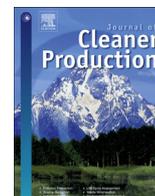




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Foreign direct investment as a way to guide the innovative process towards sustainability

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ABSTRACT

In 1972, for the first time, the term “sustainable development” was coined at the Stockholm conference, and in 1987, the Brundtland report established the sustainability-innovation “binomial”. Since then, extensive research into sustainability-oriented innovation has been conducted, focused during the last decade on SMEs and recognizing these as the main actor of sustainable development, for which foreign direct investment (FDI) is considered, from a research and institutional point of view, as a vital source, although academic literature presents conflicting conclusions. In this context, this paper aims to perform a microeconomic analysis of how FDI influences the innovative process of SMEs and how this can lead to a process oriented towards sustainability. To this end, a panel of 4667 SMEs has been analyzed, spanning a sample period between 2004 and 2013, through a binary logit model, which compares and contrasts SMEs with FDI and equivalent SMEs without FDI, over time and, therefore, exposed to a changing economy. The most significant results are that FDI is attracted mainly by factors associated with technological supply, which, when coupled with being of medium size and located in a manufacturing sector of medium-high technology, generates positive spillovers. These depend, to a large extent, on public funding, which allows these companies to be more innovative and makes it more likely they focus their innovative process on sustainability.

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1. Introduction

Can FDI make Spanish SMEs more sustainable through its influence on the innovative process? Companies can contribute to sustainable development while at the same time being successful in an increasingly dynamic and globalized market. This can be effectively achieved through innovation oriented towards sustainability (Sharma, 2002; Paramanathan et al., 2004; Schaltegger, 2011). A line of research is under development stemming from the 1987 Brundtland report, which investigates various areas in relation to sustainability-oriented innovation (Hall, 2002; Fichter and Paech, 2004; Paech, 2007; Wüstenhagen, 2008; Coenen and López, 2010; Schaltegger and Wagner, 2011).

Although, after large companies became aware that their activities can influence sustainable development so too did SMEs

(Bos-Brouwers, 2010), it should be noted that the innovative process of SMEs differs from large enterprises (Nieto and Santamaría, 2010), mainly due to a lack of economic resources and human capital (Narula, 2004). In this regard, these shortcomings can be met through FDI that provides knowledge assets (Haskel et al., 2007), external capital and management capacity, and generates new employment opportunities and facilitates technology transfer (De Gregorio, 2005; Iamsiraroj and Doucouliagos, 2015).

Moreover, in addition to filling these knowledge and capital deficiencies, sustainable development has also come under the spotlight recently (UNCTAD, 2014), as, through its positioning, FDI¹ can positively influence the well-being of societies. The scientific community's interest in the influence of this kind of investment is, therefore, being redirected, but there is a great lack of knowledge regarding the FDI-sustainability relationship (Kardos, 2014).

There is a lack of knowledge of the positive effects of FDI on innovation (Guimon, 2011; Danilovich and Croucher, 2015), its

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¹ An enterprise is considered to have foreign direct investment when the foreign participation is higher than 10%.

microeconomic influence, the reasons for its location and the internal investment it provokes (Cantwell and Mudambi, 2005).

Consequently, the questions under consideration in this paper are: What factors attract FDI to SMEs? What are the spillovers derived from their location? What elements can make SMEs more prone to innovations oriented towards sustainability?

To achieve this objective, a logit model has been used on a panel of 4667 SMEs, coming from a larger business sample, analyzed for the period 2004–2013. This panel of SMEs, in turn, has been divided into two sub-panels with the aim of comparing those with FDI with equivalent SMEs without FDI, to see what factors lead them to innovate and which do not, over time. This methodology has been chosen as it is one of the most appropriate statistical methods when the dependent variable is dichotomous, as is our case (Lee et al., 2012), and especially when it comes to innovation (Tourigny and Le, 2004; Bayona et al., 2003; Arundel, 2001).

Since most of the research conducted in analyzing the location of FDI focuses on the study of leading countries in innovation or emerging countries (Demirbag and Glaister, 2010; Kumar, 2001), this paper aims to provide a contribution that varies from the academic current, by studying the SMEs of a country classified as a “moderate innovator” by the European Innovation Scoreboard (EIS), as is the case for Spain.

To our knowledge, this is the first study to carry out such a meticulous microeconomic analysis of a moderately innovative country, linking the participation of FDI in the innovative process with sustainable development, and with such a high number of observed groups, consisting of SMEs that have survived three different economic scenarios between 2004 and 2013.

The study is structured as follows: in the next section, corresponding to the second section, the conceptual framework is established with a review of the literature. In the third section, we present the empirical study developed from an initial sample of 6890 Spanish companies in the period 2004–2013. The fourth section presents the empirical results through graphs and tables. The fifth and last section develops the conclusions derived from the study, as well as future research lines and limitations.

2. Theoretical framework

The concept of sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987: 54). Since the challenges posed in this definition include ecological, economic, and social criteria, underlying which there is subjective temporal, spatial and cultural integration, they lead us to understand sustainable innovation, as established by Charter et al. (2008), as: “A process in which sustainability considerations (environmental, social and economic) are integrated into the structure of the company, from the generation of ideas to research and development (R&D) and marketing. This applies to products, services and technologies, as well as to new business and organizational models,” evidently in a long-term perspective.

Companies striving to contribute to sustainable development are predisposed to incorporating sustainability in their activities (Labuschagne et al., 2005), offering them the chance to gain a competitive advantage (Porter and Kramer, 2007), more specifically, derived from the promotion of shared values, where the progress of society marks the success of the company (Porter and Kramer, 2011). In this context, innovation is fundamental, since it is a strategy that contributes to sustainable development, while at the same time allowing companies to benefit from the creation of new markets and segments (Fichter, 2005). This is a noteworthy factor, in the current international sphere, where competitiveness is on the rise, forcing companies to differentiate and compete

internationally, through innovation (Mcgaughey, 2002), with a special emphasis on high-technology sectors. This results in a trend that establishes the use of sustainable innovation to achieve win-win situations, interrelating economic development and sustainable development (Boons et al., 2013).

While some authors believe the realization of these innovations is not related to the size of the company (Fichter, 2005), this is not an assertion shared by all, as some consider there to be a negative relation between size and innovation related to sustainability (Schaltegger, 2005). In the case of SMEs, although they have the capacity to be prolific in terms of innovation, their lack of resources (Del Brío and Junquera, 2003), due to their size, means they have to resort to cooperation if they want to be sustainable in innovation (Boons and Roome, 2005).

In relation to this idea, Bocken (2015) states that large investments are required in sustainable enterprises. This logic implies that those companies with more business support and greater economic infrastructure, will have more chances of success (Porter and Kramer, 2011), which aligns with what the stakeholder theory tells us with regard to corporate sustainability challenges, (Matos and Silvestre, 2013).

SMEs, through sustainability-oriented innovation, can obtain a series of benefits that allow them to enjoy a competitive advantage, for which they need to be able to meet a series of requirements, as can be seen in Table 1.

It is in this context that the intervention of FDI can be decisive, since multinational corporations can amplify the social benefits, which will correlate with the purpose and values of the particular company (OCDE, 2002). More specifically, FDI can provide a number of elements that would mitigate the lack of resources and capabilities required for sustainability-oriented innovation, as well as enhance the benefits they can offer.

Its location can be decisive in assuming a stable and crisis-resistant form of financing (Lipsey, 2001), leading to benefits in terms of know-how as well as demand creation (Albulescu and Tămășilă, 2014). It is also a good catalyst for domestic investment, complements local resources and provides confidence (Agosin and Machado, 2005), which results in an improved image and, in turn, financial intermediation and credit growth (Sayek et al., 2003).

FDI leads to technological improvements and boosts income

Table 1
Sustainability oriented innovation as a competitive advantage.

	Author
Benefits	
New products and markets	Hall and Wagner (2012)
Surviving and expanding in convulsive environments	Moore and Manring (2009)
Access to long-term resources that generate more profitable production and have stable business relationships	Klewitz and Hansen (2011)
Integrate stakeholders better	Hansen and Spitzack (2010)
Lower costs of outputs and inputs	Ambec and Lanoie (2008)
More opportunities in highly competitive markets and create value	Hockerts and Wüstenhagen (2010); Horbach (2008)
Requirements	
Technological and financial capacity	Taylor et al. (2003)
Ability to manage and create alliances	Arora and Ali-Kazmi (2012)
Ability to adapt to changes in the environment	Varis and Littunen (2010)
Responding to market risk (unsatisfied demand)	Hansen and Klewitz (2012)
Responding to directional risk (Uncertainty)	Hansen et al. (2009)
Maximizing the value creation of innovation through patents	Horbach (2008)
Absorption capacity to recognize this value	Delmas et al. (2011)

Source: Compiled by author

levels (Lemoine and Ünal-Kesenci, 2004), which can have a bearing on sustainability issues through the increase in human capital and competition, by stimulating innovation in companies of the same sector (Vahter, 2010; Kneller and Pisu, 2007). In short, FDI has a positive effect on economic growth (Tvaronavičius and Tvaronavičiene, 2008).

However, as Doruk (2016) points out, there is no consensus on the positive relationship between FDI and innovation. Indeed, there is a literary trend that states that the positive effects of FDI depend on the level of technological progress, economic stability, public funding, the degree of openness and the quantity of human capital in the receiving economy (Wang and Kafourous, 2009). For their part, authors such as Huang (2013) and De Backer and Sleuwaegen (2003) believe that FDI shows an inverse relationship with innovation, since it creates technological barriers and displaces national companies.

Having established the opportunities and requirements derived from an innovative process oriented to sustainability, the next step would be to understand what reasons lead to FDI being located in certain SMEs. The local environment is relevant to location, influencing its strategic role and enabling the subsidiary to adapt its resources and capabilities to be competitive (Phene and Almeida, 2008).

The environmental factors that allow SMEs to attract FDI can be seen from two perspectives: firstly, in terms of market demand, and secondly, related to technological supply. The first perspective is based on internalization theory (Buckley and Casson, 1976; Teece, 1986; Hennart, 1989), according to which the decision on where to locate R&D in another country, is motivated by the transfer of technology from the matrix to the subsidiary, in order to exploit a company's competitive advantage. According to the Resource and Capability Theory (Prahalad and Hamel, 1990; Cantwell, 1994), multinationals, who are attracted by the second perspective, consider internationalization as a source of value creation to gain new competitive advantages, benefitting from the knowledge that destination countries can provide.

Among the factors associated with market demand are: size and market potential (Guimón, 2009; Galan et al., 2007); dynamism and competition (Sachwald, 2008; Beise, 2004); and the extent to which FDI serves as a platform to access adjacent markets (Neary, 2009). Among the factors related to technological supply would be: availability of qualified personnel (Ke and Lai, 2011; Demirbag and Glaister, 2010); access to leading research infrastructures (Chaminade and Vang, 2008); the existence of innovative dynamism as a door to collaboration between companies, universities and research centres (Link et al., 2008; Li, 2010); the existence of public funding (Tassey, 2007; Atkinson, 2007); and the extent to which FDI favours the protection of innovation through industrial property (Hagedoorn et al., 2005).

Therefore, it is necessary to know which capacities are best suited to responding to the challenges of sustainable development, such as innovation (Marcus and Anderson, 2006; Aragón-Correa and Sharma, 2003). This inherently leads us to establish which elements influence the innovative process, following the classification established above, as shown in Table 2, by collecting their theoretical effects and adding their limitations as a factor, which is fundamental to establishing the environment in which the company moves (Iammarino et al., 2009). Cost, knowledge and market factors, as well as reasons for not innovating are, therefore, variables that affect innovation.

Fig. 1 shows how the different factors involved in the innovation process interact with market demand or technological supply determining the attractiveness of FDI. Depending on the weight of each factor and how easy it is to cope with the constraints established by the environment, SMEs will decide whether or not to

innovate (Shiang and Nagaraj, 2011) and whether this process can meet all the requirements necessary for sustainability-oriented innovations and to reap all its benefits.

3. Methodology

In this section, we present the database and the sample used, the proposed economic model and the variables for responding to the stated goal.

3.1. Database and sample

For this study, we have used data from the Technological Innovation Panel (TIP) which monitors the innovative activities of Spanish companies. The database depends on Spain's National Statistics Institute (INE) and on the scheme from the Community Innovation Survey (CIS), which provides information regarding the state of innovation in the European Union and Norway. These kinds of databases have been used for analyzing innovation as, among other factors, they follow the guidelines laid out in the Oslo Manual (OCDE, 2005) and enable the comparison of innovation indicators between countries.

For this study, from the annual dataset included in the panel we have used the years included in the period 2004–2013, which provide constantly updated information of 6890 companies in operation throughout the sample period. From this initial sample, we have narrowed the group down to include only SMEs with or without FDI, setting aside public enterprises, associations and research institutions as has been detailed in Table 3.

The sample period under consideration has been divided into three important time periods of Spain's recent economic history: the period before the economic crisis (years 2004–2007), period of the economic crisis (years 2008–2011) and the beginning of the economic recovery (2012–2013). These particular periods have been chosen as most research works focused on innovation in Spanish companies have been based on a time frame of one to three years, and, as a consequence, provide an overly partial view of the subject. The added value of this study, therefore, is, precisely, the time span, which offered us a comprehensive vision of the subject of study. At the same time, the companies have been classified in two groups, FDI and NFDI, depending on whether or not the company had foreign direct investment in each of the time spans included in the sample.

3.2. Model specification

The contrast model states, as a dependent variable, that “the conduct of activities of internal innovation (R&D)” is a dichotomous variable which takes value 1 when the company undertakes activities of internal innovation and 0 when it does not promote any of these activities. As with the theoretical framework, in the empirical model we are going to deal with the propensity to innovate with regard to the factors involved in the process.

Internal innovation activities (R&D) = $f(\text{sector, export, company size, cooperation}^2, \text{protection}^3, \text{public funding, limitations})$ (1)

² Cooperation for innovation consists of active participation with other companies, suppliers, customers, competitors, consultants, universities and research centres in innovation activities. It is not necessary for the two parties to derive a commercial benefit. It excludes mere subcontracting of works without active cooperation.

³ Patents, registration of a design or industrial model, trademark and copyright are considered a system of protection.

Table 2
Influential elements in the innovative process.

Type of factor	Elements	Author	Effect on innovation
Structural	Size (TE)	Zhang et al. (2006) De Jong and Marsili (2006) Dahlander and Gann (2010) Laforet and Tann (2006)	Smaller size but more innovation Smaller size less innovation
	Sector (S)	Martínez-Román et al. (2011) Arora and Gambardella (2010) Lichtenthaler (2008) Bhaskaran (2006)	Positive
Factor of technological supply	Cooperation (C)	Afcha (2011) Tomlinson (2010) Tödtling et al. (2009) Holl and Rama (2014) Ebersberger et al. (2011)	Positive Doubt in the presence of FDI
	Protection (P)	Belderbos et al. (2004) Carlton and Gertner (2003) Arqué-Castells and Mohnen (2015)	Positive
	Public Financing (FP)	García-Vega and López (2010) Blanes and Busom (2004) Almus and Czarnitzki (2003) Filatotchev and Piesse (2009)	Positive
Market demand factor	Export (X)	Levenburg et al. (2006) Kropp and Zolin (2005) Bleaney and Wakelin (2002)	Positive
Environment (Based on limitations)			
Financial factors	Lack of funds within the company or group (K1) Lack of funding from outside sources of the company (K2) High costs of innovation (K3)	Costs and Financial Limitation	The main factor behind the innovations is cost and financial innovations, and at a second level of importance is the market factor and the lack of knowledge
Factor of technological supply	Lack of qualified personnel (K4) Lack of information on technology (K5) Difficulty of finding cooperation partners for innovation (K7)	Limitation Knowledge	
Market demand factor	Lack of market information (K6) Market dominated by established companies (K8) Uncertainty regarding the demand for innovative goods and services (K9)	Limitation Market	The limitations to innovation are complementary and not exclusive
	Not necessary due to previous innovations (K10) It is not necessary because there is no demand for innovations (K11)	Other Limitations	

Compiled by author.

Bearing in mind the nature of the dependent variable, we specify a binary logit model, using a cumulative distribution function, where the conditional probability is:

$$L_i = \ln \left[\frac{P_i}{1 - P_i} \right] = z_i \tag{4}$$

Therefore, our model for estimation would be:

$$P_i = \Pr(Y = 1|X_i) = \int_{-\infty}^{\beta'X} \varphi(z) dz = \frac{1}{1 + e^{-z}} \tag{2}$$

$$R + D_{it} = \ln \left[\frac{P_i}{1 - P_i} \right] = \alpha_0 + \sum_{j=1}^3 \beta_j S_{jit} + \varphi_1 X_{it} + \sum_{h=1}^3 \gamma_h TE_{hit} + \delta_1 C_{it} + \theta_1 P_{it} + \vartheta_i FP_{it} + \sum_{k=1}^{11} \mu_k LIM_{kit} + \varepsilon_{it} \tag{5}$$

where

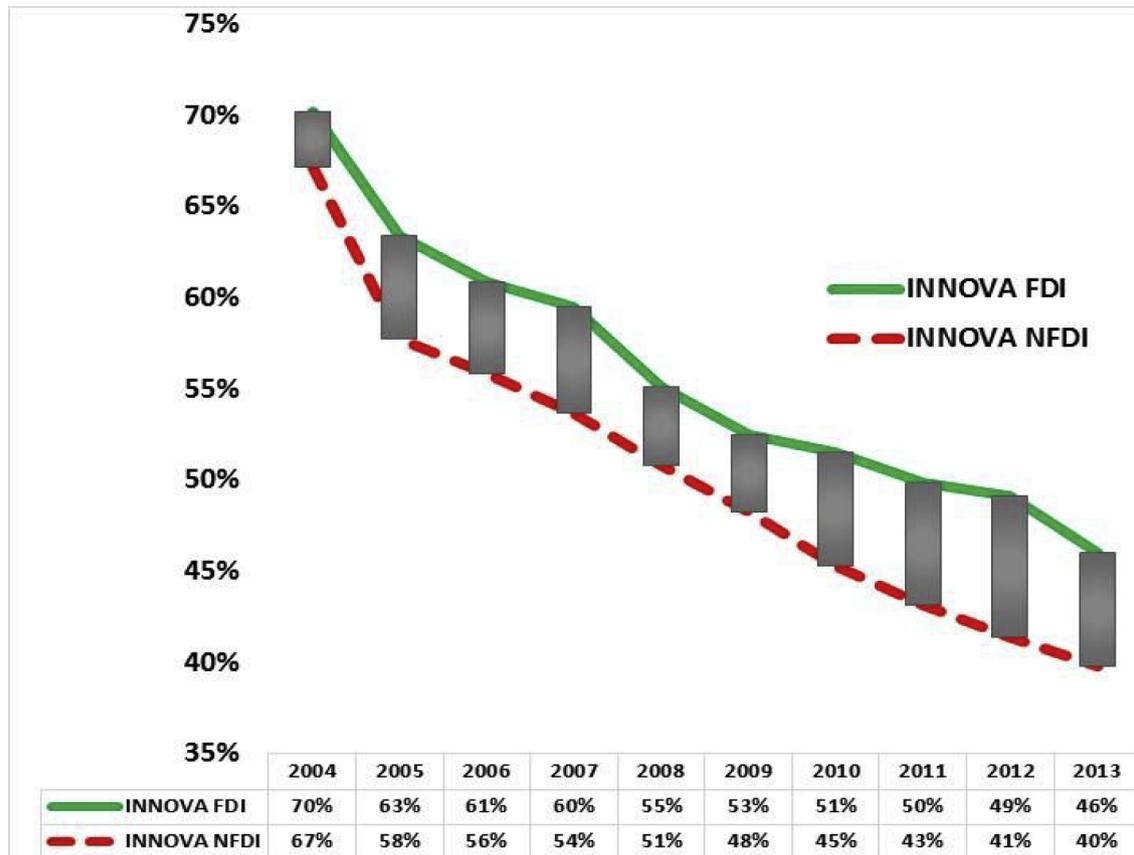
$$z = \alpha_0 + \sum_{j=1}^3 \beta_j Sector_{jit} + \varphi_1 Export_{it} + \sum_{h=1}^3 \gamma_h Size_{hit} + \delta_1 Cooperation_{it} + \theta_1 Protection_{it} + \vartheta_i Public Funding_{it} + \sum_{k=1}^{11} \mu_k Limitation_{kit} + \varepsilon_{it} \tag{3}$$

Being the logit model, the logarithm of the likelihood ratios⁴ is:

In the end, equation (5) was used for the two groups: FDI and NFDI, depending on whether or not the company has foreign direct investment, in each one of the time periods in the sample. This division has been made considering the changes in the content of the question “company types” made by the TIP database, so that:

- Up to 2007
- Public.

⁴ Considering the probability of a nonoccurrence of the event.



Source: Compiled by author

Fig. 1. Framework for implementing a sustainability-oriented innovative process.

Table 3
Description of the sample.

Type of Companies	Number
FDI Companies	1064
NFDI Companies	5383
Public enterprises	311
Associations and Research Institutions	132
Total companies in the starting sample	6890
FDI SMEs	508
NFDI SMEs	4159
Total companies of the sample for the study	4667

Source: Compiled by author

- Private with a participation of ≥50% of foreign capital.
- Research associations and other research institutions.

To homogenize these different classifications, it is assumed that companies with a foreign participation of <10% of foreign capital, are companies without foreign direct investment, and those companies with a participation of ≥10% and <50% of foreign capital, from 2007, are companies with FDI, for the whole sample.

In such case, we will obtain different equations for the aforementioned groups:

- Private without foreign participation.
- Private with participation of ≥50% of foreign capital.
- Research associations and other research institutions.
- From 2007
 - Public.
 - Private without foreign participation.
 - Private with a participation of <10% of foreign capital.
 - Private with a participation of ≥10% and <50% of foreign capital.

$$\begin{aligned}
 R + D(FDI)_{it} &= \ln \left[\frac{P_i}{1 - P_i} \right] \\
 &= \alpha_0 + \sum_{j=1}^3 \beta_j S_{jit} + \varphi_1 X_{it} + \sum_{h=1}^3 \gamma_h TE_{hit} + \delta_1 C_{it} + \theta_1 P_{it} \\
 &\quad + \vartheta_i FP_{it} + \sum_{k=1}^{11} \mu_k LIM_{kit} + \varepsilon_{it}
 \end{aligned}
 \tag{6}$$

$$\begin{aligned}
 R + D(NFDI)_{it} &= \text{Ln} \left[\frac{P_i}{1 - P_i} \right] \\
 &= \alpha_0 + \sum_{j=1}^3 \beta_j S_{jit} + \varphi_1 X_{it} + \sum_{h=1}^3 \gamma_h TE_{hit} + \delta_1 C_{it} \\
 &\quad + \theta_1 P_{it} + \vartheta_i FP_{it} + \sum_{k=1}^{11} \mu_k LIM_{kit} + \varepsilon_{it}
 \end{aligned}
 \tag{7}$$

3.3. Variables

Having determined the model, we then describe the dichotomous variables,⁵ which take the value 1 in the affirmative case and 0 otherwise, thus representing each theoretical perspective.

- > Dependent or explained variable:
 - I+D+_i_{it}: may or may not have internal innovation activity for company “i” in the time variant “t”.
- > Independent or explanatory variables:
 - S_{jit}: technological sector “j” to which the company “i” belongs in the time variant “t”. We have considered three sectors: high-technology manufacturing, medium-high-technology manufacturing and high-technology service.
 - X_{it}: company “i” sells or does not sell outside national borders in the time variant “t”.
 - TE_{hit}: takes the value 1 if the company “i” has a size “h” in the time variant “t” and value 0 otherwise. Being h = 1 if it is a micro company, h = 2 if it is a small enterprise, and h = 3 if it is a medium-sized enterprise. We consider micro-enterprise to be a company with <10 employees, small enterprise with between 10 and 50 employees, and medium-sized enterprise with 50–250 employees.
 - C_{it}: is the variable that indicates if company “i” does or does not cooperate with other companies in the time variant “t”.
 - P_{it}: company “i” does or does not have protection over its innovations through patents or other intellectual and industrial rights (registration of design or industrial model, trademark or copyright) in the time variant “t”.
 - FP_{it}: company “i” does or does not receive funding from a public source (regional and local authorities, state administrations; European Union) in the time variant “t”.
 - LIM_{kit}: is the level of importance of the limitation “k” which company “i” has in the time variant “t”. This variable takes value 1 if the limitation is not significant and 0 if it is. In the model proposed this variable is divided into 11:
 - Cost factors:
 - ✓ k = 1 lack of funding within the company or group.
 - ✓ K = 2 lack of financing from sources outside the company.
 - ✓ K-3 high costs of innovation.
 - Knowledge factors
 - ✓ K = 4 lack of qualified staff.
 - ✓ k = 5 lack of technological information.
 - ✓ k = 6 lack of information on the market.
 - ✓ k = 7 difficulty in finding cooperation partners for innovation.
 - Market factors
 - ✓ k = 8 the market is dominated by established companies.
 - ✓ k = 9 uncertainty with regard to the demand for innovative goods and services.
 - Reasons for not innovating
 - ✓ k = 10 not necessary due to previous innovations.
 - ✓ k = 11 not necessary because there is no demand for innovations.

4. Results of the empirical analysis

Before analyzing the results of the binary logit model for equations (6) and (7) we will observe, in Fig. 2, the evolution of innovative behaviour in SMEs with and without foreign direct investment. The graph reveals a downward trend for companies from the beginning of the sample period. However, there are two differentiating factors, which we will call “innovative gap” and “loss of hegemony of companies with innovative activity”.

In reference to the “innovative gap” we observe that this does not follow a consistent behavioural pattern but rather shows fluctuations according to the period undergone. Initially, the loss is 3 percentage points in 2004 and 6 percentage points at the end of the period in 2013. The highest peak is reached at the end of the crisis period and beginning of the economic recovery with 8 percentage points.

We refer to the “loss of hegemony in companies with innovative activity” when the innovative companies are no longer the majority with regard to non-innovative companies. In the case of FDI, the loss of hegemony occurs in 2012, whilst in the case of NFDI, it occurs in 2009. This circumstance highlights the fact that the existence of foreign participation in a company does not prevent a fall in the trend, but rather slows it down and softens it over time, implying that the SMEs with FDI feel the effects of the period of economic crisis later. It also minimizes the effects of the crisis with regard to their counterparts, as they show a more sustainable innovative behaviour.

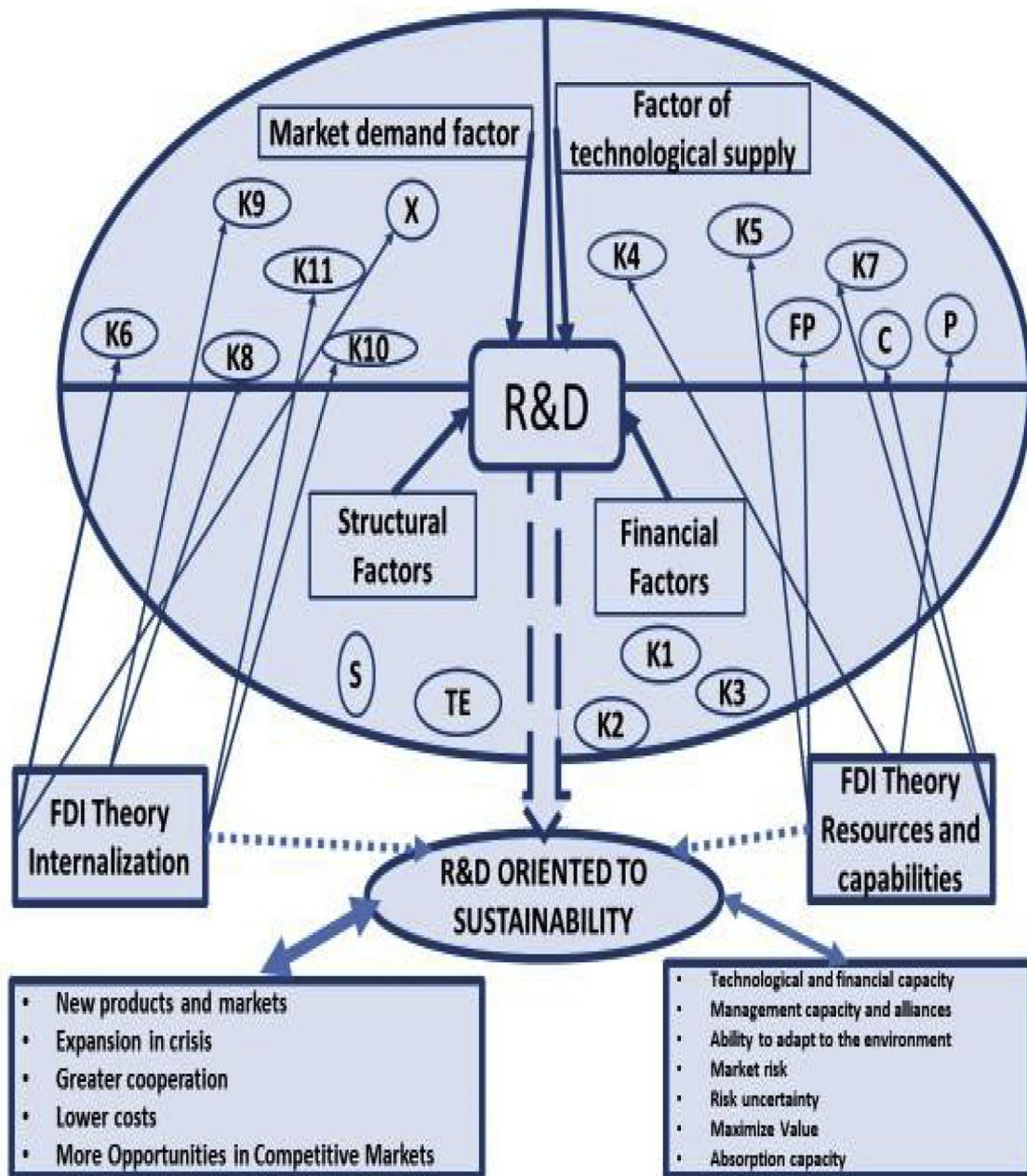
Table 4 presents the results obtained from the binary logistic regression for the companies with FDI, as well as for the companies without FDI (NFDI) allowing us to carry out both an intergroup and intertemporal analysis by analyzing the spillover effects from foreign participation.

The results illustrate how, in the last years of economic growth, the most innovative SMEs were those belonging to technological sectors, regardless of whether or not they received foreign direct investment. In the case of FDI SMEs, in order of importance, and in reference to the odds ratio and the sign of the coefficient of the variable, in first place are the companies in the high-technology manufacturing sector, followed by the companies within the medium-high-technology manufacturing sector and finally the companies belonging to the high-tech service sector. In the technological NFDI companies, the order of importance remains the same, with the exception of the change of order between the last two sectors.

With the arrival of the economic crisis, as we saw in Graph 2, there is a downturn in the SMEs’ innovative process, although this was less pronounced in the FDI companies. The positive and significant relationship in the variable S_{2i}, shows us how FDI enables the innovative process to continue in the medium-high-tech manufacturing sector, as it generates spillovers which allow the companies to leverage the technological push generated in this sector. This circumstance then makes the sector more dynamic and sustainable at the beginning of the economic recovery in the years 2012–2013 by ensuring its relevance.

With regard to the NFDI SMEs, we can observe how, following the period of economic recession, innovation suffered a sharp

⁵ For more information consult the descriptive statistics of Annexes 1 and 2.



Source: Compiled by author

Fig. 2. Evolution of internal R&D in SMEs with FDI or NFDI.

downturn. This is due to the fact that, during the crisis, there is a decrease in the involvement of the technological sectors, resulting in the negative and significant signs of the coefficient of the variables S_{3i} , and S_{1i} , respectively. These sectors reassert themselves during the following period, as S_{1i} , and S_{2i} are not statistically significant and the variable S_{3i} is significant but negative.

Analysis of the relative importance of the “belonging to a sector” factor reveals that, following the economic upswing, this emerges as one of the least influential factors in the two following economic periods, for both FDI and NFDI companies. We will now look at what the results reveal about the other factors involved in innovation.

For all SMEs, the results show that the main factor for innovative

development is public funding. The significance of the results in this area partly explains the difference in the evolution of innovative activity among the different types of companies. The biggest decrease in the first two economic periods is suffered by NFDI companies, which is directly related to the minor influence of the aforementioned factor (odds ratio = 4.77 and 8.08), with respect to the weight that this variable has for the FDI companies (odds ratio 6.71 and 10.7). The subsequent decline can be explained by the equation of the weight of the aforementioned factor in the innovative process (odds ratio = 9.82 and 9.25).

Following the approach outlined above, we observe how the other factors do not follow a behavioural pattern that is as standardized as that of public funding, reflecting an alteration in these

Table 4
Logistic regression results.

	2004–2007				2008–2011				2012–2013			
	FDI		NFDI		FDI		NFDI		FDI		NFDI	
	β	Exp(β)	β	Exp(β)	β	Exp(β)	β	Exp(β)	β	Exp(β)	β	Exp(β)
S1i	1.45***	4.26	1.53***	4.64	-0.02	0.98	-0.18***	0.83	0.38*	1.46	0.13	1.14
S2i	1.08***	2.94	1.02***	2.77	0.61***	1.83	-0.02	0.98	0.67***	1.96	0.1	1.11
S3i	0.52***	1.68	1.06***	2.89	-0.25	0.78	-0.66***	0.52	-0.38	0.69	-0.33*	0.72
Xi	0.86***	2.37	0.72***	2.06	0.8***	2.22	0.81***	2.25	0.52***	1.69	0.86***	2.35
TE1i	1.31***	3.69	0.44***	1.55	0.14	1.15	-0.15**	0.86	-0.43	0.65	-0.46***	0.63
TE2i	0.65***	1.92	0.44***	1.55	-0.14	0.87	0.24***	1.28	0.2	1.22	0.23***	1.25
TE3i	0.7***	2.01	0.67***	1.95	0.56***	1.75	0.54***	1.72	0.38***	1.46	0.47***	1.6
Ci	0.96***	2.6	1.09***	2.97	1.21***	3.36	1.23***	3.44	1.47***	4.35	1.38***	3.99
Pi	1.04***	2.82	0.7***	2.01	1.54***	4.66	0.88***	2.42	1.42***	4.16	1.03***	2.81
FPi	1.9***	6.71	1.56***	4.76	2.37***	10.7	2.09***	8.08	2.28***	9.82	2.22***	9.25
LIM1i	-0.35**	0.71	0.03	1.03	-0.16	0.85	-0.04	0.96	-0.36**	0.7	-0.04	0.96
LIM2i	-0.07	0.93	-0.41***	0.66	-0.37***	0.69	-0.33***	0.72	-0.19	0.82	-0.25***	0.78
LIM3i	-0.33***	0.72	-0.26***	0.77	0.28**	1.32	-0.14***	0.86	0.13	1.14	-0.15**	0.86
LIM4i	-0.12	0.89	0.2***	1.22	-0.1	0.91	0.02	1.02	0.29	1.34	0.09	1.1
LIM5i	0.13	1.13	0.01	1.01	0.08	1.08	0.08	1.09	0.18	1.2	0.002	1.00
LIM6i	-0.03	0.97	-0.2***	0.82	-0.46***	0.63	-0.22***	0.8	-0.84***	0.43	-0.19**	0.82
LIM7i	0.19	1.21	0.07	1.07	0.08	1.09	0.14***	1.15	0.0006	1.00	0.13*	1.14
LIM8i	-0.27**	0.77	-0.17***	0.84	-0.41***	0.66	-0.27***	0.76	-0.33**	0.72	-0.37***	0.69
LIM9i	-0.47***	0.62	-0.17***	0.84	-0.54***	0.58	-0.18***	0.83	-0.44***	0.64	-0.18***	0.83
LIM10i	0.54***	1.72	0.42***	1.52	0.48***	1.62	0.31***	1.36	0.49***	1.63	0.29***	1.34
LIM11i	1.25***	3.48	1.01***	2.74	1.31***	3.72	1.07***	2.93	1.14***	3.13	1.12***	3.07
CTE	-2.86	0.06	-2.62	0.07	-2.48	0.08	-2.62	0.07	-2.26	0.1	-2.81	0.06

Note: *, **, ***, significant coefficients at 10%, 5% and 1%, respectively. Exp(B) = Odds Ratio.

factors' order of importance for the different companies, and between the different periods considered. Although the public funding factor is a common denominator for the innovative SMEs, for both those with and without foreign direct investment, the difference in the innovative process is a consequence of the other factors.

With regard to the “company size” factor, in the period of economic growth, all the SMEs innovated, regardless of whether or not they had FDI. As shown in the statistical significance of all the FDI SMEs, the micro-enterprises are the most innovative, odds ratio = 3.60, whilst within the NFDI group, the medium-sized enterprises are the most innovative, odds ratio = 1.95. With the beginning of the economic crisis, we observe a greater resistance to stopping innovation among the small and medium enterprises without foreign direct investment, given the negative but significant relation. This behaviour endures throughout the recovery period, maintaining signs and a similar odds ratio. In contrast, among the SMEs with FDI, the medium-sized enterprises are able to maintain their innovative activity in the two following periods, as they are the only companies that show a positive and significant relation.

From this analysis, we can derive that the medium-sized enterprises show the most consistency in terms of innovative behaviour. According to the odds ratios, the highest tendency to innovate in the two first periods can be seen in the FDI companies, the trend reversing for the last period.

Cooperation among companies is necessary as a decisive factor for internal innovation, given its constant statistical significance. This factor, however, was more prominent initially in the innovative companies with NFDI odds ratio = 2.97. With the beginning of the recession, the FDI companies considered cooperation to be a determining factor for maintaining the innovative process, reflected in the gradual increase in their odds ratios. The latter starts in the period of crisis (3.63) and reaches its highest value (4.35) in the recovery period.

With regard to the protection of innovation, the SMEs with FDI show a higher tendency than the NFDI companies, although

initially the tendency to protect innovation was very similar, since their odds ratio was 2.82 as compared with 2.1 for NFDI companies. As economic conditions worsen, these differences increase, standing at 4.66 against 2.42 in the crisis period, and 4.16 against 2.81 in the recovery period.

At the outset, the companies' innovative processes were not affected by the amount of exports, despite this being a significant factor statistically, especially in the case of companies with FDI, showing a fall in the value of their odds ratio from 2.37 to 1.69. In contrast, for the NFDI companies, the arrival of the economic crisis gives this factor greater relevance, as it gradually increases their odds ratio (2.06–2.25–2.35). These companies may have considered the “export” factor to be a sustainable competitive advantage, adopting it as a strategic posture against the FDI companies.

Last but not least, this innovative process is not without its limitations and depends on the environment of the companies, which will change based on the existence or absence of FDI as well as regarding the period's economic cycle. Table 5 shows the limitations which have transpired to be statistically significant, in order of importance, with regard to their odds ratio.

The SMEs with NFDI find their main obstacle in the “lack of external funding”, to which can be added, since the economic crisis, the “domination of the companies established in the market”, although this is not the case for “the lack of internal funds”. In contrast, the SMEs with FDI consider the “uncertain demand of innovative goods and services” to be an insurmountable obstacle, to which can be added during the crisis the “lack of information about the market”.

It can be observed that the SMEs with FDI have problems with a “lack of internal funds” in periods of economic growth, and with “external funding” in the period of recession, whilst the problems for the NFDI companies are linked with “external funding”.

It should be highlighted that not all the limitations are an obstacle to innovation, as is the case for the factor “reasons not to innovate”, which registers a positive and constant behaviour over time for both types of SMEs, although there is a higher propensity to innovate in the case of the FDI companies. By the same token,

Table 5
Effects of the limitations in SMEs according to the economic cycle.

FDI	NFDI
Economic Expansion	
Uncertain demand of innovative goods and services (–)	Lack of external funding to the company (–)
Lack of funds within the company or group (–)	High costs of innovation (–)
High costs of innovation (–)	Lack of information about the market (–)
Market dominated by established companies (–)	Uncertain demand of innovative goods and services (–)
Not necessary due to existing innovations (+)	Market dominated by established companies (–)
Not necessary due to lack of demand of innovations (+)	Lack of qualified personnel
	Not necessary due to existing innovations (+)
	Not necessary due to lack of demand of innovations (+)
Economic Crisis	
Uncertain demand of innovative goods and services (–)	Lack of external funding to the company (–)
Lack of information about the market (–)	Market dominated by established companies (–)
Market dominated by established companies (–)	Lack of information about the market (–)
Lack of external funding to the company (–)	Uncertain demand of innovative goods and services (–)
High costs of innovation (+)	High costs of innovation (–)
Not necessary due to existing innovations (+)	Difficulty to find partners (+)
Not necessary due to lack of demand of innovations (+)	Not necessary due to existing innovations (+)
	Not necessary due to lack of demand of innovations (+)
Economic Recovery	
Lack of information about the market (–)	Market dominated by established companies (–)
Uncertain demand of innovative goods and services (–)	Lack of external funding to the company (–)
Lack of funds within the company or group (–)	Lack of information about the market (–)
Market dominated by established companies (–)	Uncertain demand of innovative goods and services (–)
Not necessary due to existing innovations (+)	High costs of innovation (–)
Not necessary due to lack of demand of innovations (+)	Not necessary due to existing innovations (+)
	Not necessary due to lack of demand of innovations (+)

Source: Compiled by author

neither the “lack of qualified personnel” nor the difficulty in finding partners has represented an impediment for them.

5. Discussion and conclusions

The objective of this work has been the empirical analysis of the factors that attract FDI to SMEs, which generate spillovers and can make them prone to innovations oriented towards sustainability.

With regard to the factors that attract FDI, those SMEs that have greater access to public financing are more attractive thanks to their effective systems of protection, especially in the recession period, as well as SMEs that are likely to cooperate and generate an innovative dynamic, by establishing growing and lasting ties of collaboration. In addition, having access to a market where there is a strong demand for innovations and which is not dominated by established companies would attract FDI that is not looking for a platform to access adjacent markets, since the propensity to export is downward in the entire sample period.

Therefore, technological supply factors, as established by the theory of resources and capacities, are the dominant factors in the location of FDI. However, the importance of proxy variables of market potential and the fact that these are not considered a platform to access other markets, indicates that the Spanish market has the capacity to absorb the innovations made and that it has the means to develop them.

These factors, therefore, are what make SMEs with FDI more innovative, although they will most likely be of a medium size and in the medium-high technology sector. The main constraints that will affect them will be those related to market factors and market knowledge, while NFDI SMEs will be hampered by cost and market factors. From this study, it is derived that the order of importance established in previous studies, which can be found in the literary review, is only true for the NFDI companies.

It is confirmed that FDI generates positive spillovers by enhancing innovation, increasing competition, despite the

existence of uncertainty in the demand for innovative goods and services, and achieving technological improvements in all SMEs, regardless of whether or not they have FDI, shows that in any period or for any type of SME, technological information is required and a lack of qualified personnel is a limitation. FDI is shown to stabilize financing, since when the company has a lack of internal funds, it has access to both private and public external funds, and vice versa. However, it does not boost exports, nor does it increase the innovation of other companies in the same sector, which suggests a shift in NFDI companies.

Our study would be in line with those by authors who consider that FDI generates positive spillovers but subject to public financing, which could have acted as an attenuating factor on economic fluctuation during the sample period.

Finally, FDI makes these SMEs more suited to developing innovations oriented to sustainability by meeting the requirements of technological capacity, thanks to qualified personnel, technological information and financial capacity, either through public or private external funds or internal funds. It has been observed how they have adapted to the environment despite its uncertainty, and how they would be able to create value and capture it, thanks to its protection system. However, the fact that the weight of cooperation was growing and non-dominant throughout the period is a sign that this kind of investment requires time to place companies in a more cooperative position than companies without FDI.

This study is the beginning of a line of research which is aimed at exploring how FDI affects the development of sustainable innovations, the effects of this investment most notably being on the three basic pillars of sustainability (economic, social and environmental). What can be ascertained from the limitations derived from this study, regarding the integration of the interested parties, is knowing what benefits society and the company receives if the investment shows a stable performance, or not, as this would affect the entry and exit of FDI.

Annexes

Annex 1

Descriptive statistics of target variables.

	FDI SMEs					
	2004–2007		2008–2011		2012–2013	
	No Innovation	Innovation	No Innovation	Innovation	No Innovation	Innovation
High-technology manufacturing sector	0 602	951	908	983	556	486
	1 22	130	140	158	68	80
Medium-high-technology manufacturing sector	0 500	682	973	1.030	572	514
	1 124	399	75	111	52	52
High technology services sector	0 593	1.021	1.043	1.141	624	566
	1 31	60	5	0	0	0
Export	0 130	63	193	76	107	41
	1 494	1.018	855	1.065	517	525
Micro companies	0 606	1.055	986	1.108	575	549
	1 18	26	62	33	49	17
Small companies	0 491	873	761	929	461	448
	1 133	208	287	212	163	118
Medium Companies	0 151	234	349	245	212	135
	1 473	847	699	896	412	431
Cooperation	0 538	654	924	643	562	282
	1 86	427	124	498	62	284
Protection	0 562	729	990	767	585	399
	1 62	352	58	374	39	167
Public Financing	0 569	642	997	672	603	350
	1 55	439	51	469	21	216
Lack of funding within the company or group	0 198	559	486	699	257	345
	1 426	522	562	442	367	221
Lack of financing from sources outside the company	0 170	528	424	688	223	325
	1 454	553	624	453	401	241
High costs of innovation	0 223	650	503	726	247	353
	1 401	431	545	415	377	213
Lack of qualified staff	0 159	392	271	407	121	155
	1 465	689	777	734	503	411
Lack of technological information	0 124	330	223	379	104	149
	1 500	751	825	762	520	417
Lack of information on the market	0 108	296	200	356	96	183
	1 516	785	848	785	528	383
Difficulty in finding cooperation partners for innovation	0 92	265	221	327	97	169
	1 532	816	827	814	527	397
The market is dominated by established companies	0 186	484	366	574	167	274
	1 438	597	682	567	457	292
Uncertainty with regard to the demand for innovative goods and services	0 178	525	398	664	202	333
	1 446	556	650	477	422	233
Not necessary due to previous innovations	0 154	104	293	124	165	56
	1 470	977	755	1.017	459	510
Not necessary because there is no demand for innovations	0 235	122	373	115	233	58
	1 389	959	675	1.026	391	508

Annex 2

Descriptive statistics of target variables.

	NFDI SMEs					
	2004–2007		2008–2011		2012–2013	
	No Innovation	Innovation	No Innovation	Innovation	No Innovation	Innovation
High-technology manufacturing sector	0 6.654	8.796	8.043	7.118	4.658	3.176
	1 186	902	734	625	407	288
Medium-high-technology manufacturing sector	0 5.963	7.031	7.994	7.170	4.624	3.195
	1 877	2.667	783	573	441	269
High technology services sector	0 6.493	8.530	8.522	7.687	4.911	3.437
	1 347	1.168	255	56	154	27
Export	0 3.723	2.793	4.432	1.673	2.388	607
	1 3.117	6.905	4.345	6.070	2.677	2.857
Micro companies	0 6.197	8.647	7.250	7.101	3.871	3.192
	1 643	1.051	1.527	642	1.194	272
Small companies	0 3.280	4.921	4.436	4.082	2.770	1.878
	1 3.560	4.777	4.341	3.661	2.295	1.586

Annex 2 (continued)

	NFDI SMEs						
	2004–2007		2008–2011		2012–2013		
	No Innovation	Innovation	No Innovation	Innovation	No Innovation	Innovation	
Medium Companies	0	4.203	5.828	5.868	4.303	3.489	1.858
	1	2.637	3.870	2.909	3.440	1.576	1.606
Cooperation	0	6.054	5.816	8.025	4.385	4.701	1.866
	1	786	3.882	752	3.358	364	1.598
Protection	0	5.737	5.976	7.792	5.059	4.708	2.424
	1	1.103	3.722	985	2.684	357	1.040
Public Financing	0	5.813	4.434	8.104	3.493	4.850	1.736
	1	1.027	5.264	673	4.250	215	1.728
Lack of funding within the company or group	0	3.156	6.246	5.074	5.580	3.048	2.554
	1	3.684	3.452	3.703	2.163	2.017	910
Lack of financing from sources outside the company	0	2.896	6.177	4.730	5.562	2.838	2.565
	1	3.944	3.521	4.047	2.181	2.227	899
High costs of innovation	0	3.637	6.886	5.312	5.721	2.997	2.542
	1	3.203	2.812	3.465	2.022	2.068	922
Lack of qualified staff	0	2.685	4.428	3.344	3.433	1.719	1.306
	1	4.155	5.270	5.433	4.310	3.346	2.158
Lack of technological information	0	2.292	3.868	2.978	2.957	1.489	1.143
	1	4.548	5.830	5.799	4.786	3.576	2.321
Lack of information on the market	0	2.027	3.842	2.809	3.181	1.496	1.343
	1	4.813	5.856	5.968	4.562	3.569	2.121
Difficulty in finding cooperation partners for innovation	0	1.840	3.571	2.805	3.147	1.630	1.424
	1	5.000	6.127	5.972	4.596	3.435	2.040
The market is dominated by established companies	0	2.723	5.223	3.879	4.440	2.115	1.995
	1	4.117	4.475	4.898	3.303	2.950	1.469
Uncertainty with regard to the demand for innovative goods and services	0	3.079	5.669	4.647	5.141	2.573	2.300
	1	3.761	4.029	4.130	2.602	2.492	1.164
Not necessary due to previous innovations	0	1.855	1.111	2.441	882	1.382	382
	1	4.985	8.587	6.336	6.861	3.683	3.082
Not necessary because there is no demand for innovations	0	2.770	1.153	3.558	952	2.120	432
	1	4.070	8.545	5.219	6.791	2.945	3.032

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