



**FOREIGN MNES AND DOMESTIC INNOVATIVE
CAPABILITES:ARE THERE CONDITIONS FOR
REVERSE SPILLOVERS IN THE SPANISH
INDUSTRY?**

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Abstract

We analyse, over 2004-2008, a sample of approximately 700 foreign subsidiaries and 4,500 domestic firms located in Spain in order to understand the relationship between local R&D cooperation and innovativeness of the firm. Our ultimate objective is to understand whether foreign subsidiaries are likely to make a contribution to local innovative capabilities or if, conversely, they may eventually benefit from conditions for reverse spillovers. Using a variety of specifications for the innovation-related activities of the firm, we find that foreign subsidiaries are more cooperative than the average firm located in Spain, but not necessarily more than affiliated domestic firms (entrepreneurial groups). However, foreign subsidiaries are more cooperative than affiliated domestic firms in sectors considered highly dynamic by international technological standards, whether Spain has a technical advantage in these specific sectors or not. When we focus on companies which are more innovative than the two-digit industries in which they operate, we find that foreign subsidiaries tend to be more cooperative than domestic firms in sectors where Spain displays technological advantage. These sectors comprise traditional industries displaying little innovation dynamism from an international point of view. This finding suggests that there may be conditions for reverse spillovers in these specific Spanish sectors (though measuring them is beyond the objectives of this paper).

Key words: Multinationals, innovation, Spanish industry.

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1. Introduction

Policy makers often wish to attract foreign direct investment (hereafter, FDI) because they see it as a potential source of skills and new knowledge for the host-country. Consequently, competition among countries to attract research and development (hereafter, R&D) intensive FDI has increased (Guimón, 2009).

However, attracting R&D-intensive FDI may not be sufficient. Multinational enterprises (hereafter, MNEs) may operate as enclaves, with little technological impact on the companies and institutions of the host-country (Croné and Roper, 1999; UNCTAD, 2001). Foreign subsidiaries (hereafter, FS) might find the technological resources they need within the multinational network or prefer to cooperate with independent foreign firms or institutions rather than with agents located in the host country. This strategy is likely to hamper their potential influence on host-countries since technology transfers from FDI are more effective when FS build local cooperation linkages (Radosevic and Dyker, 2007; UNCTAD, 2001).

FS may encounter a liability of foreignness (LOF) in host countries. According to some studies, they may find it difficult to establish local linkages owing to their insufficient social capital in the host-country and, therefore, the greater transaction costs which they may incur (Ahuja, 2000). These circumstances may limit their local embeddedness and consequently their potential for transferring knowledge to the domestic economy. On the other hand, countries which have put instruments in place to promote spillovers from FS to the local economy wish to avoid the hollowing out of the local R&D base (Damijan, Kostevc, and Rojec, 2010). Certain authors have, at least theoretically, posed the problem of “multinationals without advantages” (Fosfuri and Motta, 1999). Therefore, it is important to understand whether highly innovative FS are engaged in local R&D cooperation to a greater extent than highly innovative domestic firms, and in what sectors of the host country. However, results of empirical research are not conclusive. Some studies based on the Community Innovation Survey (CIS) of the European Union (EU) find that FS are more prone

to cooperate with agents external to the firm than domestic companies, though exceptions have been reported (Knell and Srholec, 2005; Molero and Heijs, 2002; Torbett, 2001). Analyses of the local linkages of FS in the EU are even less conclusive, since the impact of foreign status seems to change by country and sector (Ebersberger, Herstad, Iversen, Kirner and Som, 2011). To summarise, from the available evidence it is still difficult to tell whether highly innovative FS are intensively engaged in local R&D cooperation.

This paper attempts to contribute to this literature. We examine whether FS that are well endowed with regard to R&D are likely to build local innovative networks and, if so, in which sectors. First, we compare FS and domestic firms, both affiliated and unaffiliated to Spanish entrepreneurial groups. The inquiry takes into account a typology of Spanish sectors that combines the analysis of national technological advantages and the technological dynamism of economic sectors worldwide (Molero and García, 2008). The contributions of our paper are two fold. To our knowledge, this is one of the few studies which compare innovation-intensive FS and innovation-intensive domestic firms. Another contribution of our paper is the analysis of foreign MNEs in different sectors of the host-country, classified according to two complementary axes: the level of host-country technological specialisation and technological opportunity at the international level.

To explore these questions, we use a sample of firms which is statistically representative of the Spanish economy. Spain is one of the most important recipients of inward FDI in the EU (UNCTAD, 2012), hence the interest in studying the Spanish case.

2. Theoretical background and research questions.

2.1 Foreign ownership and local R&D cooperation

According to a review of the literature, in spite of still concentrating most of their R&D activities in the home-country, MNEs tend to increa-

singly innovate abroad (Dunning and Lundan, 2009). Knowledge absorbed from the host country is more important than knowledge absorbed from the rest of the multinational network to ensure quality innovation in the subsidiary (Almeida, 2004; Phene and Almeida, 2008). These findings seem to predict that MNEs would be likely to engage in local cooperation for innovation in their host-countries. However, there are at least two caveats: First, these companies may find it difficult to cooperate for innovation with partners located in the host-country. According to the International Business (IB) literature, the liability of foreignness (LOF) is the additional costs of doing business abroad that are not incurred by domestic firms (Caves, 1996). Owing to their insufficient social capital, the argument runs, FS as compared with domestic firms, may find it difficult to establish cooperative linkages for innovation in the host country. The empirical literature is not conclusive in this respect. Srholec (2009), studying 12 European countries, finds that foreign ownership facilitates R&D cooperation with external partners, especially those located abroad. Busom and Fernández Ribas (2008), in a sample of firms located in Spain, find that it is a predictor of R&D collaboration. In contrast, working with data for the Czech manufacturing sector, Knell and Srholec (2005) observe that foreign ownership is a predictor of not only less local R&D cooperation but also reduced in-house R&D. A study on 22 countries suggests that, in the EU, the presence of FS may be associated with a “branch plant syndrome”, denoting the isolation of these companies with regard to innovation (Ebersberger, Herstad, Iversen, Kirner and Som, 2011). The study actually finds that foreign status is negatively associated with domestic collaboration for innovation. Within Europe, poor embeddedness of FS seems to be more common in countries that are not at the forefront in science and technology (Srholec, 2009).

Other studies recommend that researchers take into account the nature of domestic firms when comparing the R&D cooperative behaviour of these firms to that of FS. Group membership seems to play an important role. In a sample of innovative firms located in Spain, Segarra-Blasco and Arauzo-Carod (2008) find

that, as compared to unaffiliated domestic firms, both FS and affiliated domestic firms are more likely to engage in R&D cooperation (local R&D collaboration is not tested in their model). Molero and Heijs (2002) reach similar conclusions. Annique-Un and Romero-Martínez (2009), studying service companies in Spain, find that membership in a group has positive effects on R&D cooperation (ownership is not considered in their model). Therefore, in this article we compare FS to two different groups: all domestic firms (affiliated and non-affiliated) and, more specifically, affiliated domestic firms. We formulate the following research questions:

RQ1a: Are FS engaged in domestic R&D cooperation to a higher degree than domestic firms?

RQ1b: Are FS engaged in domestic R&D cooperation to a higher degree than affiliated domestic firms?

Regarding host-country expectations, a second caveat is that the foreign company which penetrates the domestic market may be a “multinational without advantages”, to use the phrase coined by Forsfuri and Motta (1999) (or, at least, without technological advantages). In this case, even if it establishes local linkages for promoting innovation, the transfer of technology to the host-country may be weak. Frost (2001) finds that the likelihood that a FS patent cites patents produced in the host-country, a proxy for R&D local collaboration in his study, is positively associated with the innovation scale of the FS as measured by the total number of patents issued to the FS in the application year. His results suggest that highly innovative FS are likely to engage in local R&D cooperation. However, a problem with studies based on patent analysis is that they use citations of local patents as a proxy for local collaboration. They do not measure the actual collaboration between FS and agents located in the host country. This methodological difficulty is overcome in studies based on the Community Innovation Surveys (CIS) of the EU or similar surveys, such as the Spanish PITEC survey used here, because these surveys focus on actual R&D cooperation.

As stated, some studies suggest that poor embeddedness of FS seems to be more common

in countries which are not at the forefront in science and technology (Srholec, 2009). A quite different problem, reverse spillovers, may occur where the domestic industry is R&D intensive (Fosfuri and Motta, 1999). Some studies have found theoretical support for the possibility of technology sourcing, as opposed to technology exploiting, as a motivation for FDI (Driffield and Love, 2003; Kuemmerle, 1999). The IB literature defines technology sourcing as FDI by less advanced companies that seek to upgrade their technology (Bjorvatn & Eckel, 2006).

Defined according to patent analysis (Molero & García, 2008), in our study priority sectors are highly dynamic sectors where worldwide technological evolution is particularly rapid. Spain displays technological advantages in some of these sectors but not in all. Attracting skilled FS to priority sectors may contribute to the upgrading of the Spanish industry. Transfers of technology may be facilitated if the foreign companies engage in domestic cooperation for innovation. Therefore, we propose the following research question:

RQ2: In priority sectors, are highly innovative FS more cooperative than highly innovative domestic firms?

An EU study on innovation classifies Spain within a group of high income, low R&D countries (Ebersberger, Herstad, Iversen, Kirner and Som, 2011). However, some specific Spanish industries may be technologically developed. Therefore, we analyse the behaviour of FS in different Spanish industries. Following the above mentioned study (Molero and García, 2008), we find that Spain displays some technological advantages in specific sectors, and we explore whether conditions for reverse spillovers may exist in those sectors (though the measurement of spillovers themselves is beyond the scope of this paper). Therefore, we investigate the following question:

RQ3: In sectors where Spain has a technological advantage, are highly innovative FS more cooperative than highly innovative domestic firms?

2.2 Innovation and cooperation for innovation

Are innovative firms more willing than other companies to engage in R&D cooperation? Annique-Un and Romero-Martínez (2009) analyse the effects of a variety of innovation indicators on the probability that a firm engages in such collaboration. Companies that are more likely to collaborate, they find, tend to be product or process innovators, or to purchase external R&D. Moreover, they argue, the importance firms assign to internal flows of knowledge is much more relevant to determine collaboration than R&D intensity itself. According to another study, R&D cooperation may be an important strategy to develop new products but not necessarily to develop new industrial processes (Vega-Jurado, Guitiérrez-García and Fernández-de-Lucio, 2009). These results suggest the need to approximate innovation from a variety of angles.

After reviewing the literature, Damijan *et al* (2010) conclude that one of the reasons for the greater propensity of FS to innovate as compared to domestic firms is that the former tend to operate in high tech sectors of the host-country. In our opinion, it is not enough to observe whether a subsidiary is innovation-intensive; it is also necessary to measure whether it is more innovation-intensive than the domestic firms in the industry in which it operates. Consequently, we analyse several indicators of innovativeness and use them to build a combined index. We turn to this question below.

3. Methodology

We use the PITEC database which provides anonymised microdata for Spanish companies that comes from the Spanish Innovation Survey in 2004-2008¹. For a description of the variables used in our study, see Annex 1.

Firms. The database distinguishes different categories of firms: unaffiliated companies and firms belonging to a group. Within the latter, information is provided about the location of the headquarters of the company. If they are located in a foreign country, the company is

¹ This was the available period at the time of research.

classified here as a FS. If not, the company is classified as an affiliated domestic firm, i.e. Spanish firms belonging to a group. Companies not belonging to a group are classified as unaffiliated domestic firms cooperation for innovation. We calculate an indicator called intensity of cooperation which indicates whether the breadth of local cooperation for innovation of the focal firm is above that of the average company in its two-digit industry. This variable indicates the number of different types of cooperative linkages in which the company is engaged in the host-country (e.g. suppliers, customers, other firms of its group). This variable takes values 0 (no domestic cooperation) to 7.

Innovation. We calculate several indicators of intensity of innovation, which measure whether the company is more innovative than the average company in its two-digit industry: Internal R&D expenditures, external R&D expenditures, expenditures to acquire external knowledge, R&D personnel per 1000 employees and, more importantly, an aggregated index that synthesizes the four previous indicators. The combination of the two intensity approaches, cooperation intensity and innovation intensity is important to understand the possible qualitative effects of foreign MNEs on the Spanish economy.

Sector. Another central methodological issue concerns the sectoral breakdown. The theoretical literature strongly supports the need to take sectors into account, since innovation displays critical parameters related to the so-called sectoral systems of innovation and production (Malerba, 2002). The most extended praxis is to use taxonomies that aggregate sectors according to particular innovative factors (see, for instance, Pavitt, 1984). Here, we use a taxonomy (Molero and Garcia 2008, 2010) which combines two complementary indicators: 1), the presence of revealed technological advantages or disadvantages of a country in one particular sector in a determined period of time and, 2), the dynamic international behaviour of a sector based on whether it gains or loses weight in world technological production². Combining both classifications, we arrive at four types of sectors: Dynamic Specializa-

tion (the sector is dynamic worldwide and the host country displays technological advantages); Lost Opportunities (the sector is dynamic worldwide but the host-country shows technological disadvantages); Stationary Specialization (the host-country shows technological advantages but the sector shows scarce technological dynamism worldwide) and Retreat, (the host-country has technological disadvantages and the sector displays poor technological dynamism worldwide). Each sector may include several two-digit industries (for details on this taxonomy, see Molero & García, 2008). CNAE industries. The database contains information on the industry in which the company operates. The Spanish Clasificación Nacional de Actividades Económicas (CNAE), similar to the NACE Rev classification of the EU statistics, is used here to calculate whether the company is cooperation intensive and/or innovation intensive above the respective average levels in its two-digit industry.

Intensity. Since industry effects may affect some variables, we define dummies to capture whether each observation is above CNAE-industry average or not.

4. Results

Before tackling our research questions, we briefly present descriptive analyses of i) the relationship between innovation intensity and local cooperation and ii) the characteristics of the sampled FS as compared to the sampled domestic firms.

4.1 Innovation intensity and local cooperation

We start by exploring whether firms (national or foreign) engaged in cooperation for innovation with agents located in Spain, i.e. other companies or institutions, tend to be intensive in innovation, as measured by scores higher than their respective industry averages. Here, the cooperation variable is a dummy reflecting whether the company cooperates for innovation with a partner located in Spain. We cross tabulate, for instance, the intensity of R&D expenditures (above and below CNAE-industry) and domestic cooperation (Y/N) at the company level; the data are analyzed using

² See Molero and Garcia, 2008 for details

Table nº 1: Analysis of the statistical associations between cooperation intensity of firms and a selection of innovation intensity variables. Summary of results

Innovation intensity over industry average	Significant association with cooperation	Type of sectors
Internal R&D expenditures	Yes	All (except R and SS)
External R&D expenditures	Yes	All
R&D personnel	Yes	All
Knowledge acquisition expenditures	Yes	All
Importance of own R&D resources	Yes	All
% of new products	Yes	All
Sales	Yes	All
Employment	Yes	All
Exports	Yes	All

Key: DS= dynamic Specialization; LO= Lost Opportunities; SS= Stationary Specialization; R= Retreat sectors
Definitions of variables in Annex 1.

Source: own elaboration with PITEC data

Table 2: Statistical associations between cooperation intensity and intensity of Obstacles to Innovate (selection). Summary of results

Intensity of the obstacles over industry average	Significant association with cooperation	Type of sectors
Insufficient external funding	No	All except in DS
Insufficient internal funding	No	All
High innovation costs	Yes	All except R and DS
Insufficient qualified personnel	No	All except in DS
Insufficient technological information	Yes	All
Insufficient market information	No	All except DS and SS
Difficulties to find partners	Yes	All
Demand uncertainties	No	All except DS
Difficulties to access knowledge	Yes	All except R and DS
Insufficient competitiveness	No	All except DS

Key: DS= Dynamic Specialization; LO= Lost Opportunities; SS= Stationary Specialization; R= Retreat sectors
Definitions of variables in Annex 1

Source: own elaboration with PITEC data

Chi squared tests. The results summarized in table 1 show, in most cases, a significant and positive association between the innovation variables and the domestic cooperation variable, a result which clearly points to the idea that local cooperation is not a substitute for the inner innovative effort of enterprises but rather complementary to it -at least according to this general approach³.

³ The summary refers to the association between the indicators of innovation and cooperation, as measured by cooperation intensity with regard to the industry. We also performed some tests with two other measurements of domestic cooperation (the presence of cooperation, Y/N, and the number of different types of cooperation partners). Results were not qualitatively different.

If we repeat the statistical test for each of the four categories of sectors from our taxonomy, the association is confirmed in most of the cases, though there is a noticeable exception. The intensity of internal R&D expenditures and domestic cooperation are not significantly associated in two sectors, Retreat and Stationary. Interestingly enough, both are sectors where technological international dynamism is below average.

Another important aspect of the question is the extent to which there is a relationship between different kinds of innovation obstacles and the cooperative activity of firms. In other

words, is domestic cooperation a mechanism used by firms to overcome obstacles to innovate? From table 2 we can draw some interesting conclusions.

- Regarding difficulties of access to new knowledge, there is a positive association with domestic cooperation in the Lost Opportunities and Dynamic Specialization sectors. Given that both sectors display a higher than average world technological dynamism, this result may suggest that, in these cases, firms use cooperation as a compensatory mechanism.
- Concerning other types of obstacles, the most remarkable is that there is virtually always a positive relationship with cooperation. Again, this suggests that domestic cooperation is used as a compensatory mechanism. However, obstacles and domestic cooperation are virtually never associated in industries included in Dynamic Specialization. Moreover, when the obstacle to innovation is the cost, we again find positive associations with cooperation in Lost Opportunities sectors; again, both are sectors endowed with a substantial technological dynamism worldwide.

Two complementary findings deserve a mention: First, firms oriented to local and regional markets tend to cooperate less than companies oriented to international markets. Secondly, foreign status increases the probability of cooperating; this result is particularly important for our research⁴.

4.2 Characteristics of FS. General overview

In order to clarify the importance and characteristics of FS, as compared to domestic firms, we first performed some cross tabulations and variance analyses to understand the relationship between ownership of the firm (Spanish or foreign) and a large number of variables that measure above average innovation intensity. For a description of variables, see Annex 1. Statistical results are available upon request. A set of interesting findings emerges:

1. The position of FS is higher than that of domestic firms regarding:
 - Size (measured either by sales or workforce). This result is found at the general level and for each of the four types of sectors (from now on: all sectors).
 - The proportion of firms intensive in inner R&D effort (all sectors).
 - The proportion of firms intensive in external R&D effort (all sectors).
 - The propensity to acquire external knowledge (all sectors).
 - R&D personnel over 1000 employees (all sectors).
 - The importance of own resources in financing innovation (all sectors).
 - The percentage of new products on total sales (all sectors).
 - Orientation to national and foreign markets (all sectors).
2. The position of FS is lower than that of domestic firms regarding:
 - Orientation to local or regional markets (all sectors).
 - Any type of obstacles to innovate (all sectors).
 - The importance of resources from other companies to finance innovation (all sectors).
3. There are no significant differences between FS and domestic firms concerning:
 - The share of firms intensive in training expenditures (all sectors)
 - The share of firms intensive in expenditures for introducing innovations into the market (all sectors)
 - The share of firms intensive in expenditures for preparing and distributing innovations (all sectors).

4.3. Impact of foreign status on domestic cooperation.

Following from our central purpose of studying the association of innovation intensity and cooperation intensity, in this section we subdivide the sample into two groups: firms which display a higher propensity to cooperate than the average company operating in the

⁴ Data supporting these two questions are available upon request

same industry and those which do not. We continue taking into consideration only the most innovation intensive companies, since receiving innovation intensive FDI is clearly a priority for the Spanish economy.

In doing so, we have followed a two stage procedure: first, we compared the cluster of FS with all Spanish companies. Next, we selected for comparison a subsample of Spanish firms that belong to groups (SFG), as this is a more symmetrical exercise, since all FS belong to a business group by definition.

4.3.1 Comparison of FS and all Spanish firms

To start, we carried out a twofold analysis: The first and more general one consisted of a comparison between all Spanish companies without distinction and FS (table 3, row 1).

tensive cooperative behavior. S means there is a positive and significant association (over 95% confidence) between the foreign status of firms and their local cooperative activities. An asterisk means that the level of significance is less than 5% (in most of the cases it is less than 10%). N means there is not a significant association between foreign status and cooperation. Table 3 summarizes the results.

The analysis carried out for all firms indicates clearly that foreign status increases the probability that a particular firm cooperates with local agents in innovative tasks (RQ 1a). Thus, based on this result we can assert FS have a positive influence on cooperation in the Spanish Innovation System. Interestingly enough, the positive association is present in the four types of sectors used in the study, so the influence of foreign status on local cooperation is quite widely spread.

Table 3: Comparison between foreign subsidiaries and all Spanish companies. Total sample and subsamples of innovative firms

	All sectors	Lost Opportunities	Retreat	Dynamic Specialization	Stationary
All firms	S	S	S	S	S
Innovation intensive firms according to internal R&D expenditures	S	S	S	S	S
Innovation intensive firms according to external R&D expenditures	S	S	S*	S	S
Innovation intensive firms according to external knowledge acquisition	S	S*	S*	S*	S
Innovation intensive firms according to R&D personnel per 1000 employees	S	S	S*	S	S
Innovation intensive firms according to the aggregate index	S	S	S	S	S

Source: Own elaboration based on PITEC. See definitions of variables in Annex 1.

The second, was an analysis of differences between FS and all Spanish firms in selected subsamples of highly innovative companies (table 3, rows 2-6). In order to go in depth into the consequences of FDI for the Spanish Innovation System, we repeated the exercise for each of the four categories of sectors focused on in the study.

The method is always the same; each time we first observe the weight of FS and Spanish firms in the total sample and then the weight of each of them in the group of firms with in-

Furthermore, we find similar results when we use different criteria to define innovation intensity (e.g. R&D effort, R&D personnel or external knowledge acquisition). Additionally we calculated an aggregate intensity index, which integrates a set of innovation dimensions (see Annex 1). Irrespectively of the method adopted, the positive and significant association of foreign status and local cooperation is also confirmed for those specific subsamples.

The only qualification has to do with the test in which innovation intensity is measured

through expenditures for acquiring external knowledge. In this case the level of significance is lower for three of the four types of sectors with the only exception being the Stationary sector. Therefore, we find some room to hypothesize that there could be a substitution effect between cooperating and acquiring access to external knowledge (for instance, via the outsourcing of R&D services).

4.3.2 Comparing FS and Spanish firms belonging to a group.

So far, results seem to support the idea that FS encourage cooperation for innovation in Spain. This is not unimportant in that Spanish firms in general do cooperate less than firms

In this second stage we followed the same steps as in the former set of comparative exercises: First, we analyzed the relationships between all FS and SFG for all sectors together and specifically for each sector. Then, we performed a similar analysis restricted to companies displaying above average innovative activity (both SFG or FS); criteria for selection are the same as before.

The results shown in table 4 suggest a situation quite different from that revealed in table 3. The positive effect of FS on domestic cooperation is now less clear. In most cases, the association between foreign status and cooperation is negative or not statistically significant. In other words, in general, the positive influence of FS on the Innovation System is not mainly

Table 4: Comparison between foreign subsidiaries and affiliated Spanish companies. Total sample and subsamples of innovative companies

	All firms	Lost Opportunities	Retreat	Dynamic Specialisation	Stationary
	All firms	Lost Opportunities	Retreat	Dynamic Specialization	Stationary
All firms	S*	S*	S*	S*	S
Innovation intensive firms according to internal R&D expenditures	S	S*	S*	N	S
Innovation intensive firms according to external R&D expenditures	N	S*	N	N	N
Innovation intensive firms according to external knowledge acquisition	S*	N	N	N	S
Innovation intensive firms according to R&D personnel per 1000 workers	S	S*	N	S*	S*
Innovation intensive firms according to the aggregate index	N	N	S*	N	S*

Source: own elaboration based on PITEC

located in other European countries (Molero, 2008). However, in earlier research we have demonstrated a remarkable difference across Spanish companies depending on whether they are affiliated or not with a group (Molero and Garcia, 2008). Consequently, next we explore RQ1b. The second stage consists of a set of new comparisons between FS and Spanish firms affiliated with a business group (SFG). In other words, we aim to assess to what extent the apparently positive influence of FS comes from foreign ownership or from the connection to a business group.

due to their foreign status but to their connection to a group. Therefore, when we compare FS and SFG, the strong positive influence of foreign status that we had previously found disappears or actually becomes a negative influence; according to some of the tests FS seem less likely to cooperate than SFG.

Table 4, row 1 shows findings concerning a general comparison between FS and SFG. The influence of foreign status on cooperation decreases considerably compared to results displayed in table 3, since in practically all the

cases the level of significance is now below a 95% confidence level. The sectoral breakdown confirms this point with the only exception being activities included in Stationary sectors; in this case, the cooperative activities of FS are still positive and significantly higher than those of the Spanish groups. Although we shall come back to this question below, it is interesting to notice that the Stationary sectors include important traditional manufacturing activities in which Spain displays relative technological advantages. Does our result mean that FS tend to cooperate more than domestic firms in those sectors in order to take advantage of domestic capabilities? Does it point to the existence of favorable conditions, in certain Spanish sectors, to reverse spillovers in favor of FS?

In order to understand the behavior of highly innovative firms, in rows 2-6 of table 4 we summarize the results of the analysis taking into account only the most innovative intensive companies above industry average). We use the same measurements as previously used to calculate innovative intensity.

Starting with the aggregate index (definition in Annex 1), the first conclusion is that for all sectors together, FS cooperate less than Spanish groups. The negative association is confirmed in two of the four sectoral categories: Lost Opportunities and Dynamic Specialization. An important subjacent issue is that these two sectors are characterized by a substantial technological dynamism worldwide; in one of them (Lost Opportunities), Spain has technological disadvantages and in the other (Dynamic Specialization), Spain shows technological advantages. In other words, irrespectively of the technological position of Spain, FS cooperate less than Spanish groups in internationally dynamic sectors. As shown in previous research (Molero and Garcia, 2008), this situation may point to the scarce contribution of FS to upgrading the Spanish international position in technologically dynamic activities. In the other two sectors –Retreat and Stationary- FS seem likely to cooperate somewhat more than SFG but differences are not statistically significant. Note that both sectors have in common their below average international technological dynamism.

Compared to the general analysis of FS and all SFG, the panorama seems to differ in two subsamples of innovative intensive companies (table 4, rows 2 and 5, column 1): companies with above average internal R&D expenditures and companies with above average R&D personnel per 1000 workers. In both cases the positive influence of FS on domestic cooperation is statistically significant. Nevertheless, the sectoral breakdown shows a different pattern. First, we focus on companies with above average internal R&D expenditures (row 2):

- In Dynamic Specialization sectors -the most appreciated ones in an internationalized economy- most of the estimations give a negative, statistically significant association between foreign status and cooperation. Only one is positive but with little statistical significance.
- In Lost Opportunities and Retreat sectors, differences between FS and SFG are not statistically significant.
- The only case in which the influence of FS on cooperation is clearly positive is for Stationary sectors, where some estimations point to the positive role of FS as compared to national groups. This result provides a robust confirmation that the accumulated advantages of Spanish firms in these sectors –many of which are traditional ones- may be seen as opportunities by FS. Furthermore, in many of those sectors, the Spanish domestic market is both large and expert, probably an additional stimulus for FS to cooperate with domestic firms and institutions.

Similarly, the sectoral breakdown of companies with above average R&D personnel (row 5) reveals that differences between FS and SFG are not statistically significant in three of the four sectors, while in the fourth, SFG are more likely than FS to cooperate in the domestic market.

To summarize: In priority sectors, FS tend to cooperate more than SFG. However, highly innovative FS tend to cooperate less than highly innovative SFG or do not differ significantly from them (RQ 2).

In traditional sectors where Spain displays

technological advantages, the cooperative behavior of FS and SFG does not differ significantly. However, highly innovative FS tend to cooperate more than highly innovative SFG (RQ 3).

5. Conclusions

As expected, the consequences for the Spanish Innovation System of the cooperative activity of FS are not simple or linear. A number of significant nuances arise from the empirical investigation which can be taken into account to orient policies in favor of intense R&D FDI. The most significant findings can be summarized as follows:

- A. Three contextual issues deserve particular attention.
 - In the global cluster of innovative companies, cooperation complements rather than substitutes for the firm's own innovative efforts.
 - Similarly, cooperation seems to emerge as a way of compensating for obstacles to innovation, particularly in the most valuable kind of sectors: Dynamic Specialization.
 - The wider the market of the firms the stronger is the cooperative activity.
- B. The general comparison of FS with Spanish firms confirms the higher level of cooperative activities of the former: This general finding is not negligible for a country characterized by a relatively low level of cooperation among firms and institutions.
- C. However, when we control for the crucial factor of group affiliation, the situation is substantially different.
 - In most cases the idea of a higher level of cooperative activity among FS is rejected. Either domestic companies are more likely to cooperate or FS seem to cooperate somewhat more but the differences are not statistically significant.
 - Superior cooperation levels of Spanish affiliated firms are especially evident in sectors characterized by international technological dynamism, irrespective of whether Spain has technological advantages in those sectors or not. This is a remarkable finding insofar as

it is precisely in these sectors where we would, instead, expect to see technological spillovers from innovation intensive FS.

- The most significant exception to the general trend is seen in Stationary Specialization sectors. Actually, in these sectors, innovation intensive FS do perform significantly more intensive cooperative activities. Interestingly enough, these sectors comprise a quite substantial number of so called traditional industries. The importance of Spain's technological advantages, together with the magnitude and depth of the domestic market, explain, in our view, the proactive cooperative behavior of FS, which are likely to obtain positive inputs for their whole multinational network from cooperation in the host country.

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Annex 1. Description of variables

Name	Description	Values
Type of firm	Foreign subsidiary (1)	Foreign ownership is \geq 50%
	Domestic firm (0)	Spanish firms and joint ventures (foreign ownership is \leq 50%)
Industry	CNAE classification of economic activities	26 two-digit industries
SFG	Spanish company belonging to an entrepreneurial group	Y/N
Size	<ul style="list-style-type: none"> • Employment (no. Of employees) • Sales (in €) 	
Market	<ul style="list-style-type: none"> • Sales in national market • Sales in local/regional markets in the last 2 years • Sales in the EU, in EU candidate countries or EFTA countries • Sales in other countries 	Y/N Y/N Y/N Y/N
Importance of own resources to finance innovation	Share of own resources of the focal company (including credits) in total resources used to finance internal R&D	%
Importance of resources from other Spanish companies to finance innovation	Share of resources from other companies of the group, public sector enterprises, private sector enterprises and research associations in total resources used to finance internal R&D by the focal firm	%
R&D personnel over 1000 employees	No. of employees involved in internal R&D (includes researchers, technicians and auxiliary personnel) over 1000 employees	
Internal R&D expenditures	Internal expenditures in R&D, including personnel, equipment, acquisition of software, etc. in previous year	In €
External R&D expenditures	External expenditures in R&D, including personnel, equipment, acquisition of software, etc. in previous year	In €
Propensity to acquire external R&D	Outsourcing of R&D services through subcontracting or purchases in previous year	Y/N
Share of new products	Percentage of new products in total sales (products are new for the company)	%

Annex 1. Description of variables (cont.)

Name	Description	Values
Obstacles to innovation in the last 2 years	<p>12 different obstacles:</p> <ul style="list-style-type: none"> • insufficient qualified personnel • insufficient technology information • insufficient market information • insufficient internal funding • insufficient external funding • high innovation costs • availability of previous innovations • insufficient demand for innovation • market dominated by other firms • demand uncertainties • difficulties in finding partners • difficulties in accessing knowledge 	1-4 Likert
Aggregated obstacles variables	The obstacles variables were aggregated and re codified into four categories: technological, economic, market and competitive obstacles	4 types of obstacles (the 12 obstacle variables were aggregated and re codified through factor analysis)
Innovation intensity		
Internal innovation expenditures (1)	Internal expenditure in R&D	Y/N
External innovation expenditures	External expenditure in R&D	Y/N
External knowledge acquisitions for innovation	Expenditures with acquisitions of services and licences related to the use of patents and to non patentable technical knowledge	Y/N
Expenditures in technology acquisition	Expenditures in acquisition of machinery, equipment, advanced hardware or software	Y/N
Training expenditures	Internal or external training of the workforce with the specific aim to developing or introducing new or significantly improved products or industrial processes	Y/N
Innovation expenditures	Introduction of new or significantly improved goods and services into the market, including market research and advertisement	Y/N

Annex 1. Description of variables (cont.)

Name	Description	Values
Cooperation variables		
Domestic cooperation variable	Cooperates with partners located in Spain	Y/N
Cooperation intensity	Breath of cooperation (no. of domestic partners types)	Above/below average breath in the two-digit industry in which the firm operates

Notes.

(1) Innovation expenditures are specifically related to the obtaining of new or substantially modified products based on science, technology and other areas of knowledge.

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