente En La Empresa Del Futuro,* Ed. Mundi-Prensa. Madrid. pp. 132 y ss.

Gallego-Bono, J.R. and Chaves-Avila, R. (2016) 'Innovation cooperative systems and structural change: An evolutionary analysis of Anecoop and Mondragon cases', *Journal of Business Research,* In press, doi:10.1016/j.jbusres.2016.04.051

Ghisetti, C. and Rennings, K. (2014) 'Environmental innovations and profitability: how does it pay to be green? An empirical analysis on the German innovation survey', *Journal of Cleaner Production,* No. 75, pp. 106–117.

González-Benito, O., Muñoz-Gallego, P.A. and García-Zamora, E. (2016) 'Role of collaboration in innovation success: differences for large and

small businesses', *Journal of Business Economics and Management*, Vol.17, No. 4, pp. 645-662.

Hart, S. and Ahuja, G. (1996) 'Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance', *Business Strategy and Environment*, Vol. 5, No.1, pp. 30–37.

Henriques, I. and Sadorsky, P. (1999) 'The relationship between environmental commitment and managerial perceptions of stakeholders importance', *Academy of Management Journal*, Vol. 42, No.1, pp. 87–99.

Horbach, J., Rammerb, C. and Rennings, K. (2012) 'Determinants of eco-innovations by type of environmental impact — The role of regulatory push/pull, technology push and market pull', *Ecological Economics*, No. 78, pp. 112–122.

Jensen, M. and Meckling, W. (1976) 'Theory of the firm: managerial behaviour, agency costs and ownership structure', *Journal of Financial Economics*, Vol. 3, No. 4, pp. 305–360.

Jensen, M. and Roy, A. (2008) 'Staging exchange partner choices: when do status and reputation matter?', *Academy of Management Journal*, Vol. 51, No.3, pp. 495–516.

John, A. and Nelson, F. (1984) *Linear probability, logit and probit models.* Newbury Park, CA: Sage.

Johnstone, N., Haščič, I. and Popp, D. (2010) 'Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts', *Environmental and Resource Economics*, Vol. 45, No.1, pp. 133–155.

Johnstone, N. and Labonne, (2006) 'Environmental policy. Management and R&D', *OECD Economic Studies*, No. 42, pp. 168–201.

Kammerer, D. (2009) 'The effects of customer benefit and regulation on environmental product innovation: empirical evidence from appliance manufacturers in Germany', *Ecological Economics*, No. 68, pp. 2285–2295.

Kemp, R. and Oltra, V. (2011) 'Research insights and challenges on eco-innovation dynamics', *Industry and Innovation*, No.18, pp. 249–253.

Kemp, R. and Pearson, P. (2008) Final report MEI project about measuring eco-innovation, Maastricht.

Kenji-Kondo, E. (2001) *Desarrollo de indicadores estratégicos en ciencia y tecnología: principales problemas*, ACIMED. Editorial de Ciencias Médica ECIMED (Cuba), (Published) [Journal Article (On-line/Unpaginated)].

Kesidou, E. and Demirel, P. (2012) 'On the drivers of eco-innovations: Empirical evidence from the UK', *Research Policy*, Vol. 41 No. 5, pp. 862–870.

Ketata, I., Sofka, W. and Grimpe, C. (2015) 'The role of internal capabilities and firms' environment for sustainable innovation: evidence for Germany', *R&D Management*, Vol. 45, No.1, pp. 60–75.

Lanjouw, J. and Schankerman, M. (2004) 'Patent quality and research productivity measuring innovation with multiple indicators', *The Economic Journal*, No.114, pp. 441–465.

Li, J., Chen, Z. and Schøtt, T. (2016) 'Innovation benefitting exporting: benefit enhanced by transnational networking', *International Journal of Business and Globalisation*, Vol. 16, No. 3, pp. 245-263.

Llera, E., Marco-Fondevila, M., Scarpellini, S., Aranda, J. and Aranda-Usón, A. (2013) *Nichos de empleo sostenible y emprendizaje innovador Consejo Económico y Social de Aragón*, Edición digital.

Maddala, G.S. (1983) *Limited-dependent and qualitative variables in econometrics*, New York/Cambridge: Cambridge University Press.

Marin, G. (2014) 'Do eco-innovations harm productivity growth through crowding out? Results of an extended CDM model for Italy' *Research Policy*, Vol. 43, No. 2, pp. 301–317.

Miguel-Molina, M., Merizalde-Freire, E., Peiró-Signes, A. and Segarra-Oña, M.M. (2015) 'Análisis comparativo del fomento de la eco-innovación empresarial en las Comunidades Autónomas' *Revista de Estudios Regionales*, No. 104, pp. 15–31.

Mondéjar-Jiménez, J., Segarra-Oña, M., Peiró-Signes, A., Payá-Martínez, A.M. and Sáez-Martínez, F.J. (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*, Vol. 86, No.1, pp. 238–244.

Moneva, J.M. (2007) *¿Es la responsabilidad social corporativa rentable para la empresa?*, Responsabilidad social corporativa, Barcelona, ACCID Contabilidad y Dirección, pp. 55–76.

Montabon F., Sroufe, R. and Narasimhan, R. (2007) 'An examination of corporate reporting, environmental management practices and firm performance' *Journal of Operations Management*, No. 27, pp. 998–1014.

Murillo-Luna, J.L., Garcés-Ayerbe, C. and Rivera-Torres, P. (2008) 'Why do patterns of environmental response differ? A stakeholders pressure approach', *Strategic Management Journal*, Vol. 29, No.11, pp. 1225–1240.

O'Brien, J.P. (2003) 'The capital structure implications of pursuing a strategy of innovation', *Strategic Management Journal*, No. 24, pp. 415–431.

OCDE (2005) *Manual de Oslo: guía para la recogida e interpretación de datos sobre innovación* Organización de Cooperación y Desarrollo Económicos y Oficina de Estadísticas de las Comunidades Europeas. Ed. OCDE (2005).

OECD (2013) OECD Stat (http://www.oecd.org/sti/inno/oecdpatentdatabases.htm)

Oltra, V., Kemp, R. and de Vries, F.P. (2009) *Patents as a measure for eco-innovation Cahiers du GREThA 2009-05*, Groupe de Recherche en Economie Thorique et Applique.

Ortas, E., Moneva, J.M. and Salvador, M. (2014) 'Do social and environmental screens influence ethical portfolio performance? Evidence from Europe', *Business Research Quarterly*, Vol. 17, No.1, pp. 11–21.

Paramanathan, S., Farrukh, C., Phaal, R. and Probert, D. (2004) 'Implementing industrial sustainability: the research issues in technology management', *R&D Management*, Vol. 34, No.5, pp. 527–537.

Polzin, F., Flotow, P. and Klerkx, L. (2016) 'Addressing barriers to eco-innovation: Exploring the finance mobilisation functions of institutional innovation intermediaries', *Technological Forecasting and Social Change*, No.103, pp. 34–46.

Porter, M. (1991) *America's green strategy*, Scientific American, 264.

Porter, M.E. and Van der Linde, C. (1995) 'Toward a new conception of the environment–competitiveness relationship', *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 97–118.

Potocan, V., Nedelko, Z., Peleckienė, V. and Peleckis, K. (2016) 'Values, environmental concern and economic concern as predictors of enterprise environmental responsiveness', *Journal of Business Economics and Management*, Vol. 17, No. 5, pp. 685-700.

Power, E.J. (2012) 'Sustainable developments in knitting', *International Journal of Business and Globalisation*, Vol. 9, No.1, pp. 1-11.

Przychodzen, J. and Przychodzen, W. (2015) 'Relationships between eco-innovation and financial performance – evidence from publicly traded companies in Poland and Hungary', *Journal of Cleaner Production*, Vol. 90, No.1, pp. 253–263.

Rennings, K. (2000) 'Redefining innovation – eco-innovation research and the contribution from ecological economics', *Ecological Economics*, No. 32, pp. 319–332.

Revell, A., Stokes, D. and Chen, H. (2010) 'Small business and the environment', *Business Strategy and the Environment*, No.19, pp. 273–288.

Revell, A. and Rutherfoord, R. (2003) 'UK environmental policy and the small firm: broadening the focus', *Business Strategy and the Environment*, No. 12, pp. 26–35.

Sadat Mortazavi Ravari, S., Mehrabanfar, E., Banaitis, A. and Banaitienė, N. (2016) 'Framework for assessing technological innovation capability in research and technology organizations', *Journal of Business Economics and Management*, Vol. 17, No.6, pp. 825-847.

Sáez-Martínez, F.J., Mondéjar-Jiménez, J. and Ferrari, G. (2015) 'Eco-innovation: Trends and approaches for a field of study', *Innovation: Management, Policy & Practice*, Vol. 17, No.1, pp. 1–5.

Scarpellini, S., Llera, E., Aranda, J., Marco, M. and Aranda-Usón, A. (2012) 'R&D and Eco innovation: Opportunities for Closer Collaboration Between University and Companies through Technology Centres', *Clean Technologies and Environmental Policy*, pp. 1047–1058.

Segarra-Oña, M., Peiró-Signes, A., Miret-Pastor, L. and Albors-Garrigós, J. (2011) '¿Eco-innovación, una evolución de la innovación? Análisis empírico en la industria cerámica española', *Boletín de la Sociedad Española de Cerámica y Vidrio*, Vol 50, No. 5, pp. 253–260.

Seebode, D., Jeanrenaud, S. and Bessant, J. (2012) 'Managing innovation for sustainability', *R&D Management*, Vol. 42, No. 3, pp. 195-206.

Sharma, S. and Henriques, I. (2005) 'Stakeholder influences on sustainability practices in the Canadian forest products industry', *Strategic Management Journal*, Vol. 26, No.2, pp. 159–80.

Sierzchula, W., Bakker, S., Maat, K. and Van Wee, B. (2014) 'The influence of financial incentives and other socio-economic factors on electric vehicle adoption', *Energy Policy*, No. 68, pp. 183–194.

Schiederig, T., Tietze, F. and Herstatt, C. (2012) 'Green innovation in technology and innovation management – an exploratory literature review', *R&D Management*, Vol. 42, No. 2, 180–192.

Teirlinck, P. and Spithoven, A. (2013) 'Formal R&D management and strategic decision making in small firms in knowledge-intensive business services', *R&D Management*, Vol. 43, No. 1, pp. 37–51.

Triguero, A., Moreno-Mondéjar, L. and Davia, M. (2016) 'Drivers of different types of eco-innovation in European SMEs', *Ecological Economics*, No. 92, pp. 25–33.

Valero-Gil, J., Scarpellini, S., Garcés-Ayerbe, C., Rivera-Torres, P. (2017) 'Environment and innovation in spanish business : bridging the gap between academics and practitioners', *Universia Business Review*, No. 54, pp. 90–109.

Waddock, S. and Graves, S. (1997) 'The corporate social performance—financial performance link', *Strategic Management Journal*, No. 18, pp. 303–319.

Wagner, M. (2005) 'How to reconcile environmental and economic performance to improve corporate sustainability: corporate environmental strategies in the European paper industry', *Journal of Environmental Management*, Vol. 76, No. 2, pp. 105–118.

Wagner, M. (2007) 'On the relationship between environmental management, environmental innovation and patenting: Evidence from German manufacturing firms', *Research Policy*, Vol. 36, No. 10, pp. 1587–1602.

Wagner M., Van Phu, N., Azomahou, T. and Wehrmeyer, W. (2002) 'The relationship between the environmental and economic performance of firms: an empirical analysis of the European paper industry', *Corporate Social-Responsibility and Environmental Management*, No. 9, pp. 133–46.