Is the Corporate Social Responsibility-Innovation link homogenous?: Looking for sustainable innovation in the Spanish context

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Abstract

This study examines if the relationship between Corporate Social Responsibility (CSR) and innovation is homogeneous or, on the contrary, depends on the type of CSR practice implemented and/or the type of innovation adopted. In doing so, the paper focuses on the three well known dimensions of CSR (economic, social and environmental), which is called the "three bottom line" of CSR and on the so-called "fateful triangle" of innovation, which together with the traditionally studied product and process innovation types also considers organizational innovation. The theoretical framework is based on the Resource Based View and the Knowledge Based View approaches. In order to analyse sustainable innovation in the Spanish context we look at a set of firms taking data for the 2009-2014 Spanish Community Innovation Survey. The empirical study uses random effect probit panel data methodology. The results show that, although the positive effect of CSR on innovation is confirmed for the majority of the cases, there are differences depending on the innovation type and the CSR dimension.

Keywords: Corporate Social Responsibility; Economic dimension; Social dimension; Environmental dimension; Product innovation; Process innovation; Organizational Innovation; Sustainable innovation

1. Introduction

Over last several decades, Corporate Social Responsibility (CSR) has gained relevance for practitioners, policy makers, and academics in the management field (Bocquet, Le Bas, Mothe, & Poussing, 2013; Alvarado-Herrera, Bigne, E., Aldas-Manzano, & Curras-Perez, 2017). CSR "is widely acknowledged as an imperative practice for organizations, resulting in greater competitive advantage and positive economic outcomes for companies (Lii, Wu, & Ding, 2013; García de los Salmones & Pérez, 2017)" Curras-Pérez, Dolz-Dolz, Miquel-Romero, & Sánchez-García, 2018; p. 733). Moreover, firms are currently subject to increasing pressure from customers to implement CSR practices (Anser, Zhang, & Kanwal, 2018). Innovation, which is a major contributor to economic development, should have social improvement as its objective. Moral values of contemporary society are changing, and firm innovation should be responsive to new shareholder demands (Sánchez-Hernández, Gallardo-Vázquez, Dziwiński, & Barcik, 2019*;* p. 1087). Therefore, innovation and CSR should advance hand in hand in order to guarantee the sustainable development of business and society. Because "companies must apply principles of CSR to their products, productive processes and practices that require changes in the technology applied, which may involve expenditure on R&D, […] CSR will be a driver of companies' innovation practices" (Gallego-Alvarez, Prado-Lorenzo, & García-Sánchez 2011; p. 1710). In the same vein, business innovation and CSR are linked to the main firm's principles (Pedersen, Gwozdz & Hvass, 2018), and various types of innovative approaches to corporate sustainability have been suggested under several headings, such as sustainability innovation, CSR innovation, sustainable innovation, social innovation or responsible research and innovation (RRI), among others (i.e., Robinson, 2009; Adams,

Jeanreanud, Bessant, Denyer, & Overy, 2016; Bocken, Rana, & Short, 2015; Pedersen et al., 2018; Nazarko, 2019).

In this context, the "European Commission has been promoting the concept of social innovation since 2010 and is running several projects to support its development" (SWD, 2019). Furthermore, "RRI has become a cross-cutting priority in EU's Horizon 2020 Framework Programme for Research and Innovation (H2020)" (Nazarko, 2019; p. 129). However, "a significant gap remains between the goals of the European Commission and the perceptions of scientific CSR academics" (European Commission, 2011*; p.* 12; Bocquet *et al.*, 2013*; p.* 642). In this vein, the agenda of the Seventh Framework Program called for more actions and developed "more ambitious goals … relating CSR to … innovation" (European Commission, 2011*; p.* 33; Bocquet *et al.*, 2013*; p.* 642). This study attempts respond to this call by analysing the relation between CSR and innovation in the Spanish context for the period 2009-2014.

Our contribution to the literature is threefold. First, although most of the existing literature seems to empirically confirm the positive effect of CSR on innovation, it has been suggested that this relationship is not homogeneous but is rather contingent on other factors (i.e., Luo & Bhattacharya, 2006; Du, Bhattacharya, & Sen, 2007; 2011; Luo & Du, 2015). However, to the best of our knowledge, this is the first paper to address this open question. This paper analyses whether the link between innovation and CSR is homogenous or, on the contrary, whether it is contingent on both the type of innovation and the CSR dimension. Second, to analyse contingencies on the relationship between innovation and CSR, we use the broadly accepted view of the "triple bottom line" (Vanelslander, 2016; Martínez-Conesa, Soto-Acosta, & Palacios-Manzano, 2017; Bohlmann, Krumbholz, & Zacher, 2018), which covers three core fields: economic, social and environmental. Although there is no consensus about the best definition of

the CSR concept, there is some degree of agreement about its multidimensional nature (Ratajczak & Szutowski, 2016; Anser et al., 2018; Gallagher, Hrivnak, Valcea, Mahoney, & LaWong, 2018) and how CSR allows firms to show their commitment to economic, social and environmental development (Guerrero-Villegas, Sierra-García, & Palacios-Florencio, 2018). However, the previous literature has failed to use a measure that includes all three dimensions (Gallagher *et al.*, 2018) and has been mostly focused on limited dimensions of CSR (i.e., Wagner, 2010; Shu, Zhou, Xiao, & Gao, 2016) and/or on a unique construct of CSR (i.e., Wagner, 2010; Mahmoud & Hinson, 2012; Luo & Du, 2015). Third, we focus on the so-called "fateful triangle" of innovation. This approach is gaining importance in the academic sphere (Ballot, Fakhfakh, Galia, & Salter, 2015) because, in addition to the widely analysed product and process innovation (i.e., Kim, Song, Sambamurthy, & Lee, 2012; Shu et al., 2016; Martínez-Conesa et al., 2017), it also considers organizational innovation.

By using random effect probit panel data methodology, our results show that although a positive effect of CSR on innovation is confirmed for the majority of cases under analysis, there are significant differences depending on the innovation type and the CSR dimension.

The reminder of this paper is structured as follows. Section 2 presents the literature review that gives support to the research hypotheses. Section 3 explains the dataset and variables. Section 4 describes the estimation procedure and methods. Section 5 presents the empirical results and discussion. Finally, the conclusions, limitations and avenues for future research are discussed.

2. Literature review

2.1. Relationship between CSR and innovation

From an empirical point of view, the previous literature has mainly confirmed the positive effect of CSR on innovation (Wagner, 2010; Mahmoud & Hinson, 2012; Luo & Du, 2015; Martínez-Conesa *et al.*, 2017; Briones, Bernal, & de Nieves, 2018; Guerrero-Villegas *et al.*, 2018). However, studies have also suggested a negative effect of CSR on innovation (Gallego-Alvarez *et al.*, 2011).

From a theoretical point of view, while some authors accept the existence of a relationship between CSR and innovation (e.g., Gallego-Alvarez et al., 2011), others highlight the difficulty of finding an acceptable theory to explain this link (Ratajczak & Szutowski, 2016). Consistent with Gallego-Alvarez *et al.* (2011) and Luo & Du (2015), this relationship can be explained by a joint integration of the Resources Based View (RVB) and the Knowledge Based View (KBV).

The RVB considers the firm as a unit of resources and capabilities creating competitive advantages and fostering firm performance (Barney, 1991). As CSR practices promote the development of a firm's intangible resources, social responsibility practices develop capabilities that lead them to obtain sustained competitive advantages (Gallego-Alvarez *et al.*, 2011).

Due to the weaknesses of the RVB in explaining the distinction between general resources and knowledge-based capabilities (Grant, 1996), we complemented this theoretical analysis with the KBV, which considers that firms are able to integrate and distribute knowledge (Grant, 1996). CSR practices allow firms to develop networks and strong relations with their stakeholders (Jansen, Van Den Bosch, & Volberda, 2016). As socially responsible firms, they must recognize the importance of each stakeholder and incorporate this knowledge into their strategy (Gras-Gil, Palacios Manzano, & Hernández Fernández, 2016). In this sense, CSR allows the inflow of external

knowledge to the firm, which broadens the firm's knowledge base (Luo & Du, 2015), resulting in new ideas (Katila & Ahuja 2002) and making firms more innovative.

Based on these arguments, we formulate the following hypothesis (see figure 1):

H1: CSR practices have a positive impact on innovation.

Figure 1 here

2.2. Factors affecting the CSR–innovation relationship

Although the majority of prior research seems to empirically confirm the positive effect of CSR practices on innovation, this relationship is not homogeneous; rather, it is dependent on other factors (i.e., Luo & Bhattacharya, 2006; Du *et al.*, 2007; 2011; Luo & Du, 2015), such as the type of CSR practices and the type of innovation. As previously noted by Bocquet *et al.* (2013), most existing studies (i.e., Wagner, 2010; Gallego-Alvarez *et al.*, 2011; Mahmoud & Hinson, 2012; Luo & Du, 2015) have focused on a multidimensional construct of CSR practices and have not considered different types of innovation. Only previous anecdotal empirical evidence exists on this issue. Kim *et al.* (2012) confirm the existence of differences on the CSR-link depending on the type of CSR practice. They studied the effect of six different CSR practices on innovation: human rights, human resources, environment, business behaviour, community involvement and corporate governance. These authors found that the positive effect of CSR on innovation was only for the case of human rights, whereas a negative effect was confirmed for corporate governance and no effect was found for the other CSR practices. Shu *et al.* (2016) confirmed the existence of differences in the CSR–innovation link depending on the innovation type adopted. They found that the effect of green management is stronger with radical than with incremental product innovations. Last, Bocquet *et al.* (2013; 2017) confirmed that strategic orientation

towards CSR causes firms to be more innovative in terms of processes, as well as product and process innovations together. However, a responsive CSR attitude (the most basic level of CSR) has a negative effect on process (Bocquet *et al.*, 2013; 2017), product (Bocquet *et al.*, 2017) and both product and process innovation (Bocquet *et al.*, 2017). Taking into account the limitations of the previous literature, we focus on the intersection of the "fateful triangle" of innovation and the so-called "triple bottom line" of CSR.

The "fateful triangle" of innovation concept developed by Ballot *et al.* (2015) considers organizational innovations together with product and process within firms' innovation strategies (i.e., Ballot *et al.*, 2015; Guisado-Gonzalez Tiu Wright, & Guisado-Tato, 2017). Although in the previous literature "the default innovation type is product or process,… another key type of innovation … encompasses human resource practices, operational practices such as logistics, and external relationships such as alliances" (Cozzarin, 2017*; p.* 405): organizational innovation, which was included in the CIS survey in 2005. It is commonly recognized that effective organizational innovation is a key factor in fostering the efficient use of product and process innovations (Piva & Vivarelli, 2002). In this vein, the "fateful triangle" perspective suggests that organizational innovation is a necessary condition to introduce product and process innovations (Armbruster, Bikfalvi, Kinkel, & Lay, 2008), as its structure, knowledge management practices and collaborative relationships are important managerial factors that foster innovation. Product innovation consists of the introduction into the market of new or significantly improved goods or services with respect to basic features, technical specifications, embedded software or intangible other components, desired purposes or benefits (OECD, 2005). They are"the result of searching for technological competitiveness and are market-oriented innovations" (Carboni & Russu, 2018*; p.* 202).

Process innovations are the implementation of new or significantly improved production processes and marketing efficiency, distribution methods or support activities for goods and services (OECD, 2005; Carboni & Russu, 2018). Finally, an organizational innovation is the implementation of new organizational methods in the internal operation of a company (including knowledge management), new workplace organization or external relations that have not been previously used by the firm (OECD, 2005) and that are normally linked to new managerial and working practices (Damanpour, 1987).

The contemporary approach towards CSR "implies that businesses have responsibilities beyond profit-seeking and must to conduct their businesses in a manner that meets also social and environmental standards according to the triple bottom line (Elkinton, 1994)" (Sánchez-Hernández *et al.*, 2019; p. 1087). This approach, which is largely accepted by both practitioners and academics (i.e., Sarkar & Searcy, 2016; Vanelslander, 2016; Martinez-Conesa *et al.*, 2017; Bohlmann *et al.*, 2018; Chowdhury, Choi, Ennis, & Chung, 2018), "gives equal weight to economic, environmental, and social dimensions" (Hussain, Rigoni, & Orij, 2018*; p.* 411). From this perspective, consistent with Du *et al.* (2011*; p.* 1528), CSR can be defined as "a firm's commitment to maximize long-term economic, societal and environmental well-being through business practices, policies, and resources" (Alvarado-Herrera *et al.*, 2017*; p.* 245; Currás-Péres *et al.*, 2018*; p.* 735). To the best of our knowledge, no previous studies have addressed the intersection of this so called "triple bottom line" of CSR and different innovation types.

The aim of the **economic dimension** of CSR is to achieve harmonic development (Sánchez-Hernández *et al.*, 2019). It "refers to society's expectations that the firm will be profitable in the long term, and obtain utilities as incentives and rewards for its efficiency and effectiveness by producing and selling quality goods and services

(Alvarado-Herrera *et al.*, 2017)" (Curras-Pérez et al., 2018*; p.* 735). First, when firms are looking to increase their efficiency, they tend to improve their process through cost-cutting practices. These practices lead firms to develop new or improved processes (Bocquet *et al.*, 2013; Chowdhury *et al.*, 2018). Second, all of the internal changes required to improve efficiency can foster the development of unique organizational capabilities (organizational innovations) (Bocquet *et al.*, 2013). Finally, when firms are looking for efficacy, they look for new forms of responding to customer demands, maintaining their competitiveness in the market or increasing their profits. All of these practices will reinforce product innovation as a mechanism for improving the competitive advantage of firms, one of the most relevant elements of the economic CSR dimension (González Padrón, Hult, & Calantone, 2008). Therefore, we expect the economic CSR dimension to positively affect product, process and organizational innovation. Thus, hypotheses 2a, 2b and 2c are stated as follows:

H2a: The effect of the economic CSR dimension on product innovation is positive.

H2b: The effect of the economic CSR dimension on process innovation is positive.

H2c: The effect of the economic CSR dimension on organizational innovation is positive.

The aim of the **social dimension** of CSR is to reduce inequalities (Sánchez-Hernández et al., 2019). It "refers to the relationship of the firm with its socio-cultural environment" (Currás-Pérez *et al.*, 2018*; p.* 735). It is related to practices aimed at hiring people in danger of social exclusion, improving employees' living and working conditions (i.e., reconciling professional and social life, protecting employees' health and work safety), involvement with the professional development of employees, maintenance and improving standards of living and supporting social issues, and avoiding discrimination and violations of human rights (Martin & Aroca, 2016). The

relation between social CSR practices and innovation is mainly based on their role as important factors in the attraction and retention of talented workers (Kim & Park, 2011). Social CSR initiatives can improve a company's reputation and promote its positive image (Cavazotte & Chang, 2016), increasing the company's capacity to attract the most talented and innovative workers available in the labour market (Kim & Park, 2011; Guerrero-Villegas *et al.*, 2018). This can be strategic for companies (Cavazotte & Chang, 2016) as the knowledge and skills of these kinds of workers have been systematically related to company performance, leading to better innovation (product, process and organizational) (Bocquet *et al.* 2013; Cavazotte & Chang, 2016). Furthermore, social CSR practices can promote positive employee sentiment and increase employee loyalty, thereby improving employee performance, as well as engendering organizational effectiveness in a firm (organizational innovations) (McWilliams, Siegel, & Wright, 2006). Based on these arguments, hypotheses 3a, 3b and 3c are formulated as follows:

H3a: The effect of the social CSR dimension on product innovation is positive.

H3b: The effect of the social CSR dimension on process innovation is positive.

H3c: The effect of the social CSR dimension on organizational innovation is positive.

Last, the aim of the **environmental dimension** of CSR is to preserve a healthy and balanced environment (Sánchez-Hernández *et al.*, 2019). It refers to the impact that companies can have on nature, ecosystems, the Earth, air and waste (Martin & Aroca, 2016). Environmental CSR practices are related to making the optimum use of natural resources; improving waste management; minimizing ecological externalities in production processes; promoting eco-friendly products; and/or introducing processes to reduce pollution, resource depletion and even environmental damage, among others (Choi & Ng., 2011). In terms of the effect of the environmental CSR dimension on

innovation, developing environmentally friendly processes and products requires firms to be more innovative (Bocquet *et al.*, 2013). Environmental CSR practices cause firms to pay close attention to government policies, customers and public interests (Luo & Du 2012). All of this information flowing from outside a firm fosters innovative product development (Shu *et al.*, 2016). In the same vein, sustainable firms must adopt innovation in processes and products in order to increase energy efficiency and reduce the consumption of materials (Bansal & Roth, 2002), and the impact of the use of products/services on the environment, as well as CO2 emissions, among others. Blattel-Mink (1998) suggests that environmental innovations could result in the creation and introduction of new products, new systems and new markets. Wagner (2010) notes how environmental activities can enable environmental product differentiation. However, the effect of the environmental CSR dimension on organizational innovations could potentially be compromised for two main reasons. The first is that these types of practices may cause tension and conflict with an internal logic of work efficiency (Fiss & Zajac, 2006). Second, environmental CSR practices should be promoted by legal regulations (Golebiowsky & Lewandowska, 2015), and imposed practices increase bureaucracy and set lower standards than firms would set for themselves (Bocquet *et al.*, 2013). Therefore, these facts would limit the possibility of developing organizational innovation. Thus, we formulate the following hypotheses:

H4a: The effect of the environmental CSR dimension on product innovation is positive.

H4b: The effect of the environmental CSR dimension on process innovation is positive.

H4c: The effect of the environmental CSR dimension on organizational innovation is negative.

(see figure 2).

Figure 2 here

3. Methods

3.1. Research methodology

The research method used to test our hypotheses is quantitative for two main reasons. First, quantitative research highlights quantification in the collection and analysis of data (Bryman & Bell, 2003) and relies on quantitative information (i.e., numbers and figures) (Blumberg, Cooper, & Schindler, 2014). Second, quantitative research is the most appropriate for testing hypotheses and analysing how one variable affects another (Blumberg et al., 2014).

To test the research hypotheses developed regarding the effect of different CSR dimensions of innovation types, we regress each innovation type (product, process and organizational) on the CSR dimensions and a group of innovation factors. For this estimation, we use panel data with a probit random effects model. First, we select panel data due their benefits listed in the literature (Hsiao, 1985; 1986; Klevmarken, 1989; Solon, 1989; Baltagi, 2002*; p.*5) as controlling for individual heterogeneity or allowing for identification and measurement of effects that are simply not detectable in pure cross-section on pure time-series data, among others. Second, we use a random effects probit model due to its advantages regarding a fixed-effect probit estimation (Hsiao, 2003; Badillo & Moreno, 2016) as overcoming the "incidental parameter problem", being appropriate to random samples from large populations or allowing for the treatment of omitted factors.

The model specification is as follows (Frees, 2004; Badillo & Moreno, 2016):

$$y^*_{it} = \alpha_i + X'_{it}\beta + \varepsilon_{it} \qquad (1)$$

where y^*_{it} is the latent variable that represents whether firm i introduced an innovation (product, process or organizational) in year t. The term α_i represents the random effects and β the fixed effects that are the vector parameters of the observable characteristics of the firm (x_{it}). ε_{it} is a time-specific error term that is distributed as N (0,1).

To ensure that the significance of the regression equation was not solely caused by the control variables, hierarchical regressions were run. Due to space constraints, only full models are reported[1].

3.2. Dataset

The empirical section uses data from the Spanish Survey of Innovation in Companies for the period 2009–2014, available in the Technology Innovation Panel (PITEC), which is part of the Community Innovation Survey (CIS). The objective of these surveys is to collect data on firms' innovative behaviour following the methodological guidelines of the Oslo Manual (OECD, 2005). After cleaning the dataset, there are 57,008 observations in total.

3.3. Measures and control variables

Innovation measures (dependent variables)

To test for the existence of differences regarding the effect of CSR on innovation, we use the three different innovation types identified in the "fateful triangle" model (Ballot *et al.*, 2015): product, process and organizational innovation. In line with the previous literature (i.e., Karlsson & Tavassoli, 2016; Criscuolo, Laursen, Reichstein, & Salter, 2017) $Product_{it}$, $Process_{it}$ and $Organizational_{it}$ are dummy variables that take the value 1 when firm i has introduced a product, process or organizational innovation over the two previous years, respectively, and 0 otherwise.

CSR measures (independent variables)

The process of measuring CSR is not free of complexity (Martinez-Conesa *et al.*, 2017). A wide variety of measures can be found in the previous literature due to the diversity of data used, such as KLD data (i.e., Wagner, 2010; Luo & Du, 2015); the Dow Jones Sustainability

[1] Partial models are available from the authors upon request.

Index (DJSI) (i.e., Gallego-Alavarez *et al.*, 2011), firms' own surveys with choice instruments (i.e., Shu *et al.*, 2016; Martinez-Conesa *et al.*, 2017; Curras-Pérez *et al.*, 2018), or secondary surveys (i.e., Bocquet *et al.*, 2013; 2017). In this paper, the variables used to measure CSR are organized into three groups, as they are related to the economic, social or environmental dimensions of CSR. They have been selected on the basis of a careful literature review that has utilized similar items. In more concrete terms, the CSR variables are adapted from the CSRConPerScale developed by Alvarado-Herrera *et al.* (2017) and used in the recent paper by Curras-Pérez *et al.* (2018), combined with other items used in the previous literature (i.e., Kim *et al.*, 2012; Chowdhury *et al.*, 2018).

- Economic CSR: improving the quality of products (goods and services) ($Quality_{it}$); increasing the production capacity ($Prodcapacity_{it}$); increasing the flexibility of production ($Prodflexibility_{it}$); and increasing the market share ($Marketshare_{it}$). Firms were asked to rate the importance of these items of economic CSR objectives in terms of relevance to innovation development on a 4-point scale (1-4).
- Social CSR: improving workplace conditions with regard to health and safety ($Healthsafety_{it}$); retaining employees ($Retainemploy_{it}$); increasing the number of employees ($Employ_{it}$); and increasing qualified number of employees ($Qualiemploy_{it}$). Firms were asked to rate the importance of these items of social CSR objectives in terms of relevance to innovation development on a 4-point scale (1-4).
- Environmental CSR: decreasing the environmental impact ($Envimpact_{it}$), decreasing materials per unit produced ($Materials_{it}$), and decreasing energy consumption ($Energy_{it}$). Firms were asked to rate the importance of these items of environmental CSR objectives in terms of relevance to innovation development on a 4-point scale (1-4).

Control variables

As a firm's innovation is also affected by firm characteristics related to both innovation and general characteristics (Cassiman & Veugelers, 2006; Schmiedeberg, 2008; Catozzella & Vivarelli, 2014), the empirical model also includes this type of variable, selected from previous papers that have studied the determinants of innovation (i.e., Peters, 2009; Karlsson & Tavassoli, 2016; Criscuolo *et al.*, 2017). We include a set of control variables to ensure that the results are not biased (Blumberg et al. 2014).

The first group of variables measures expenditures on different innovation activities and cooperation:

- Internal R&D expenditures ($Irdex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred internal R&D expenditures in year t, and 0 otherwise.
- External R&D expenditures ($Erdex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred external R&D expenditures in year t, and 0 otherwise.
- Training expenditures ($Trainex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred employee training expenditures in year t, and 0 otherwise.
- Machinery acquisition expenditures ($Machex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred expenditures for the acquisition of machinery, equipment or software in year t, and 0 otherwise.
- Market introduction expenditures ($Markiex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred expenditures for the introduction of innovation in the markets in year t, and 0 otherwise.
- External knowledge acquisition expenditures ($Eknowex_{it}$) is a dummy variable that takes a value of 1 when firm i has incurred expenditures for external knowledge in year t, and 0 otherwise.
- Cooperation ($Coop_{it}$) is a dummy variable that takes a value of 1 when firm i has engaged in collaborative agreements with other firms or institutions in year t, and 0 otherwise.

Characteristics in the second group, general firm characteristics, are measured as follows. Similar to the study of Guisado-Gonzalez *et al.* (2017), export (Export Intensity$_{it}$) is measured as the turnover from exports as a percentage of total turnover for firm i in year t. Group (Group$_{it}$) is a dummy variable that takes a value of 1 when firm i belongs to a group in year t, and 0 otherwise, as in Catozzella & Vivarelli (2014) and Criscuolo *et al.* (2017). Size (Size$_{it}$) is measured as the log of firm's i employees in year t, similar to previous research in the innovation field (i.e., Catozzella and Vivarelli, 2014; Karlsson and Tavassoli, 2016; Criscuolo et al., 2017; Hervas Oliver et al., 2017; Carboni & Russu, 2018). Finally, a set of forty-three industry dummies (defined following the NACE 2009 two-digit-level classification), as well as six time-specific dummy variables, are included to control for sector and time effects, respectively.

4. Results and discussion

Descriptive statistics and correlations for independent variables are shown in Table 1. As high and significant values of two pairwise correlations ($r > 0.7$) can point to multicollinearity problems, both the Variance Inflation Factors (VIF) and the Condition Indexes (CI) for each of the independent variables have been carried out. The results suggest that multicollinearity is not a concern because all the VIFs range between 1.03 and 4.09 and all CIs are lower than 30 (Myers, 1990).

Table 1 here

Table 2 summarizes the results of the regression analyses.

Table 2 here

Regarding control variables, a group of controls have a positive and significant effect for all the innovation types in the majority of the models ($Trainex_{it}$, $Machex_{it}$, $Coop_{it}$ and $Size_{it}$). On the other hand, some variables are only significant for specific innovation types – $Irdex_{it}$, $Erdex_{it}$ and $Markiex_{it}$ – for both product and organizational innovation in the majority of the models; Export $Intensity_{it}$ has a negative and significant effect on organizational innovation.

Following the general effect of CSR on innovation, the results show that H1 is only partially supported, since its positive effect on the three innovation types is not confirmed for the three CSR dimensions analysed. This result is of considerable importance, as it confirms our main research question: the link between CSR and innovation is not homogeneous but is rather dependent on the type of innovation and the dimension of CSR.

The effect of each dimension of CSR on the three types of innovation considered (product, process and organizational innovation) is tested as stated on hypotheses 2, 3 and 4. Starting with the economic dimension, the results show a positive effect of $Quality_{it}$, $Prodflexibility_{it}$ and $Marketshare_{it}$, on product innovation, supporting H2a. Hypothesis H2b is only partially supported, as only $Prodcapacity_{it}$ and $Prodflexibility_{it}$ have a positive effect on process innovation whereas the effect of $Quality_{it}$ and $Marketshare_{it}$, on process innovation is negative. Hypothesis H2c is accepted, as the effect of $Quality_{it}$, $Prodcapacity_{it}$ and $Prodflexibility_{it}$ on organizational innovation is positive. As far as the social CSR dimension is concerned, the effect of $Healthsafety_{it}$ and $Qualiemploy_{it}$ on product innovation is positive, confirming H3a. H3b is only supported for $Qualiemploy_{it}$. However, the effect of $Healthsafety_{it}$ and $Retainemploy_{it}$ is negative. Hypothesis H3c is also only partially supported. Although the effect of three

variables ($Healthsafety_{it}$, $Employ_{it}$ and $Qualiemploy_{it}$) on organizational innovation is positive, the effect of $Maintainemploy_{it}$ is negative.

Lastly, the results related to the environmental CSR dimension show a positive effect of the variable $Envimpact_{it}$ on product innovation, whereas the effect of $Materials_{it}$ is negative. Therefore, hypothesis H4a is only partially confirmed. Hypothesis H4b is confirmed for the variable $Energy_{it}$, as its effect on process innovation is positive. Finally, hypothesis 4c is rejected, because none of the variables related to the environmental CSR dimension have a significant effect on organizational innovation.

Taken together, six variables related to CSR have a positive impact on product innovation. The economic CSR is the dimension that has a more positive impact on product innovation (3 variables), followed by the social CSR dimension (2 variables). However, the effect of the environmental CSR dimension is mixed: the effect of $Envimpact_{it}$ is positive and the effect of $Materials_{it}$ is negative.

Regarding process innovation, four variables related to CSR have a positive impact, and four variables impact it negatively. The economic and social dimensions have a more positive impact (2 variables) followed by the environmental (1 variable) and social dimensions (1 variable). $Quality_{it}$ and $Marketshare_{it}$ (economic dimension) and $Healthsafety_{it}$ and $Retainemploy_{it}$ (social dimension) negatively impact process innovation.

Finally, six variables related to CSR have a positive effect on organizational innovation. Economic CSR is the dimension that has a more positive impact on process innovation (3 variables). The effect of the social dimension on organizational innovation is mixed with three variables that have a positive impact, and $Maintainemploy_{it}$ whose effect is negative.

Therefore, the economic and social dimensions are those that more intensely improve innovation, whereas the environmental dimension has a very limited effect as a driver of any of the three innovations types under consideration. As Dermirel & Kesidou (2011*; p.* 1554) assert, this result shows that "while environmental awareness and protection is an important foundation for CSR, the costly nature of environmental protection and the externalities associated with these expenditures appear to get in the way of CSR as a powerful driver for environmental protection". On the other hand, the results highlighted previously confirm that the link between CSR and innovation is not homogeneous as suggested by the previous literature (Luo & Bhattacharya, 2006; Du *et al.*, 2007; 2011; Bocquet *et al.*, 2013; 2017; Kim *et al.*, 2012; Luo & Du, 2015; Shu *et al.*, 2016). Moreover, they show that some CSR practices have the opposite effect depending on the innovation type. This is the case of $Quality_{it}$ and Healthsafety (positive effect on product and organizational innovation and negative effect on process innovation) and Marketshare (positive effect on product innovation and negative on process innovation).

Taking together and to summarize all these results, Table 3 shows that the positive effect of CSR on innovation is found in 48.49% of the cases analysed. This result, consistent with most previous empirical literature (Sánchez-Hernández *et al.*, 2019), suggests that CSR can provide opportunities for innovation. However, consistent with Gallego-Alvarez *et al.* (2011), a negative effect of CSR on innovation is also confirmed by the data in our sample for 18.18% of cases, suggesting that those CSR practices are not useful in promoting innovation. This is the case of $Retainemploy_{iy}$ and $Materials_{it}$, whose effect is negative or not significant for all innovation types.

Table 3 here

5. Conclusions

The aim of this paper is to study the effect of CSR on innovation within the Spanish context for the period from 2009-2014. It contributes to previous research by analysing whether the CSR–innovation link is homogeneous or dependent on the type of innovation and the CSR dimension. In doing so, it focuses on the "fateful triangle of innovation and the "triple bottom line" of CSR.

Although the importance of CSR for firm innovation has been previously recognized in the literature, the results of this study point to the need for additional evidence on the effect that different dimensions of CSR (economic, social and environmental) have on different types of innovation (product, process and organizational). In this sense, consistent with the works of Wagner (2010), Mahoud and Hinson (2012) and Martínez-Conesa *et al.* (2017), the positive effect of CSR on innovation is confirmed for the majority of cases analysed. Therefore, CSR can play a significant role in contributing to sustainable development while enhancing firms´ innovation (Sánchez-Hernández *et al.*, 2019*; p.* 1099). Moreover, the CSR–innovation link has been demonstrated to be non-homogenous; it depends rather on the innovation type and the CSR dimension, which gives additional support to previous research (Bocquet *et al.*, 2013; 2017; Kim *et al.*, 2012; Su *et al.*, 2016).

The results of this study have practical implications for managers in the business environment and serve as a guide for developing more appropriate CSR strategies in order to foster innovation. Regarding this issue, this study suggests that firms interested in pursuing product and organizational innovation should rely more on economic and social dimensions of CSR. However, firms more oriented towards process innovation

should pay special attention to individual CSR practices, because several variables have been found to discourage innovation.

Taken together, practices related to the economic dimension of CSR have been proven to contribute more to fostering innovation. More attention should be paid to practices related to the social CSR dimension, as the results are mixed with both positive and negative effects on innovation. Finally, practices related to the environmental dimension of CSR seems to have a limited effect on innovation. This indeed has important implications for environmental innovation policy and "poses questions on how much we can rely on the corporate goodwill and voluntary compliance in environmental matters" (Demirel & Kesidou, 2011*;* p. 1554).

Although this study suggests that more research is needed to develop a more nuanced understanding of the link between different types of innovation and different types of CSR practices, companies wishing to promote corporate social innovation should pay special attention to the different types of CSR practices.

This study can also serve as an interesting guide for developing research in the theoretical sphere in the academic field. In line with the theoretical assumptions of the RBV and the KBV, the empirical evidence suggests that CSR practices allow firms to develop strong relations with their stakeholders (Jansen *et al.*, 2016), as well as integrate and distribute knowledge (Grant, 1996), facilitating the development of networks and the inflow of external knowledge (Luo & Du, 2015), thereby fostering the development of new ideas (Katila & Ahuja 2002).

This study is not without limitations. First, as the sample data only cover Spanish firms, the results might not be generalizable to other countries. Second, the type of data source used has conditioned the way in which the variables have been constructed. Third, we have focused on the individual effect that each CSR dimension has on firm innovation;

however, we have not considered whether these dimensions of CSR can reinforce each other.

In light of these limitations, the following avenues of future research are suggested. First, we suggest extending the analysis to other countries. Second, it could also be of interest to develop a survey that allows for the measurement of all the variables in a more appropriate way. Third, future research should take into account complementarities between the CSR dimensions in fostering innovation.

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Table 1: Correlation matrix

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. $Irdex_{it}$	0.429	0.495																				
2. $Erdex_{it}$	0.204	0.403	0.450***																			
3. $Trainex_{it}$	0.106	0.308	0.237***	0.209***																		
4. $Machex_{it}$	0.130	0.336	0.134***	0.130***	0.310**																	
5. $Markiex_{it}$	0.161	0.367	0.359***	0.233***	0.2669***	0.235***																
6. $Eknowex_{it}$	0.015	0.122	0.058***	0.083***	0.1643***	0.148***	0.115***															
7. $Coop_{it}$	0.123	0.328	0.283***	0.253***	0.142***	0.099***	0.125***	0.058***														
8. Export $Intensity_{it}$	1.949	1.668	0.112***	0.055***	0.008***	-0.005	0.037***	0.0006***	0.066***													
9. $Group_{it}$	0.424	0.494	0.083***	0.127***	0.061***	0.089***	0.066***	0.046***	0.121***	0.001												
10. $Size_{it}$	4.066	1.762	0.081***	0.126***	0.102***	0.151***	0.097***	0.076***	0.103***	-0.073***	0.446***											
11. $Quality_{it}$	3.073	1.127	0.346***	0.174***	0.131***	0.081***	0.195***	0.052***	0.129***	0.039***	0.032***	0.050***										
12. $Prodcapacity_{it}$	3.073	1.127	0.192***	0.114***	0.173***	0.176***	0.107***	0.061***	0.095***	-0.019***	0.064***	0.130***	0.431***									
13. $Prodflexibility_{it}$	2.744	1.080	0.159***	0.093***	0.168***	0.167***	0.104***	0.062***	0.080***	-0.016**	0.080***	0.155***	0.393***	0.720***								
14. $Marketshare_{it}$	2.802	1.162	0.375***	0.180***	0.115***	0.046***	0.227***	0.049***	0.128***	0.069***	0.052***	0.017***	0.647***	0.376***	0.330***							
15. $Healthsafety_{it}$	2.306	1.195	0.282***	0.174***	0.128***	0.078***	0.138***	0.035***	0.097***	0.005	0.074***	0.125***	0.430***	0.421***	0.393***	0.402***						
16. $Mantainemploy_{it}$	2.375	1.201	0.326***	0.192***	0.154***	0.067***	0.163***	0.032***	0.146***	0.035***	0.004	0.010**	0.441***	0.399***	0.361***	0.463***	0.504***					
17. $Employ_{it}$	1.894	0.955	0.294***	0.180***	0.132***	0.044***	0.132***	0.027***	0.127***	0.031***	0.030***	0.032***	0.386***	0.373***	0.331***	0.431***	0.478***	0.668***				
18. $Qualiemploy_{it}$	2.033	1.053	0.318***	0.198***	0.164***	0.058***	0.154***	0.046***	0.144***	0.041***	0.038***	0.049	0.415***	0.397***	0.360***	0.439***	0.503***	0.691***	0.857***			
19. $Envimpact_{it}$	2.154	1.086	0.2455***	0.245***	0.089***	0.081***	0.120***	0.032***	0.091***	0.027***	0.091***	0.108***	0.375***	0.504***	0.472***	0.385***	0.522***	0.401***	0.405***	0.409***		
20. $Materials_{it}$	2.177	1.100	0.383***	0.238***	0.097***	0.091***	0.111***	0.037***	0.105***	0.009	0.104***	0.133***	0.372***	0.512***	0.471***	0.364***	0.569***	0.418***	0.419***	0.429***	0.797***	
21. $Energy_{it}$	2.348	1.193	0.299***	0.299***	0.117***	0.072***	0.134***	0.040***	0.142***	0.004	0.097***	0.134***	0.417***	0.376***	0.342***	0.389***	0.771***	0.479***	0.453***	0.469***	0.521***	0.596***

Statistical significance: at *** 1%, ** 5% and * 10%

Table 2. Random Effects Probit estimations results (marginal effects) for product innovation, process innovation and organizational innovation

	Product innovation	**Process innovation**	**Organizational innovation**
$Irdex_{it}$	0.313 (0.049)***	-0.221 (0.048)***	0.207 (0.042)***
$Erdex_{it}$	0.092 (0.046)**	-0.031 (0.043)	0.220 (0.037)***
$Trainex_{it}$	0.111 (0.059)*	0.677 (0.059)***	0.351 (0.044)***
$Machex_{it}$	-0.172 (0.048)***	1.425 (0.059)***	0.219 (0.037)***
$Markiex_{it}$	2.191 (0.073)***	0.045 (0.038)	0.184 (0.033)***
$Eknowex_{it}$	0.247 (0.160)	-0.012 (0.141)	-0.047 (0.107)
$Coop_{it}$	0.314 (0.052)***	0.430 (0.049)***	0.159 (0.043)***
Export $Intensity_{it}$	-0.010 (0.01)	-0.012 (0.013)	-0.036 (0.011)***
$Group_{it}$	0.011 (0.057)	0.030 (0.053)	0.668 (0.048)
$Size_{it}$	0.061 (0.022)***	0.231 (0.022)***	0.190 (0.020)***
Sector dummies	Yes	Yes	Yes
Time dummies	Yes	Yes	Yes
Economic CSR practices			
$Quality_{it}$	0.157 (0.023)***	-0.130 (0.023)***	0.041 (0.020)**
$Prodcapacity_{it}$	-0.027 (0.026)	0.434 (0.025)***	0.144 (0.021)***
$Prodflexibility_{it}$	0.114 (0.026)***	0.221 (0.025)***	0.073 (0.021)***
$Marketshare_{it}$	0.253 (0.023)***	-0.068 (0.023)***	0.008 (0.20)
Social CSR practices			
$Healthsafety_{it}$	0.045 (0.027)*	-0.048 (0.025)*	0.1344 (0.002)***
$Mantainemploy_{it}$	-0.042 (0.039)	-0.081 (0.037)**	-0.089 (0.031)***
$Employ_{it}$	0.081 (0.037)**	0.037 (0.035)	0.105 (0.029)***
$Qualiemploy_{it}$	-0.007 (0.024)	0.0512 (0.022)**	0.051 (0.019)***
Environmental CSR practices			
$Envimpact_{it}$	0.055 (0.029)*	0.044 (0.028)	0.036 (0.024)
$Materials_{it}$	-0.074 (0.031)**	-0.011 (0.029)	-0.011 (0.025)
$Energy_{it}$	0.013 (0.027)	0.044 (0.025)*	-0.018 (0.022)
σ	1.434 (0.040)	1.355 (0.036)	1.319 (0.032)
ρ	0.673 (0.122)	0.647 (0.012)	0.635 (0.011)
Wald Chi2	1912.17 (0.0000)	2421.48 (0.0000)	1462.97 (0.0000)
Log Likelihood	-7252.236	-7755.2131	-9697.3141

Statistical significance: at *** 1%, ** 5% and * 10% (standard errors in brackets)

Table 3. Summary of results

CSR dimension	Variables	Product innovation			Process innovation			Organizational innovation			TOTAL		
		+ effect	- effect	n.s.	+ effect	- effect	n.s.	+ effect	- effect	n.s.	+ effect	- effect	n.s.
Economic	4	3	0	1	2	2	0	3	0	1	8	2	2
Social	4	2	0	2	1	2	1	3	1	0	6	3	3
Environmental	3	1	1	1	1	0	2	0	0	3	2	1	6
TOTAL	11	6	1	4	4	4	3	6	1	4	16	6	11