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Efforts to Innovate Favouring the Absorption of Foreign Direct Investment So as to Achieve Beneficial Outcomes from Innovation

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Abstract: This piece of work provides new findings about the effects of interactions between efforts to innovate and foreign direct investment on the results of innovation in Spanish firms. Examples of beneficial outcomes would be patents, as well as new products and processes. In addition, consideration will be given to the innovation activities that can favour from foreign direct investment in such a way as to attain innovation objectives of this sort. The source of the information used is PITEC, the Spanish Panel for Technological Innovation, together with figures from DataInvex, which contains the official statistics on foreign investment and other trade figures, provided by the Spanish Ministry of Commerce. In this study, we use logistic regression models to explain the impacts that attempts to innovate have upon the absorption of the foreign direct investment to attain the innovation outcomes. R&D expenditures, external collaboration, and public funds for innovation favour the absorption of Foreign Direct Investment to achieve beneficial outcomes from the innovation.

Keywords: foreign direct investment; process innovation; patents; product innovation; absorptive capacity; research and development

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1. Introduction

The aims of this paper concentrate on providing new findings about the effects of the foreign direct investment received by a sector on the results of innovation, such as patents or novel processes and products. Consideration is also given to any foreign presence and to efforts to innovate, which include spending on research and development (R&D), cooperation with other economic agents, or public funding. Attention is paid to the combined impacts of each of these strivings to innovate in conjunction with foreign direct investment and any foreign presence in the sector. R&D expenditures, external collaboration, and public funds for innovation favour the absorption of Foreign Direct Investment to achieve beneficial outcomes from the innovation.

In undertaking this work, logistic regression models were used, with the calculations being performed using the Stata 14.0 software package. The figures were drawn from the PITEC databases and from DataInvex statistics. The polarity and intensity of efforts to innovate made by Spanish companies were investigated, in conjunction with their ability to absorb foreign direct investment in order to achieve beneficial outcomes from innovation.

The paper is structured as follows. Section 2 looks at the literature review; Section 3 presents the models, data, and methodology used to explain the factors of the interaction between efforts to innovate and foreign direct investment that affect the results of innovation. The final section concludes the paper.

2. Literature Review

2.1. Foreign Direct Investment and Innovation Results

The literature regarding foreign direct investment (FDI) and the related outcomes of innovation highlight the fact that the movement of capital from multinational companies to Spanish enterprises is indirectly related to the achievement of certain innovatory results, as may be seen in [1]. These authors studied the impact of foreign direct investment and the capacity to absorb it upon the outcomes of innovation, using figures for the patent applications that were submitted and the new technologies that were developed. They demonstrated a significant positive effect of FDI on innovation. There has also been confirmation of a positive linkage between FDI and the expansion of innovatory technology, leading to noteworthy financial growth in the involved firms [2].

Álvarez-Herranz et al. [3] showed that the very process of innovating had a positive influence on the attainment of beneficial results from innovation. Baumann and Kritikos [4] found that micro-enterprises obtained comparable advantages from innovatory processes to those of larger firms, since they were equally capable of enhancing the results of innovation. New approaches also trigger technological progress, allowing for the use of cleaner energy, enhancements in energy efficiency, and reductions in polluting emissions. However, innovatory activities are always accompanied by a high level of risk, so large investments of resources may not be rewarded [5]. Shen et al. [6] observed that no evidence was found to demonstrate that innovation has secondary effects on productivity. Consequently, the present study aims to check whether there is any positive impact from efforts to innovate that would favour the absorption of FDI, to achieve good results from innovation.

Zheng et al. [7] suggested that there is a long-term relationship of considerable extent and significance between foreign direct investment and innovation.

2.2. Absorptive Capacity from Foreign Direct Investment

Huang and Zhang [8] discovered that FDI stimulated the innovatory activities of domestic companies. Alsebai et al. [9] found a positive relationship between FDI and participation in total capital formation in terms of economic growth. Other studies, such as Cohen and Levinthal [10], agreed on the importance of applying any new knowledge that is acquired, since if this is not applied then there will be no way of exploiting existing skills or building up new competences.

Moreover, local spending on R&D is a highly significant determinant of the capacity to innovate [11].

FDI is seen as a motor for growth and enhancements in productivity via technology [12]. Prior work has suggested that FDI tends to have a technological spillover effect, increasing the productivity of domestic firms as well [13,14]. Most of the published literature concentrates on FDI's impact on Total Factor Productivity, paying less attention to its influence on the results of innovation.

Foreign direct investment improves the absorption of outcomes from innovation and economic growth through the diffusion of novelties in host firms. Furthermore, it is said that innovation is a motor, driving successful companies at the micro level [15]. Innovation takes place when firms can create new processes to produce existing products more efficiently, differentiate current products, or introduce completely novel products, so as to increase sales and market performance [16].

Research and development not only acts as a stimulus for innovation, but also permits a company to identify, assimilate, and exploit know-how from outside sources [17]. In addition, thanks to the availability of funds, companies receiving FDI are likely to attract and retain more qualified personnel by offering higher pay [18,19]. Hence, access to funding stimulates innovation in firms [20].

Arun and Yıldırım [21] investigated how FDI plays a central role in raising the level of innovation in most countries. FDI and collaboration with outside bodies need to be combined to boost innovation.

The hypothesis the present piece of work aims to confirm, following suggestions from earlier studies, is that the enterprises receiving the most FDI are more likely to achieve beneficial innovation outcomes.

Lutz et al. [22] noted that a foreign presence, established through FDI, can have a positive impact on the competitive performance of domestic firms. This is because the productivity of local enterprises can be enhanced through technology transfer or its effects, which can act as an example or demonstrate how things can be done. Lutz et al. [22] and Ongena et al. [23] showed that a foreign presence and FDI could have a positive influence on production and exports in domestic businesses.

As noted in previously published work, a foreign presence in a sector can act as a spur for companies to undertake direct investments abroad. The present investigation is intended to demonstrate that the interaction between foreign direct investment and the activities of a foreign presence in a sector tends to yield favourable results through innovation.

2.3. External Collaboration for Innovation

At present, those studying the management of innovation, firms, and those with political responsibilities all recognize that collaboration with outsiders is crucial if organizations are to obtain new knowledge. Cooperating with others offers many advantages to firms, including gaining access to new skills, reducing the cost of acquiring these skills, increasing innovation, and decreasing the risks associated with R&D activities and projects for innovation [24]. In this way, collaborating with outsiders enhances the innovation performance of companies [25–27].

The extent of external cooperation is important if firms are to acquire the knowledge necessary for innovation [28].

Numerous studies have shown that collaboration with others enhances the innovation performance of businesses. Faems et al. [25] suggested that there is a positive relationship between the innovatory performance of an enterprise and its cooperative links with other organizations. Huang and Yu [29] found that, in the information and communications technology, industry collaboration, whether or not it is competitive, had a positive influence on the innovation of an enterprise. The impact of cooperating with outsiders differed in accordance with the kind of innovation involved. Un et al. [30] discovered that collaboration on research and development with suppliers and universities was beneficial for process innovation, but other sorts of collaborative contact either had no significant effect or were of no great use.

Likewise, Ollila and Yström [31] noted that the building up of networks and multifunctional encounters in open spaces for innovation, where member organizations could meet to innovate together, were of value in facilitating a creative climate. We propose, according to the literature review, Hypothesis 1:

Hypothesis 1 (H1): *The external collaboration for innovation favours the absorption of Foreign Direct Investment so as to achieve beneficial outcomes from innovation.*

2.4. R&D Expenditures

It has been demonstrated that R&D activities favour good results regarding innovation in businesses [32,33]. Havins [34] linked R&D expenditure, along with the management of innovation, as being among the principal components for tackling the unique challenges facing present-day organizations and, in this way, improving the quality of the decisions they took.

Yıldırım and Arun [35] showed that work on R&D in combination with FDI improved innovation outcomes. León et al. [36] highlighted the considerable value of open models for innovation for organizations in enhancing their levels of R&D and innovation.

Spending on research and development is normally undertaken with the goal of achieving useful outcomes regarding innovation. The piece of research reported here investigated Hypothesis 2 (H2):

Hypothesis 2 (H2): *There is a positive link between the interaction of FDI and R&D spending with the attainment of good results from innovation.*

2.5. R&D Activities: Internalization and Externalization

Sbernini et al. [37] investigated the relationships between strategic development decisions for global products, including sub-contracting, outsourcing, and strategies for alliances, together with their impact on day-to-day business, in the context of open global innovation. Cammarano et al. [38] considered that the adoption of open innovation, particularly the externalization of R&D, positively affected innovation.

Supported by this technical perspective, Audretsch and Vivarelli [39] indicated that gaining knowledge from outside sources is more likely in those enterprises with a larger amount of specific resources devoted to acquiring and assimilating foreign technology.

Watkins and Paff [40] pointed out that the complementarity of internal and external R&D activities was especially common in sectors characterized by complexity and rapid technological change. They noted that, in sectors of this kind, the learning effect arising from internal R&D plays a decisive role in the assimilation of information gleaned from external sources.

These features, together with the growing complexity of innovatory processes, create incentives for enterprises to include external sources of knowledge in their technology strategy [41]. Recent studies have analysed how public subsidies stimulate this interaction. Busom and Fernández-Ribas [42] concluded that subventions of this kind had a positive effect on the setting up of cooperation agreements. Their findings demonstrated that subsidies encouraged cooperation with customers and suppliers, as well as with universities and research centres. Similar results were noted in Afcha Chavez [43] for central and regional government subventions in Spain.

Martínez-Noya and García-Canal [44] analysed various factors in enterprises and the environment that influenced the decision to outsource R&D services.

The present piece of work proposes Hypothesis 3 (H3):

Hypothesis 3 (H3): *The interaction of FDI with R&D outsourcing has a positive link with the achievement of good outcomes from innovation.*

2.6. Relationships with the State in Terms of Innovation

Junior et al. [45] highlighted the fact that public funding played an important role in stimulating research and development activities. Oliver-Espinoza et al. [46] stated that they found no relationship between public financing and the results regarding innovation. This may be an exception, since various successful policies giving rise to radical innovations have concentrated on the formation of markets through direct generalized public funding [47].

Government subventions have an influence on the combination of internal and external R&D expenditure, favouring a good innovatory performance by firms [48].

In Spain, the percentage of companies involved in subsidized cooperative agreements was greater than those participating but receiving no subsidy [43]. Furthermore, the receipt of public aid permitted enterprises to demonstrate their financial viability, together with the scientific and technical quality of their R&D work, hence reducing uncertainty, assisting in the correction of information asymmetries that may make it hard for a given firm to gain access to external funding, and aiding the sales of its products in a technological marketplace [49].

Public funding is a very great help to firms in the development of innovatory actions. The present paper aimed to investigate Hypothesis 4 (H4):

Hypothesis 4 (H4): *The interaction of FDI with government financing stimulates the attainment of beneficial outcomes from innovation.*

2.7. Patents

The findings published by Lampe and Moser [50] suggest that when the establishment of patent rights by firms has been extensive and strong, the same enterprises also achieved other positive results regarding innovation.

Lema et al. [51] concluded that the effects of patents as incentives to innovation are stronger in some sectors than in others. Kim et al. [52] investigated patents with regard to innovation performance.

Baten et al. [53] held that firms expand their number of low-quality patents with an eye to protecting their strategic, higher-quality patents. Zemla-Pacud [54] suggest that if a system for patents was to function well it had to provide incentives to innovate, safeguarding dynamic competition and protecting the public interest. This constitutes a balancing act and is faced with considerable difficulties in today's joined-up world.

2.8. Product Innovations

Enterprises investing more in R&D succeed in innovating their procedures before their competitors. This allows them to enhance the quality of their products and grow more rapidly, making them able to enter new markets [55].

Investigations by Saeed et al. [56] indicated that where there is a capacity for absorption, only collaboration with research organizations and competitors could be seen to have positive effects on the ability to innovate products. Jiang et al. [57] revealed that the presence or absence of unease about this matter could increase or diminish company profits, and encourage or impede product innovation.

The innovation of products can make a strategic difference to the goods an organization offers in the marketplace. This can satisfy demands, build customer loyalty, and improve the firm's profitability. Innovations in processes, on the other hand, point to a current of renovation within an enterprise [58].

2.9. Process Innovations

Hervas-Oliver et al. [59] showed that innovation in processes was complemented by novelties in organization that favoured innovatory performance.

Lager [60] explained that the objective of product innovation is to develop new products, improve the characteristics of existing products, enhance their quality, etc.

In addition to the presence of a capacity for absorption, cooperation with research organizations and competitors has a positive impact on the ability to undertake upgrading of this sort. However, when it comes to renovating processes, collaborations with research organizations and with suppliers become the weightiest factors [56].

The development of process innovation is strongly linked to external factors; Wheelwright [61] suggested that three currents drive this kind of improvement. These include intense international competition, fragmented but demanding markets, and a wide range of rapidly changing technologies. Cetindamar et al. [62] felt that technology managers should receive training on team administration, data analysis, and development techniques so as to be able to achieve increasing technological innovation. This is principally because innovation in enterprises has been increasing, in parallel with general worries about sustainability.

Milewski et al. [63] showed that flexible hierarchical structures and the building up of a technological infrastructure favoured process innovation, as well as technological or organizational changes in accordance with the level of standardization that is desired.

Frishammar et al. [64] stressed the need to understand the requirements for production, to evaluate product characteristics, to have a full implementation plan, to grasp what resources a project might want, and to anticipate, at an early stage, what results may be expected to achieve good innovation outcomes. Damanpour and Aravind [65] suggested

that, in order to create a more unified management, the adoption of novel technologies should go hand in hand with new processes and systems of organization, since performance depends on how well different types of innovation promote organizational objectives. Parida et al. [66] considered that formalized procedures reduced uncertainty, although they might have a downside in adversely affecting process innovation.

3. Data, Model and Methodology

The PITEC database was used to obtain annual information from a total of 12,849 firms, covering the period from 2003 to 2016. Similarly, annual data for the same years were drawn from DataInvex, the statistical resource for foreign investment in Spain, maintained by the Ministry of Industry, Trade and Tourism.

The variables investigated in the model were as follows:

PAT: Patent applications. If a company registered any patents in year t, the variable takes the value 1. If not, it is set at 0.

PRODINN: Product Innovation. This variable takes the value 2 if the firm has achieved any of the following innovation objectives: the incorporation of new materials, the use of novel components or intermediate products, adopting new designs or forms of presentation, and adding further functionality to a product. If none of these have occurred, the variable is given a value of zero.

PROCINN: Process Innovation. The value for this variable is 1 if an enterprise has implemented any of the following changes in processes: the introduction of novel machinery or new methods of organizing production. If this has not happened, the variable is set at zero.

Ln(FDI). The natural logarithm of foreign direct investment at constant prices according to sector and market share. This is calculated by multiplying the market share of firm i in year t by the logarithm of the amount of FDI for year t in the sector of company i.

PRE: Foreign presence in the sector: This variable is calculated as the total sales made by foreign companies in sector s during year t, divided by the sales of all the firms of the sector, both local and foreign, in that same year, expressed as a percentage.

COOP: External cooperation. Shows the level of cooperation with the various external agents considered (companies in the same group, suppliers, customers, competitors, consultancy firms, universities, and public research establishments). The values for this run from 0 (zero), if there is no collaboration with any of these, up to 7, if there is a cooperative link with all of them.

RDIN: Internal R&D expenditures to indicate if a firm has internal R&D expenditures. This variable equals 1 if a firm has internal R&D expenditures; it equals zero other-wise.

RDEX: External R&D expenditures to indicate if a firm has external R&D expenditures. This variable equals 1 if a firm has external R&D expenditures; it equals zero other-wise.

Intensity. R&D intensity is the ratio of the number of employees working in the R&D department to total staff.

FIN. Public funding for innovation to indicate if a firm receives financial support for innovation activities from national governments, the European Union, or local or regional institutions. This variable equals 1 if a firm receives public funding for innovation; it equals zero otherwise.

Ln(SIZE). The natural logarithm of the number of employees.

Ln(GDP). The natural logarithm of the gross domestic product (GDP) deflator for the year t.

This study uses a logistic regression with unbalanced panel data. For this purpose, nine logistic regression models were produced. Checks were made as to whether it was feasible to confirm the hypothesis that the outcomes from innovation could be expressed as a function of the innovatory efforts that favour the absorption of foreign direct investment.

For Models 1, 2, and 3, the individual efforts to innovate will be included.

In Models 4, 5, and 6, the interaction of foreign direct investment with efforts to innovate will be considered.

Here, the independent variables will be derived from the product derived by multiplying each innovation effort by the amount of foreign direct investment.

Models 7, 8, and 9 will study the interaction of a foreign presence in a sector with the attempts to innovate noted in the previous models.

In these three models, the independent variables will be obtained by multiplying each innovatory effort by the value of the foreign presence variable referring to the given firm i in the year t.

The statistical description and the correlation matrix of the variables used in the models for this study are shown in Tables 1 and 2.

Table 1. Descriptive statistics.

Variable	Obs.	Mean	S.D.	Min.	Max.
Ln(FDI)	135,795	6.0191	3.0408	0.0002	12.9989
PAT	135,797	0.1013	0.3017	0	1
PRODINN	135,799	0.4646	0.4987	0	1
PROCINN	135,798	0.4677	0.4889	0	1
PRE	17,486	0.9841	2.3808	0	50
COOP	179,886	0.5234	1.2770	0	7
RDIN	135,806	0.4917	0.4999	0	1
RDEX	135,799	0.2292	0.4203	0	1
INTENSITY	133,622	0.1156	0.2558	0	1
FIN	135,646	0.2298	0.4582	0	1
Ln(SIZE)	133,709	4.199	1.7241	−9.2103	10.6337
Ln(GDP)	179,886	0.1515	0.058	0.0099	0.1952

Source: own calculations from PITEC.

Table 2. Correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11	12
1. PAT	1.000											
2. PRODINN	0.239	1.000										
3. PROCINN	0.152	0.412	1.000									
4. COOP	0.274	0.355	0.305	1.000								
5. RDIN	0.292	0.522	0.354	0.408	1.000							
6. RDEX	0.216	0.326	0.245	0.38	0.402	1.000						
7. INTENSITY	0.116	0.174	0.061	0.182	0.361	0.202	1.000					
8. FIN	0.252	0.298	0.230	0.388	0.447	0.359	0.246	1.000				
9. Ln(FDI)	0.163	0.246	0.248	0.137	0.175	0.106	0.053	0.117	1.000			
10. PRE	0.099	0.078	0.088	0.1908	0.100	0.100	0.008	0.126	0.043	1.000		
11. Ln(SIZE)	0.049	−0.024	0.073	0.109	−0.060	0.040	−0.234	0.030	0.003	0.387	1.000	
12. Ln(GDP)	−0.052	0.016	0.047	0.037	−0.057	−0.059	0.006	−0.026	0.012	−0.011	−0.082	1.000

Source: own calculations from PITEC.

As shown in the correlation matrix, all the relationships between the variables from 1 to 10 are positive.

4. Results and Discussion

The section below will consider the effect of innovatory efforts that affect the absorption of foreign direct investment to achieve good innovation outcomes. A logistic regression model was utilized, rather than a linear one, to present the results using odds ratios, which provides an idea of the impact of variants of individual binary variables.

The intention was to demonstrate, in this way, that innovation in firms, foreign direct investment, and its absorption were not haphazard, but depended to a great degree upon strivings towards innovation on the part of Spanish companies.

On the same lines as in previous work, in the first three models, attention will first be paid to the individual variables mentioned above. Thereafter, consideration will be given to the interaction of foreign direct investment and any foreign presence in the sector with efforts to innovate.

The results obtained with Stata 14.0 from the nine models are summarized in Table 3.

Table 3. Logistic regression results.

	PAT	PRODINN	PROCINN	PAT	PRODINN	PROCINN	PAT	PRODINN	PROCINN
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**
Constant	−9.183 (0.000) ***	−4.3 (0.000) ***	−4.743 (0.000) ***	−6.859 (0.000) ***	−2.389 (0.000) ***	−2.354 (0.000) ***	−7.141 (0.001) ***	−3.308 (0.009) ***	−3.698 (0.000) ***
Ln(FDI)	0.15 (0.000) ***	0.151 (0.000) ***	0.155 (0.000) ***						
PRE	0.019 0.57	−0.044 (0.055) *	−0.047 (0.017) **						
COOP	0.182 (0.000) ***	0.321 (0.000) ***	0.382 (0.000) ***						
RDIN	2.157 (0.000) ***	1.882 (0.000) ***	1.262 (0.000) ***						
RDEX	0.331 (0.004) ***	0.695 (0.000) ***	0.526 (0.000) ***						
INTENSITY	1.555 (0.000) ***	−0.383 0.273	−1.392 (0.000) ***						
FIN	0.372 (0.001) ***	0.176 (0.039) **	0.311 (0.000) ***						
Ln(FDI) * COOP				0.015 (0.000) ***	0.045 (0.000) ***	0.04 (0.000) ***			
Ln(FDI) * RDIN				0.124 (0.000) ***	0.189 (0.000) ***	0.139 (0.000) ***			
Ln(FDI) * RDEX				0.047 (0.000) ***	0.038 (0.000) ***	0.061 (0.000) ***			
Ln(FDI) * INTENSITY				0.004 0.697	−0.012 0.157	−0.066 (0.000) ***			
Ln(FDI) * FIN				0.046 (0.000) ***	0.029 (0.000) ***	0.036 (0.000) ***			
PRE * COOP							0.017 (0.013) **	0.036 (0.000) ***	0.057 (0.000) ***
PRE * RDIN							0.053 0.289	0.082 (0.025) **	0.014 0.696
PRE * RDEX							0.069 (0.052) *	0.132 (0.000) ***	0.172 (0.000) ***
PRE * INTENSITY							−0.04 0.578	−0.248 (0.016) **	−0.238 (0.012) **
PRE * FIN							0.022 0.522	0.039 0.289	0.022 0.558
Ln(SIZE)	0.102 0.227	0.005 0.917	0.228 (0.000) ***	0.31 (0.000) ***	0.192 (0.000) ***	0.303 (0.000) **	0.071 0.383	0.041 0.363	0.228 (0.000) ***
Ln(GDP)	−6.623 (0.000) ***	2.175 (0.000) ***	3.79 (0.000) ***	−5.052 (0.000) ***	−0.642 (0.001) ***	0.872 (0.000) **	−7.306 (0.000) ***	0.421 0.369	2.633 (0.000) ***
Sector coefficients	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Figures with *, **, and *** indicate a level of significance of 10%, 5%, and 1%, respectively. Source: own calculations from PITEC.

According to these empirical results, the probability of a company developing new patents increases significantly with foreign direct investment in its sector, internal and external R&D spending, cooperation between organizations, the size of R&D staff, and public funding.

In the light of this, it should be clear that any decision a firm makes regarding foreign direct investment should not be seen as trivial, because its decision can have a positive influence by increasing the likelihood that the enterprise will achieve innovation, reflected in the patent applications. The same is true of inter-firm cooperation, since companies engaging in cooperation over innovation attained the best outcomes in terms of patent applications.

These results support all hypotheses presented this piece of work, as the proposed models point to a strong, significant relationship between foreign direct investment in a sector and innovation outcomes. The greater the effort to innovate when there is foreign direct investment in a business, the larger the business's capacity to achieve innovations regarding its products. So, if a firm makes a more extensive innovation effort, then it

achieves higher productivity. Sánchez-Sellero et al. [67] suggest that, as a consequence of this, innovation outcomes provide benefits in terms of productivity.

Regarding the total personnel assigned to R&D, no clear positive or negative effect was seen following the successful implementation of product innovations.

In light of these results, it would appear that the number of R&D staff may be inversely proportional to process innovation. This may be due to that fact that increasing the proportion of research and development personnel relative to the total staff might reduce company productivity, eroding attempts to innovate processes. In those firms whose employees have few qualifications, the effects on the employment of local innovatory activities are significantly negative, with these effects having no impact on the knowledge derived from other regions [68].

We accept Hypothesis 1 (H1): external collaborations for innovation favour the absorption of Foreign Direct Investment so as to achieve beneficial outcomes from innovation. This result is aligned with that of Faems et al. [25], suggesting that there was a positive relationship between the innovatory performance of an enterprise and its cooperative links with other organizations, and with that of Bataineh et al. [69], highlighting the importance of R&D investment for firms seeking to obtain a competitive advantage.

We found a positive link between the interaction of FDI and R&D spending with the attainment of good innovation results, confirming Hypothesis 2 (H2). This is in accordance with the previous finding of Yıldırım and Arun [35], which showed that work on R&D, in combination with FDI, led to better innovation outcomes.

Our results confirm Hypothesis 3 (H3), that the interaction of FDI with R&D outsourcing has a positive link with the achievement of good innovation outcomes. This finding is a new contribution in relation to the previous findings of Cammarano et al. [38], which considered that the externalization of R&D positively affected the benefits of innovation.

The previous study of Afcha and López [48] states that the government subventions have an influence on the combination of internal and external R&D expenditure, favouring a good innovatory performance by firms. In this way, our results provide an additional result: the interaction of FDI and government financing stimulates the attainment of beneficial innovation outcomes, confirming Hypothesis 4 (H4).

The empirical findings show that if a business makes efforts to innovate, combining internal and external R&D, then cooperation between entities or public funding, in conjunction with foreign direct investment, will increase the likelihood that the firm will submit patent applications.

In this model, it may be observed that only the combination of a foreign presence in the sector, external cooperation, and external de R&D actions will favour applying for patents.

Overall, the results show that the greater the attempts to innovate, as measured by the investigated variables, apart from the number of R&D staff, the greater the probability of a company innovating its products.

Only the combined effect of the variables of external cooperation with internal and external R&D spending has a significant impact on triggering product innovations in firms. In contrast, the number of R&D employees or public funding in combination with a foreign presence in a sector have no significant linkage with product innovation. In accordance with this model, it may be stated that a foreign presence in a sector, when combined with external cooperation, or internal and external spending on R&D, encourages innovations in an enterprise's products.

The results also establish that the greater the efforts to innovate, as measured by the studied variables, apart from the size of the R&D staff, the greater the likelihood of a company innovating its products. Increasing the number of R&D staff without any growth in the overall number of employees in a firm does not increase the probability of there being innovations in processes within the company.

Only the joint effect of the variables of external cooperation and internal and external spending on R&D has a significant impact on the creation of innovative products. The results show that a foreign presence in a sector, taken together with cooperation with out-

siders and internal and external expenditure on R&D, will encourage product innovations in firms.

5. Conclusions

The results from the estimates show a strong relationship between efforts to innovate, foreign direct investment, absorbing such investments, and achieving good innovation outcomes. Moreover, the combined influences of foreign direct investment, R&D spending, and the number of staff devoted to research activities further encourage the achievement of innovation in the form of patent applications in Spanish firms.

As more effort was put into innovation by Spanish companies, as seen in the R&D expenditure, external cooperation, numbers of personnel employed on research work, external funding, and FDI, a corresponding increase was seen over the thirteen years addressed by the models, in applications for patents and in process and product innovations, in the investigated businesses.

Striving to innovate creates a favourable climate for establishing patents. These are extremely valuable in protecting the competitive edge that companies attain. When the patent rights held by firms were solid and extensive, these enterprises succeeded in achieving other positive innovation outcomes.

It has been noted in the reported work that collaborating with research organizations and competitors has a positive impact on the capacity to innovate products. Such product renovations can be used to in the strategic differentiation of the goods offered for sale by an organization. This meets the demands of the marketplace, builds up customer loyalty, and improves the firm's profitability. Process innovation differs, as it is a form of renovation within a business.

Such novel procedures are also complementary to organizational innovation, without limiting innovative performance. The complex complementary links within innovation-targeting processes are a consequence of the simultaneous development and integration of new machinery and new forms of organization.

FDI was shown to be a source of competitive advantage because it offers the capacity to improve scientific and technological innovation in Spanish firms through organizational learning. The acquisition of know-how and technology through such learning accelerates innovation in companies.

This form of inward investment enhances the absorption of results from innovation and encourages economic growth thanks to the diffusion of novelties in host enterprises. Innovation takes place when firms can set up new processes to produce their existing lines of goods more efficiently, differentiate products already in existence, or introduce completely novel items to boost sales and performance on the market. When FDI reaches receptor economies, it triggers innovatory activities.

A foreign presence in a sector also has a positive effect on the achievement of good outcomes through innovation. As the complexity and cost of participating in innovation have risen, collaboration has followed suit. Through their associations with others, businesses attempt to keep up with developments, to expand their incidence in the market, to gain access to a broader base of ideas and technology, and to pinpoint new goods or services that they can put on sale more quickly than their competitors.

Companies that invest the most in R&D manage to bring novelties into their procedures faster than their competitors, and this allows them to enhance the quality of their products, and hence grow more rapidly, enabling them to move into new markets.

There is a positive relationship between performing well in terms of innovation and the inter-organizational cooperation in which a business engages. Collaboration, whether competitive or not, has a positive effect on a firm's innovation performance. Hence, the hypothesis presented above may be seen as being borne out, in the sense that collaborating with outsiders provides support for an enterprise's innovatory activities.

External collaboration on R&D has some impact on innovations in products, which arise from research cooperation with universities, suppliers, clients, and competitors. A link

between R&D outlays and the management of innovation emerges as one of the principal components in meeting the unique challenges confronting present-day enterprises, by improving the quality of the decisions that are taken.

With regard to the relationship between internal R&D activities and FDI, the empirical results demonstrate that this combination leads to favourable innovation outcomes.

A series of changes in the innovation are tightly linked to the sources of competitive advantage for an enterprise, its drivers to internationalize, the internationalization practices it has adopted, and the set of organizational capacities needed to support such moves and externalize the origins from which innovations are drawn. The results show that the use of open innovation, particularly through using outsiders in R&D, can have a positive impact on innovation performance.

Finally, attention was also paid to the effect of direct subventions, particularly their influence on decisions regarding the proportion of R&D spending directed inside or outside an enterprise. The effect of public funding is positive regarding the absorption of FDI and attaining of good results from innovation. Public subsidies encourage the combination of internal and external R&D spending to improve a firm's innovation performance.

The receipt of public subventions permits businesses to demonstrate their financial viability and the quality of their scientific and technical R&D activities. It reduces uncertainty and aids in correcting information asymmetries, which makes it difficult for firms to access outside finance and to put their products on sale in a technological marketplace.

In sum, both the literature review and the findings from the present piece of research led to the conclusion that decisions about FDI are far from trivial. Similarly, combined efforts involving external and internal spending on R&D, cooperation among enterprises, a foreign presence in a sector, the number of R&D staff, and public funding may increase the probability of good innovation being achieved in the form of establishment of patents and novelties in products and processes.

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References

1. Moreno-Mondéjar, L.; Triguero, Á.; Cuerva, M.C. Exploring the association between circular economy strategies and green jobs in European companies. *J. Environ. Manag.* **2021**, *297*, 113437. [CrossRef] [PubMed]
2. Rafique, M.Z.; Li, Y.; Larik, A.R.; Monaheng, M.P. The effects of FDI, technological innovation, and financial development on CO_2 emissions: Evidence from the BRICS countries. *Environ. Sci. Pollut. Res.* **2020**, *27*, 23899–23913. [CrossRef] [PubMed]
3. Álvarez-Herranz, A.; Balsalobre-Lorente, D.; Shahbaz, M.; Cantos, J.M. Energy innovation and renewable energy consumption in the correction of air pollution levels. *Energy Policy* **2017**, *105*, 386–397. [CrossRef]
4. Baumann, J.; Kritikos, A.S. The link between R&D, innovation and productivity: Are micro firms different? *Res. Policy* **2016**, *45*, 1263–1274. [CrossRef]
5. Li, Z.; Li, J.; He, B. Does foreign direct investment enhance or inhibit regional innovation efficiency? Evidence from China. *Chin. Manag. Stud.* **2018**, *12*, 35–55. [CrossRef]

6. Shen, X.; Lin, B.; Wu, W. R&D efforts, total factor productivity, and the energy intensity in China. *Emerg. Mark. Financ. Trade* **2019**, *55*, 2566–2588. [CrossRef]
7. Zheng, M.; Feng, G.F.; Wen, J.; Chang, C.P. The influence of FDI on domestic innovation: An investigation using structural breaks. *Prague Econ. Pap.* **2020**, *29*, 403–423. [CrossRef]
8. Huang, Y.; Zhang, Y. The innovation spillovers from outward and inward foreign direct investment: A firm-level spatial analysis. *Spat. Econ. Anal.* **2020**, *15*, 43–59. [CrossRef]
9. Alsebai, M.M.M.; Liu, P.; Nie, G. Are technological innovation and foreign direct investment a way to boost economic growth? an egyptian case study using the autoregressive distributed lag (ardl) model. *Sustainability* **2021**, *13*, 3265. [CrossRef]
10. Cohen, W.M.; Levinthal, D.A. Absorptive capacity: A new perspective on learning and innovation. *Adm. Sci. Q.* **1990**, *35*, 128–152. [CrossRef]
11. Sivalogathasan, V.; Wu, X. The effect of foreign direct investment on innovation in south Asian emerging markets. *Glob. Bus. Organ. Excell.* **2014**, *33*, 63–76. [CrossRef]
12. Alfaro, L. Gains from foreign direct investment: Macro and micro approaches. *World Bank Econ. Rev.* **2017**, *30* (Suppl. S1), S2–S15. [CrossRef]
13. Ramasamy, T.; Ruttala, H.B.; Gupta, B.; Poudel, B.K.; Choi, H.G.; Yong, C.S.; Kim, J.O. Smart chemistry-based nanosized drug delivery systems for systemic applications: A comprehensive review. *J. Control. Release* **2017**, *258*, 226–253. [CrossRef] [PubMed]
14. Amoroso, S.; Müller, B. The short-run effects of knowledge intensive greenfield FDI on new domestic entry. *J. Technol. Transf.* **2018**, *43*, 815–836. [CrossRef] [PubMed]
15. Pai, Y. Lukus Vanhonnaeker: Intellectual property rights as foreign direct investments: From collision to collaboration. *Indian J. Int. Law* **2016**, *56*, 537–542. [CrossRef]
16. Girma, S.; Kneller, R.; Pisu, M. Exports versus FDI: An empirical test. *Rev. World Econ.* **2005**, *141*, 193–218. [CrossRef]
17. Kinoshita, Y. R&D and Technology Spillovers Via FDI: Innovation and Absorptive Capacity. *SSRN* **2000**. [CrossRef]
18. Aitken, B.; Hanson, G.H.; Harrison, A.E. Spillovers, foreign investment, and export behavior. *J. Int. Econ.* **1997**, *43*, 103–132. [CrossRef]
19. Glass, A.J.; Saggi, K. Intellectual property rights and foreign direct investment. *J. Int. Econ.* **2002**, *56*, 387–410. [CrossRef]
20. Fombang, M.S.; Adjasi, C.K. Access to finance and firm innovation. *J. Financ. Econ. Policy* **2018**, *10*, 73–94. [CrossRef]
21. Arun, K.; Yıldırım, D.Ç. Effects of foreign direct investment on intellectual property, patents and R&D. *Queen Mary J. Intellect. Prop.* **2017**, *7*, 226–241. [CrossRef]
22. Lutz, S.; Talavera, O.; Park, S.M. Effects of foreign presence in a transition economy: Regional and industrywide investments and firm-level exports in Ukrainian manufacturing. *Emerg. Mark. Financ. Trade* **2008**, *44*, 82–98. [CrossRef]
23. Ongena, S.; Qi, S.; Qin, F. Impact of foreign bank presence on foreign direct investment in China. *China World Econ.* **2015**, *23*, 40–59. [CrossRef]
24. Schilling, M.A. Technology shocks, technological collaboration, and innovation outcomes. *Organ. Sci.* **2015**, *26*, 668–686. [CrossRef]
25. Faems, D.; Van Looy, B.; Debackere, K. Interorganizational collaboration and innovation: Toward a portfolio approach. *J. Prod. Innov. Manag.* **2005**, *22*, 238–250. [CrossRef]
26. Un, C.A.; Cuervo-Cazurra, A.; Asakawa, K. R&D collaborations and product innovation. *J. Prod. Innov. Manag.* **2010**, *27*, 673–689. [CrossRef]
27. Powell, W.W. Inter-organizational collaboration in the biotechnology industry. *J. Institutional Theor. Econ. (JITE)/Z. Gesamte Staatswiss.* **1996**, *152*, 197–215.
28. Chapman, A.; Fujii, H.; Managi, S. Key drivers for cooperation toward sustainable development and the management of CO_2 emissions: Comparative analysis of six Northeast Asian countries. *Sustainability* **2018**, *10*, 244. [CrossRef]
29. Huang, K.F.; Yu, C.M.J. The effect of competitive and non-competitive R&D collaboration on firm innovation. *J. Technol. Transf.* **2011**, *36*, 383–403. [CrossRef]
30. Un, C.A.; Asakawa, K. Types of R&D collaborations and process innovation: The benefit of collaborating upstream in the knowledge chain. *J. Prod. Innov. Manag.* **2015**, *32*, 138–153. [CrossRef]
31. Ollila, S.; Yström, A. 'Authoring' Open Innovation: The managerial practices of an open innovation director. In *Research in Organizational Change and Development*; Emerald Group Publishing Limited: Leeds, UK, 2015; Volume 23, pp. 253–291. [CrossRef]
32. Kim, W.J.; Hoi, T.V.; Tuan, L.N.; Trung, N.N. R&D, training and accessibility to finance for innovation: A case of Vietnam, the country in transition. *Asian J. Technol. Innov.* **2019**, *27*, 172–193. [CrossRef]
33. Zhao, S.; Zhang, B.; Shao, D.; Wang, S. Can top management teams' academic experience promote green innovation output: Evidence from Chinese enterprises. *Sustainability* **2021**, *13*, 11453. [CrossRef]
34. Havins, S.R. Decision Support Systems for Managing Innovation Through Project Selection in Public Sector R&D Environments. *IEEE Eng. Manag. Rev.* **2020**, *48*, 28–31. [CrossRef]
35. Yıldırım, D.Ç.; Arun, K. Effects of economic clusters, FDI and R&D on innovation: Developing countries in European monetary union example. *Int. J. Innov.* **2019**, *7*, 236–251. [CrossRef]
36. León, G.; Tejero, A.; Franco-Riquelme, J.N. New methodology for profiling and comparison of open innovation models to conduct R&D Activities. *IEEE Access* **2020**, *8*, 48491–48502. [CrossRef]

37. Sbernini, F.; Granini, N.; Herbert-Hansen, Z.N.L.; Khalid, W. Contextual factors influencing the success of global product development. *Int. J. Prod. Dev.* **2018**, *22*, 464–487. [CrossRef]
38. Cammarano, A.; Caputo, M.; Lamberti, E.; Michelino, F. R&D collaboration strategies for innovation: An empirical study through social network analysis. *Int. J. Innov. Technol. Manag.* **2017**, *14*, 1740001. [CrossRef]
39. Audretsch, D.B.; Vivarelli, M. Firms size and R&D spillovers: Evidence from Italy. *Small Bus. Econ.* **1996**, *8*, 249–258. [CrossRef]
40. Watkins, T.A.; Paff, L.A. Absorptive capacity and R&D tax policy: Are in-house and external contract R&D substitutes or complements? *Small Bus. Econ.* **2009**, *33*, 207–227. [CrossRef]
41. Cassiman, B.; Veugelers, R. In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Manag. Sci.* **2006**, *52*, 68–82. [CrossRef]
42. Busom, I.; Fernández-Ribas, A. The impact of firm participation in R&D programmes on R&D partnerships. *Res. Policy* **2008**, *37*, 240–257. [CrossRef]
43. Afcha Chavez, S.M. Behavioural additionality in the context of regional innovation policy in Spain. *Innovation* **2011**, *13*, 95–110. [CrossRef]
44. Martínez-Noya, A.; García-Canal, E. Technological capabilities and the decision to outsource/outsource offshore R&D services. *Int. Bus. Rev.* **2011**, *20*, 264–277. [CrossRef]
45. Junior, A.A.B.; Faria, W.R.; Montenegro, R.L.G.; Bahia, D.S.; Gonçalves, E. Research and development, productive structure and economic effects: Assessing the role of public financing in Brazil. *Econ. Model.* **2020**, *90*, 235–253. [CrossRef]
46. Oliver-Espinoza, R.; Stezano, F. Effect of private and public investment in R&D on innovation in Mexico's biotechnology firms. *J. Sci. Technol. Policy Manag.* **2021**, *13*, 746–764. [CrossRef]
47. Mazzucato, M.; Semieniuk, G. Public financing of innovation: New questions. *Oxf. Rev. Econ. Policy* **2017**, *33*, 24–48. [CrossRef]
48. Afcha, S.; López, G.L. Public funding of R&D and its effect on the composition of business R&D expenditure. *BRQ Bus. Res. Q.* **2014**, *17*, 22–30. [CrossRef]
49. Hall, B.H.; Lerner, J. The financing of R&D and innovation. In *Handbook of the Economics of Innovation*; North-Holland: Amsterdam, The Netherlands, 2010; Volume 1, pp. 609–639. [CrossRef]
50. Lampe, R.; Moser, P. Patent pools, competition, and innovation—Evidence from 20 US industries under the new deal. *J. Law Econ. Organ.* **2016**, *32*, 1–36. [CrossRef]
51. Lema, R.; Rabellotti, R.; Gehl Sampath, P. Innovation trajectories in developing countries: Co-evolution of global value chains and innovation systems. *Eur. J. Dev. Res.* **2018**, *30*, 345–363. [CrossRef]
52. Kim, M.; Park, Y.; Yoon, J. Generating patent development maps for technology monitoring using semantic patent-topic analysis. *Comput. Ind. Eng.* **2016**, *98*, 289–299. [CrossRef]
53. Baten, J.; Bianchi, N.; Moser, P. *Does Compulsory Licensing Discourage Invention? Evidence from German Patents after WWI (No. w21442)*; National Bureau of Economic Research: Cambridge, MA, USA, 2015.
54. Zemła-Pacud, Ż. Innovation in the Polish Health Sector: A Quality Assessment. *Econ. Res. Work. Pap.* **2019**, *47*, 1–49. [CrossRef]
55. Garcia-Vega, M.; Kneller, R.; Stiebale, J. Labor Market reform and innovation: Evidence from Spain. *Res. Policy* **2021**, *50*, 104213. [CrossRef]
56. Saeed, S.; Yousafzai, S.; Yani-De-Soriano, M.; Muffatto, M. The role of perceived university support in the formation of students' entrepreneurial intention. In *Sustainable Entrepreneurship*; Routledge: London, UK, 2018; pp. 3–23. [CrossRef]
57. Jiang, B.; Narasimhan, C.; Turut, Ö. Anticipated regret and product innovation. *Manag. Sci.* **2017**, *63*, 4308–4323. [CrossRef]
58. Huang, F.; Rice, J. Openness in product and process innovation. *Int. J. Innov. Manag.* **2012**, *16*, 1250020. [CrossRef]
59. Hervas-Oliver, J.L.; Sempere-Ripoll, F.; Rojas Alvarado, R.; Estelles-Miguel, S. Agglomerations and firm performance: Who benefits and how much? *Reg. Stud.* **2018**, *52*, 338–349. [CrossRef]
60. Lager, T. A structural analysis of process development in process industry: A new classification system for strategic project selection and portfolio balancing. *R&D Manag.* **2002**, *32*, 87–95. [CrossRef]
61. Wheelwright, S.C. *Managing New Product and Process Development: Text Cases*; Simon and Schuster: New York, NY, USA, 2010. [CrossRef]
62. Cetindamar, D.; Phaal, R.; Probert, D.R. Technology management as a profession and the challenges ahead. *J. Eng. Technol. Manag.* **2016**, *41*, 1–13. [CrossRef]
63. Milewski, S.K.; Fernandes, K.J.; Mount, M.P. Exploring technological process innovation from a lifecycle perspective. *Int. J. Oper. Prod. Manag.* **2015**, *35*, 1312–1331. [CrossRef]
64. Frishammar, J.; Lichtenthaler, U.; Richtnér, A. Managing process development: Key issues and dimensions in the front end. *R&D Manag.* **2013**, *43*, 213–226. [CrossRef]
65. Damanpour, F.; Aravind, D. Managerial innovation: Conceptions, processes and antecedents. *Manag. Organ. Rev.* **2012**, *8*, 423–454. [CrossRef]
66. Parida, V.; Patel, P.C.; Frishammar, J.; Wincent, J. Managing the front-end phase of process innovation under conditions of high uncertainty. *Qual. Quant.* **2017**, *51*, 1983–2000. [CrossRef]
67. Sánchez Sellero, P.; Sánchez Sellero, M.C.; Sánchez Sellero, F.J.; Cruz González, M.M. Effects of Innovation on Technical Progress in Spanish Manufacturing Firms. *Sci. Technol. Soc.* **2015**, *20*, 44–59. [CrossRef]

68. Aldieri, L.; Carlucci, F.; Vinci, C.P.; Yigitcanlar, T. Environmental innovation, knowledge spillovers and policy implications: A systematic review of the economic effects literature. *J. Clean. Prod.* **2019**, *239*, 118051. [CrossRef]
69. Bataineh, M.J.; Sánchez-Sellero, P.; Ayad, F. Green is the new black: How research and development and green innovation provide businesses a competitive edge. *Bus. Strategy Environ.* **2023**, *33*, 1004–1023. [CrossRef]