An integrative approach to international inbound sources of firm-level innovation

AN INTEGRATIVE APPROACH TO INTERNATIONAL INBOUND SOURCES OF FIRM-LEVEL INNOVATION

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Abstract

We analyze the impacts on host country innovation of three knowledge-containing, inbound flows: imports (including intermediate and capital goods), inward licensing and inward FDI (equity participation of foreign firms). We measure firm-level innovation as the number of new products introduced in the host market and new patents registered by the host-country firms. Our study is the first one to examine the simultaneous impacts of these three inbound flows on host-country firms. We empirically test our dynamic models with panel data of manufacturing firms in Spain (1994-2015). We find positive impacts of all three inward flows, as far as introducing new products to the market is concerned. However, higher equity participation of foreign firms reduces host country patenting. The main implication for host-country firms is that openness to international inflows systematically improves the quality of resource combinations, leading to new products being introduced in the market.

Keywords: imports; inward FDI; inward licensing; product innovation; patents.

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INTRODUCTION

The mainstream international business (IB) literature suggests that various inbound sources of knowledge-containing flows may affect the performance of host country firms (see Rugman (2009)). It argues that these international inflows might have 'dynamic effects,' in terms of stimulating (or hindering) subsequent innovation by the host country recipient.

Much of the extant IB literature has analyzed these dynamics from the perspective of the exporter, licensor or multinational enterprise (MNE) as foreign investor, engaging in foreign sales, licensing, or FDI respectively (Hennart, 2009). Our study complements this literature by adopting the recipients' perspective. We assess the contributions of imports, inward licensing and inward foreign direct investment (FDI) to the recipient firms' innovation outputs. Our research question is the following: *What are the innovation impacts (if any) on host-country firm from importing, purchasing foreign technology licenses and/or having equity partially or fully in the hands of a foreign company?*

A large body of prior research has examined the effects of inward knowledge-containing flows on host-country firms' performance. The literature initially focused on firm-level productivity but has gradually moved toward assessing actual innovations in the host country (García, Jin, & Salomon, 2013; Goldberg, Khandelwal, Pavcnik, & Topalova, 2010). Productivity and innovation are distinct performance measures, but several studies have established the close link between them.[1]

In the present paper, we focus on firm-level innovation. We present for the first time an integrative picture of the impact of inward, knowledge-containing flows on firm-level innovation. Here, we consider novel products brought to the market and patent registrations as a tangible expression of newly established firm-specific advantages (FSAs) of the affected host country firms, see Rugman (1981). New products brought into the market could be viewed as reflecting an increase in a firm's short to medium term innovativeness, whereas an increase in patent registrations is more a reflection of longer-term innovativeness.

There have been several studies focused on the host country impacts of imports and foreign ownership, as discussed in the second section. The studies that were explicitly focused on the host-country firms' innovation levels have generally found a positive impact of imports (Grosse & Fonseca, 2012; MacGarvie, 2006; Wang & Kafouros, 2009; Young, Huang, & McDermott, 1996; Zhang & Song, 2001). Analyses of the specific impacts of foreign ownership on host firms' innovation have been mixed, with some scholars finding a negative relationship (Bishop & Wiseman, 1999; García et al., 2013; Harris, 1991; Rogers, 2004) and other ones a positive linkage (Dachs, Ebersberger, & Lööf, 2008; Guadalupe, Kuzmina, & Thomas, 2012; Love, Ashcroft, & Dunlop, 1996). These contradictory outcomes at least partly result from the common usage of dummies, rather than continuous variables for measuring 'product innovation' and 'foreign ownership' as well as arbitrary thresholds for labelling the latter variable (Bishop & Wiseman, 1999; Blind & Jungmittag, 2004; Frenz, Girardone, & Ietto-Gillies, 2005; Frenz & Ietto-Gillies, 2007; Love et al., 1996). Only a few studies have used continuous variables (Aitken & Harrison, 1999; García et al., 2013), as we also do in the present study.

Licensing, as the third inward, knowledge-containing flow has been largely ignored by the IB literature as a potential source of subsequent innovation. Mainstream IB theory considers market failure as the key reason for internalization. Given the public goods nature of technological knowledge, licensing involves a high risk of dissipation of the licensor's knowledge advantage and it will therefore only be the preferred entry mode at the end of relevant technology's life cycle, i.e., when it is a mature technology (Rugman, 1980, 1981).

Licensing agreements are**,** therefore**,** typically viewed as a tool of licensor's knowledge exploitation. At the same time, it is broadly accepted that licensing is at the centre of the innovation process in biopharmaceutical products (DiMasi, 2000). Licensing has also been a critical innovation source in the development of chemicals, semiconductors, and precision instruments in recent decades (Arora & Ceccagnoli, 2006; Arora & Fosfuri, 2003; Fosfuri, 2004; Kim & Vonortas, 2006; Lichtenthaler, 2011). It would**,** therefore**,** appear to be relevant to complement the IB literature's view of licencing as a tool of technology exploitation, with the perspective of the licensee, who might view licensing as a tool of knowledge exploration.

As noted above, the central question in our research is whether –and how– imports, inward FDI and licensing affect the innovativeness of host-country firms, in terms of new products introduced in the host country market and new patent registrations. We develop our hypotheses based on insights from the IB strategy literature but adopting a firm-level perspective. We use panel data, spanning a twenty-two-year period (1994-2015), of manufacturing firms in Spain. The panel data include count variables (rather than dummy variables), and we utilize a quasi-differenced generalized method of moment (GMM) estimation of exponential models with endogenous regressors (Blundell, Griffith, & Windmeijer, 2002; Windmeijer, 2002, 2006) for our empirical tests.

We find that imports, inward FDI and inward licensing all have significant and positive effects on host-country firms' product innovation levels. However, increased foreign ownership in a firm reduces its patenting activity. Both firms and governments should benefit from the improved understanding of the impacts of these three sources of innovation on local firms.

Given the state-of-the-art of the mainstream IB literature on innovation, our conceptual and empirical approach enhances scholarly understanding of the role of each international inbound source of innovation. We suggest that the lack of congruent findings in previous studies stems from: (a) incomplete theorizing that neglects the role of licensing; (b) researching international inbound sources, of innovation mainly in isolation; and (c) deploying various metrics that primarily build upon dichotomous variables and, in many cases, establish arbitrary thresholds to define the "yes/no" content in terms of outcomes. Our research contributes to alleviating each of these three elements:

First, we include in our conceptual assessment and empirical analysis, the (foreign) inward licensing operating mode, in addition to imports and inward FDI, as a potential source of host-country firm innovativeness. This possibility had been largely neglected in the extant literature.

Second, we provide an integrative perspective in the sense that we simultaneously investigate the impacts of imports, inward FDI and inward licensing on product innovation levels and patent counts of host-country firms. To the best of our knowledge, no prior study has examined these direct effects in their entirety. Furthermore, we use the internalization theory of the firm to build our hypotheses, and we theorize that innovation reflects novel resource combinations of this new (inbound) knowledge with prior FSAs.

Third, from a methodological perspective, we utilize state-of-the-art empirical models and include only continuous variables, instead of dummy variables, so as to accurately measure impacts. Furthermore, we extend the empirical literature by measuring firm-level innovations as the number of new products and registered patents by domestic firms. In this way, our study captures both market-acceptance and patentable innovations (Liu & Buck, 2007; Wang & Kafouros, 2009). Hence, our findings provide a complete and systematic picture and thus provide a clearer understanding of the phenomenon.

The remainder of the paper is structured as follows: The next section provides a concise overview of the relevant empirical literature and discusses how imports, inward FDI and inward licensing might affect host-country firms' innovations, thereby leading to our hypotheses. The third section describes our research context, the data sources, samples, and the methods employed to test the hypotheses. The fourth section presents the results of the analyses. The final section includes a discussion of our findings and our conclusions, including limitations and suggestions for future research.

THEORETICAL BACKGROUND AND HYPOTHESES

Innovation reflects novel resource combinations, building upon the cumulative resource stocks of firms (Hejazi & Safarian, 1999; Hutzschenreuter & Matt, 2017). Some parts of that knowledge may be disseminated nationally and internationally (Hejazi & Safarian, 1999). The diffusion of knowledge between countries can occur in a variety of ways. Our view is that imports, inward FDI, and technology licensing are three distinct but possibly interrelated, knowledge-containing sources of innovation that could impact directly host-country firms' innovation outcomes. We therefore study these three pathways simultaneously, as potential conduits for domestic firms' innovation.

The effects of imports on host-country firms

Scholars have long researched the effects of international trade on firms' productivity; however, the results have been mixed. For example, Muûls & Pisu (2009) analyzed this topic using panel data for Belgian companies (1996-2004). They explained that their analyses could not determine the direction of causality between importing and productivity. However, they did highlight the presence of sunk costs for imports as well as the fact that importers were more productive than non-importers. Vogel & Wagner (2010) examined this phenomenon using a dataset of German manufacturing enterprises for the five-year period 2001-2005. They found that any positive link between importing and productivity resulted mainly from self-selection bias because more productive firms typically import more. They**,** therefore**,** concluded that there is no clear evidence of importing leading to higher productivity. Castellani, Serti, & Tomasi (2010), using a dataset of Italian firms for the five-year period 1993-1997, reported similar results.

On the other hand, Kasahara & Rodrigue (2008) and Halpern, Koren, & Szeidl (2015) using data from Chilean manufacturing plants (1979-96) and Hungarian manufacturing firms (1993-2002) respectively, found evidence that the use of foreign inputs improved local firms' productivity. Stone & Shepherd (2011) also found a strong positive correlation between imports in intermediate inputs and firm-level productivity, especially for developing countries. Nishimura, Nakajima, & Kiyota (2005) found similar results, based on data for Japanese firms (manufacturing and non-manufacturing) during the 1996-2002 period. In a similar vein, Blalock & Veloso (2007) using panel data (1988-1996) of Indonesian manufacturers, found a positive relationship, as did Andersson, Johansson, & Lööf (2012) for Swedish firms (1997 -2004). Finally, Zhou, Wang, & Yang (2020) using panel data from Chinese manufacturing firms (2000-2005), found that low-productivity firms were more likely to start importing; they concluded that importing had a positive effect on the firm's productivity and the reason behind was the learning-by-importing effect, rather than the self-selection effect. The extant literature thus suggests that imports enhance host-country firms' productivity.

Productivity improvements and innovativeness of a host-country firm are not the same thing, although they are closely related (Hall, 2011; Hall et al., 2009). As regards the latter, Grosse & Fonseca (2012) have argued that imports play a vital role in new FSA development of the local firm and that these FSAs can be a critical source of international competitiveness. Şeker (2012) used firm-level data from 43 developing countries (2002, 2005, and 2008) and found that importing intermediate goods had a significant positive impact on firm-level growth and product innovation. Shepherd & Stone (2012) similarly analyzed firm-level data from 17 developing countries (2002-2006) and also found a positive relationship. Further supporting empirical evidence was found in France for the period from 1986 to 1992 (MacGarvie, 2006) and India –for the 1989-2003 period– (Goldberg et al., 2010) and –for the 1989-1997 period– (Şeker, Rodríguez-Delgado, & Ulu, 2015). As regards China, there is some evidence that Chinese firms have used imports to learn more about the foreign goods involved, and ultimately, to incorporate knowledge on these goods into their own products, so as to become internationally competitive (Young et al., 1996; Zhang & Song, 2001). Wang & Kafouros (2009) found, in their study of Chinese companies in the year 2004, that imports are a driver of product innovation because firms absorb foreign knowledge, *inter alia* through reverse engineering. Recently, using data for the 2000-2006 period, Chen, Zhang, & Zheng (2017) also found support for Chinese firms' enhanced product innovations.

Hypothesis formulation

The above studies suggest that imports can be a relevant source of innovation. We support that local companies can learn directly from the knowledge embodied in foreign intermediate outputs or – through reverse engineering – from importing final goods, whereby they then try to develop their own new products at a lower cost. If the goods imported are the newest technology capital goods, these can also be instrumental in bringing new products to the host country market. We suggest that domestic firms enhance their innovation capacity by combining their existing FSAs with the new knowledge embedded in their imported goods. Consequently, we predict:

Hypothesis 1: Combining imports from foreign firms with the host-country firm's own resource base, will increase the host-country firm's innovativeness, in terms of the number of new products introduced into the domestic market and its domestic patenting activity.

The effects of inward FDI on host-country firms

The existing literature has studied the effects of inward FDI (foreign ownership) on host-country firms' productivity. Damijan, Rojec, Majcen, & Knell (2008) examined the direct effect of FDI (as well as the indirect effects through spillovers) on firm-level productivity in 10 transition countries for the period 1995-2005. They measured 'foreign ownership' through a dummy variable, with a firm considered foreign-owned if the share of foreign equity exceeded 10 percent. They only found a significant positive impact on firm-level productivity in the Czech Republic, Latvia, and Slovenia. Blomström & Sjöholm (1999), using a slightly more refined decomposition of their sample for the year 1991, distinguished among different types of foreign ownership, including firms with a minority foreign ownership (less than 50%) versus a majority foreign equity participation. They found that any level of foreign equity positively affected firm-level productivity. Aitken & Harrison (1999), using a methodologically more advanced approach, considered foreign ownership as a continuum (0%-100%): They investigated Venezuelan plants from 1976 to 1989 (except 1980) and found a positive relationship between the level of foreign equity participation and productivity.

One specific research stream focuses on host-country firms being acquired by foreign investors. Acquirers can, in principle, fully deploy their knowledge assets and drive productivity upgrades in their acquisitions (Hobday & Rush, 2007). However, not all past studies have found a positive effect on productivity. For example, Globerman, Ries, & Vertinsky (1994) examined the impact of foreign acquisitions on Canadian firms in 1985 but, after controlling for size and capital intensity, did not find any significant effects. For the British case, the results were mixed. Harris & Robinson (2002), using firm-panel data for the period 1987-1992, found some evidence that, after being acquired, productivity declined.

In contrast, Conyon, Girma, Thompson, & Wright (2002) analyzed British firms during the 1989-1994 period and found that firms acquired by foreign companies showed an increase in labour productivity of 13 percent. Girma, Kneller, & Pisu (2007) found similar results for the 1988-1996 period. The empirical results for the productivity impacts of foreign acquisitions on host-country firms in other countries have been largely positive, and have included acquisitions in Italy (Piscitello & Rabbiosi, 2005), the United States (Doms & Jensen, 1998; McGuckin & Nguyen, 1995; McGuckin, Nguyen, & Reznek, 1995), Belgium (De Backer & Sleuwaegen, 2003), and Indonesia (Arnold & Javorcik, 2009).

García et al. (2013) were among the first moving the focus from the impact of inward FDI on total factor productivity and labour productivity measures to the indigenous firms' innovativeness. When analyzing a panel of Spanish manufacturing firms (1990-2002), they found that inward FDI in an industry (and individual firms) was negatively related to the innovative output (product innovations and domestic patent counts) of host country firms. More recently, Jin, García, & Salomon (2019) corroborated these prior results (at the industry level) with a panel of Spanish firms (1993-2009) and suggested that higher levels of inward FDI in an industry, increase local market competition and harm domestic firms in terms of innovation output. Somewhat along the same lines, Shamsub (2014) used panel data for 58 developing nations (1997-2007) and found that increasing innovation attracted higher levels of inward FDI; however, higher levels of inward FDI then reduced indigenous firms' innovation performance.

On the other side of the debate, Guadalupe et al. (2012) analyzed a sample of Spanish manufacturing firms for the timeframe 1990-2006. They showed that domestic firms in Spain increased their innovation performance (process innovation and product innovation) after being acquired by a foreign entity. Similarly, Choi, Park, & Hong (2012), assessing a sample of 301 Korean firms (period: 2000–2003), found that foreign ownership was positively related to patent counts. Bena, Ferreira, Matos, & Pires (2017) assessed the impact of foreign ownership from institutional investors in 30 countries over the period 2001–2010 and found that foreign ownership led to higher innovation levels in terms of registered patents by the affected firms. More recently, Joe, Oh, & Yoo (2019) also focused on Korean firms. Using panel data from 1999 to 2013 on Korean firms, they found significant and positive effects at the firm-level and the industry-level of foreign ownership on innovation activities.

Hypothesis formulation

The limited literature on the direct effects of inward FDI on host-country firms' innovation has, so far, been less conclusive. Our analysis builds upon internalization theory (Buckley & Casson, 1976; Hennart, 1982; Rugman, 1981), which suggests in the realm of greenfield investments, that FDI will be associated with knowledge transfers to the host country. In cases of equity participation in existing firms, there will typically be bundling between the foreign investor's FSAs (such as advanced technology and managerial know-how) and the host-country firm's extant resource base (Hennart, 2009; Narula & Verbeke, 2015). A higher level of foreign ownership in host-country firms, by virtue of its higher commitment, would thereby tentatively suggest a higher propensity to transfer knowledge-based FSAs from abroad. In turn, this could then foster new resource combinations, including instances whereby foreign investors mainly introduce improved financial monitoring mechanisms and modern managerial practices, rather than conventional technology. Thus, we predict:

Hypothesis 2: Infusing equity capital and related knowledge resources from foreign investors into a host country operation, will increase the host-country firm's innovativeness in terms of the number of new products introduced to the market and its domestic patenting activity.

The effects of inward licensing on host-country firms

Research on the effects of licensing on business productivity is very scarce and offers conflicting results. For example, Kneller, Pantea, & Upward (2009) examined the relationship between different foreign trade and investment alternatives and firm-level productivity in 26 transition economies (Central and Eastern Europe) in the 2001-2004 period. They did not find any linkage between licensing and firm-level productivity. In contrast, Yasar & Paul (2007) found a significant and positive relationship between foreign licenses and firm-level productivity in a sample of Turkish firms (1990–1996). Hence, there is no consensus about the relationship between licensing and productivity.

In the more narrow realm of innovation, the IB literature on the relationship between licensing and innovation is scarce relative to the large body of past research on the impacts of imports and FDI.

Licensing agreements can be viewed as a source of knowledge exploration (Somaya, Kim, & Vonortas, 2011) because it allows firms to source external technology, and it might be part of a strategic approach to developing new technologies and new products (Bianchi, Croce, Dell'Era, Di Benedetto, & Frattini, 2016; Sikimic, Chiesa, Frattini, & Scalera, 2016). Licensing has been an important source of knowledge in several industries in recent decades (Arora & Ceccagnoli, 2006; Arora & Fosfuri, 2003; Fosfuri, 2004; Kim & Vonortas, 2006; Lichtenthaler, 2011) and it is a relevant defense mechanism to address competition swiftly (Atuahene-Gima, 1992; Moreira, Klueter, & Tasselli, 2020).

On the one hand, the advantages of licensing are well documented: licensees avoid substantial R&D investments; reduce the gestation time from upstream innovation to downstream product; and lower the uncertainties associated with developing new technologies (Elia, Munjal, & Scalera, 2020). For example, Nishimura et al. (2005) developed a model of firm-level productivity growth that distinguishes between innovation through in-house R&D expenditures versus technology absorption, with knowledge diffusion that can be ‘active’ (e.g., through patent purchases) or ‘passive’ (e.g., through learning-by-doing). They tested their model using a large-scale dataset of Japanese manufacturing and non-manufacturing firms for the 1994-2000 period. They found that innovation is a determining factor for firm's productivity and this innovation does not derive solely from in-house R&D activities, but also from purchasing licenses/patents, with the latter more impactful on innovation performance than in-house R&D expenditures.

On the other hand, licensing can also be challenging and affect negatively the firm's innovation performance. For example, Mowery & Oxley (1995) suggested that licensing agreements often require some level of absorptive capacity on the side of the recipient firm, to be successful in upgrading. Here, licensees need to be attentive to tacit elements and, often, must modify the foreign-sourced technology to allow domestic exploitation. The absence of requisite absorptive capacity held by the licensee firm or poor information transfer from the licensor, can negatively affect technology usage. Moreover, if firms rely excessively on licensing instead of nurturing their own R&D capabilities, they might become overly dependent on outsiders, and suffer from R&D myopia (Moreira et al., 2020).

On the potential negative effect of information asymmetries and the complexity of transferring knowledge through licensing, these issues can become more problematic in the context of cross-border licenses (Buenstorf & Geissler, 2013). But the literature on the effects of "foreign" technology licensing on firm-level innovation remains scarce, even though one could conceptually expect (based on varying 'distance' challenges), domestic and foreign inward licensing to have differential impacts on the firm's innovation performance (Moreira et al., 2020). A number of scholars have indeed found significant differences between licensing foreign technologies versus licensing domestic technologies (see Wang, Roijakkers, & Vanhaverbeke (2012) and Li-Ying & Wang (2015)).

There is no consensus about the impact of foreign in-licensing on a firm's innovativeness. Buenstorf & Geissler (2013) suggest that language differences and geographic distance can obscure communication and impede post-agreement licensor involvement. Their research used a dataset from the German's Max Planck Society, with information about more than 2,200 innovations and 700 licenses from 1980 to 2004. They found out that a foreign licensee (overseas company purchasing a German license) was less likely to successfully commercialize the innovation than a domestic (German) licensee. In contrast, Lederman (2010) used data from 68 countries between 2000 and 2006 to analyze the multi-level determinants of product innovation. By using firm-, industry-, and country-level variables, he found, inter alia, that purchasing foreign licenses correlated positively with firm-level product innovation. Concerning emerging economies, Yuandi Wang and colleagues undertook several panel data analyses of Chinese firms (mainly from 2000-2011), and they found a positive effect of purchasing foreign licenses on innovation performance (Li-Ying & Wang, 2015; Wang & Li-Ying, 2015; Wang et al., 2012; Wang, Zhou, & Li-Ying, 2013; Wang, Zhou, Ning, & Chen, 2015). Finally, Wang & Tao (2019) used data from the World Bank about 20 industries in China, and they found that (foreign) inward licensing had a positive influence on the ratio of total sales accounted by new products introduced between 2009 and 2011.

Hypothesis formulation

We focus on foreign inward licensing, meaning that a local firm acquires the rights to use patented technology developed by a foreign firm from across the globe. According to internalization theory, the most advanced knowledge assets may not be available through licensing because foreign MNEs often prefer to exploit them internally using wholly-owned subsidiaries to avoid the risk of knowledge dissipation (Buckley & Casson, 1981; Buckley & Casson, 1976, 2009; Rugman, 1981).

Hence, technology purchased from external international sources might be recombined with internal resources and generate a higher-level and more difficult-to-imitate new product (Bianchi, Campodall'Orto, Frattini, & Vercesi, 2010; Bianchi et al., 2016; Sikimic et al., 2016).

We sustain that inward licensing should be considered a source of knowledge instrumental to innovation, similar to imports and inward FDI. It may allow domestic firms to engage in improved product innovations and patenting. This leads to our third hypothesis:

Hypothesis 3: Combining licenses provided by foreign investors with the host-country firm's own resource base, will increase the host-country firm's innovativeness, in terms of the number of new products introduced to the market, and its domestic patenting activity.

RESEARCH CONTEXT, DATA SOURCES, AND SAMPLE

Spain offers a unique context to test our hypotheses as it is an 'intermediate' country in technological terms (Santos-Arteaga, Torrecillas, & Tavana, 2019). According to the OECD (2018), Spain remains substantially below the average of gross domestic spending on R&D (total R&D over GDP). As an example, in 2016 the average expenditure on R&D for the OECD countries was 2.3% of GDP; for the EU it was 1.9% but for Spain only 1.2%. This positions Spain among the EU nations with the lowest levels of R&D. To the extent that technological innovation is viewed as desirable for firm-level and macro-level economic 'upgrading,' the question arises what role –if any– could be performed by imports, inward FDI and inward licensing as alternative sources of innovation.

We test our hypotheses using data from the "Survey on Business Strategies" (SBS) for the period 1994-2015. The SBS is an annual survey conducted by the SEPI Foundation with the official support of the Spanish Ministry of Industry. The SBS started in 1990, and it surveys the Spanish manufacturing sector. Since then, around 1,800 firms have been surveyed each year. Two features assure representativeness. First, the SBS combines an exhaustiveness sampling criterion (applied when the firm has more than 200 employees) with a random sampling criterion (used when the firm has up to 200 workers). Second, when a firm drops out of the sample, another firm with statistically similar characteristics is entered to replace it. The SBS thus represents an unbalanced panel dataset but does not suffer from survivor bias.

In accordance with Podsakoff et al. (2003) and Chang et al. (2010), common method variance is not a concern in our case because the SBS: (a) has multiple respondents completing different sections of each questionnaire; (b) assures confidentiality of the answers and anonymity of the respondents; (c) asks for factual measures, rather than opinions; and (d) benefits from data validation (internal control checks) by the SEPI Foundation (in case of any conflict, firms are required to provide documentation to justify the answers).

Given our statistical program restrictions, we had to remove any observation with missing data[2]. Our base sample has 2,947 firms with 22,091 firm-year observations.

Variables and measurements

Dependent Variable:

In our primary models, we first measured the innovative output level by the ***number of innovative products*** (NIP). This is in line with the extant literature on this topic (Bianchi et al., 2016; Bianchi, Frattini, Lejarraga, & Di Minin, 2014; Blundell, Griffith, & Reenen, 1995, 1999; García et al., 2013; Salomon, 2002; Salomon & Jin, 2008, 2010; Salomon & Shaver, 2005).

The SBS collects information on the count of new and significantly modified products introduced in the market by each firm in a given year. According to Almodóvar *et al.* (2014), NIP is a better overall measure of innovative output levels than patent counts, because it likely includes the firm's reliance on external knowledge sources more efficiently than do patents, with the latter often tending to represent a sign of in-house research efforts. However, as we show in the present paper, external knowledge sources can complement in-house R&D to increase patent registrations, see infra.

Therefore, as a complementary dependent variable, we use the ***number of patents*** registered by each firm *i* with the Spanish Industrial Property Registry in a given year. Patent data have been widely used in technology and internationalization literature as a measure of innovation (Almodóvar, Saiz-Briones, & Silverman, 2014; García et al., 2013).

Independent Variables:

Imports: In the context of exports, Salomon and co-authors have used the natural logarithm of export value as a proxy for exporting when testing its effects on product innovation (Salomon & Jin, 2010; Salomon & Shaver, 2005). We follow the same approach for imports, and we calculate the Ln(import value in euros+one). This metric has been used before in work on the related subject matter (Almodóvar et al., 2014; García-Vega & Huergo, 2017). The use of a natural logarithmic is adequate for this variable because it has a highly skewed distribution and logarithm transformations make a positively skewed distribution more normal.

Inward FDI: Following García et al. (2013) and Salomon & Jin (2008), we use the percentage of foreign ownership held in the focal firm. Here, the SBS provides the rate of foreign participation in each firm in a given year (Almodóvar & Rugman, 2014).

Inward licensing: Following Sikimic et al. (2016), we use the total value (in euros) invested in foreign technological licenses. Thus, we calculate the Ln(inward licensing in euros+one). This metric has also been used before in research on related subjects (Azagra Caro, Fernández de Lucio, & Gutiérrez García, 2003; Chang, Chen, Hua, & Yang, 2006).

As described above, inward FDI is measured on a different scale than imports and inward licensing. To test the robustness of our results and make our variables more comparable, we standardized these variables.[3]

Because it is likely to take time for imports, inward FDI, and inward licensing to influence the affected firms' innovativeness, we lagged these three variables by 1-2-3 years. This also allows us to better analyze the temporal relationship between these inward international variables and innovation.

Control Variables:

Firm-level innovations can be driven by many internal and external sources, apart from international business activities (Love & Ganotakis, 2013). To avoid biases in the form of over- or understated effects, we introduced the following set of control variables.

R&D intensity: Almodóvar (2011) found a significant relationship between firm-level R&D intensity and innovation in the Spanish manufacturing industry. Furthermore, R&D investments generate an internal source of knowledge that promotes new product development (Almodóvar, Verbeke, & Rodríguez-Ruiz, 2016; Wang & Kafouros, 2009). In order to predict innovative 'output,' we need to consider the input drivers thereof, such as the total amount of R&D expenditures divided by total sales that can generate innovations and support firms' learning capacity (Cohen & Levinthal, 1989, 1990).

Firm size: Firm size has been shown to be broadly related to strengths in innovation (Acs & Audretsch, 1987; García et al., 2013) and often improves the firm's ability to innovate (Azar & Ciabuschi, 2017; Lederman, 2010). Here, we include firm size, measured by the natural logarithm of total employees. The firm's sales volume could also be used as an alternative proxy for size, but the firm's sales volume is typically strongly correlated with the number of new products brought to the market (Almodóvar et al., 2014; Salomon & Shaver, 2005).

Age: The company's age is a measure of the cumulative experience of the firm (Almodóvar & Rugman, 2015; Nguyen & Almodóvar, 2018). On the possible linkage between age and innovation, Balasubramanian & Lee (2008) and Grimpe, Sofka, Bhargava, & Chatterjee (2017) have argued that firm age is negatively related to innovation. Although this is a contentious point, it has been argued that flexibility and agility to innovate often decrease over time (Lewin & Massini, 2004).

Time effects: We account for aggregate (time series) trends. We expect the firm's innovativeness to be affected by some unusual events (such as the financial crisis), and therefore consider pertinent time effects, to avoid an omitted variables bias. We only report 'yes/no' effects in terms of significant *p* values.

Industry effects: In a similar manner, we expect that industry affiliation may have an impact on innovativeness. We only report 'yes/no' effects in terms of significant *p* values.

Table I depicts the breakdown of engagement with inward, knowledge-containing flows in our sample. Roughly 66.02% of firms from the sample are involved in imports. A fraction, mainly 17.42% (of the full sample) are involved in imports ánd have released new products in the market, just as 4.22% have received imports ánd registered patents in the host country. Regarding the second inward knowledge-containing flow, 19.38% declare inward FDI, but only 5.6% of the full sample have also sold new products in the market, just as 1.22% (of the full sample) registered patents. Finally, 8.35% is engaged in purchasing technology licenses; whereby 3.21% (full sample) have also produced new innovative products, and 1% have bought foreign licensing and also registered new patents. Only 2.08% of firms in our sample have released new products in the market and have not been involved with any of these three inward knowledge-containing flows, and only 0.42% have registered patents but have not been involved in either imports, inward FDI, or inward licensing.

Because our sample size is very large (22,091 firm-year observations), the presence of some small percentages above, still allows meaningful statistical analyses, for example**,** in the realm of the effects of inward licensing.

INSERT TABLE I ABOUT HERE

We report the relevant correlation matrix to detect any potential multicollinearity. Table II shows the correlations of the independent and control variables, as well as the means and standard deviations. We observe that all the pair-wise correlations of the variables in the same model are lower than the recommended 0.5 threshold, except for "Firm Size" with lagged values of "Imports." We then ran two diagnostic tests, namely the variance inflation factor (VIF) and the tolerance analysis, to detect any potential bias introduced by this high correlation. The individual VIF values are all under 2.1, well under the recommended cutoff point of 10[4]; and all measures of tolerance are all higher than 0.45, well above the suggested cutoff point of 0.1 (Hair, Black, Babin, & Anderson, 2010). The above results indicate that multicollinearity is not a concern.

INSERT TABLE II ABOUT HERE

Statistical methods: linear feedback model

Linear Feedback Model. Innovation activity is by its very nature a dynamic process. The outcome of the innovation activity is measured through a non-negative integer-valued count variable, bunched close or equal to zero. As shown in Table I, only 19.6% of firms in the sample have released new innovative products in the market, and only 4.6% have registered any patents. After the publication of Hausman, Hall, & Griliches (1984), there have been two main linear exponential (or log-link) approaches to regress innovative outputs that are highly left-skewed, namely the Poisson and negative binomial regressions. However, these models are unlikely to provide consistent results. We utilized a quasi-differenced generalized method of moments for a dynamic linear feedback model (LFM) for panel data (Blundell et al., 1995; Blundell et al., 2002). This LFM technique allows the instrumentation of endogenous and predetermined regressors (Imports, Inward FDI, Inward licensing, and R&D) by using weakly exogenous instruments (Blundell et al., 2002), whereby we use a one-year lag on these variables as instruments. The approach has been adopted in previous studies (Balsmeier, Buchwald, & Stiebale, 2014; García et al., 2013; Gurmu & Pérez-Sebastián, 2008; Salomon & Shaver, 2005; Wang & Hagedoorn, 2014). This LFM of order p, that has its source in the integer-valued autoregressive process, can be defined as:

$$y_{it} = \sum_{n=1}^{p} \gamma_n \, y_{it-n} + \exp(x'_{it}\beta + \eta_i) + u_{it} = \sum_{n=1}^{p} \gamma_n \, y_{it-n} + \mu_{it}\nu_i + u_{it}$$

whereby y_{it} the number of innovative products for firm i $(i = 1, \ldots, N)$ at time t $(t = 1, \ldots, T)$; y_{it-n} are the lags which enter the model linearly[5]; γ_n is a parameter to be estimated; $\mu_{it} = exp(x'_{it}\beta)$ where x_{it} is a vector of regressors that includes our independent variables and control variables; β is a parameter vector to be estimated; u_{it} is an additive error term; and $\nu_i = exp(\eta_i)$ is a permanent scaling factor for the individual specific mean.

With predetermined/endogenous regressors, the only consistent estimator is the Wooldridge (1997) transformation. However, when estimating β, x_{it} cannot have only non-negative/non-positive values as the corresponding estimation would be infinity. Because our regressors have this non-negative feature, we follow Windmeijer (2000, 2002) and we transform x_{it} in deviations from overall means ($\tilde{x}_{it} = x_{it} - \bar{x}$).

According to Arellano & Bond (1991), when endogenous/predetermined regressors are instrumented by their lagged values, we are assuming white noise errors. However, these instruments will lose their consistency if errors are serially correlated. Hence, to show that this is not the case, it is critical to report validity tests of these instrumental variables. We used two tests to evaluate their consistency. First, the Sargan test for over-identifying restrictions, where its null hypothesis is that all instruments are uncorrelated with the error term. Second, serial correlation tests whereby M1 tests for lack of first-order serial correlation in the differenced residuals, while M2 tests for lack of second-order serial correlation in the first-differenced residuals. Note that if we test only M2 and it does not reject the null, this could mean not only that the model is well specified, but also that the model suffers from random walk idiosyncratic errors. Hence, we need to combine the two statistics. i.e., reject M1, but not M2 (Arellano & Bond, 1991; Windmeijer, 2002). Thus, the consistency of the model can only be assured if: (a) the Sargan test is not rejected (p-value>0.05); plus (b) M1 is rejected (p-value<0.05); plus (c) M2 is not rejected (p-value>0.05).

HYPOTHESES TESTING AND RESULTS

Table III reports the estimates of the innovation and inward knowledge-containing flows relationship in seven columns. First, we explain the results related to using the Number of Innovative Products as the dependent variable (Table III: LFM0-LFM3). Second, we discuss the results when the dependent variable is the Number of Patents (Table III: LFM4-LFM7). To verify the robustness and consistency of the results depending on the variables included in the analysis, we present different models. Models LFM0 and LFM4 only show the control variables plus the lagged dependent variable. Models LFM1-3 and LFM5-7 incorporate the full set of variables. We have also run different models containing only the independent variables and the results remain the same. In order to reduce the manuscript's length, we do not report these extra columns. Furthermore, and consistent with prior research, all independent variables are lagged one, two or three years to analyze different timing effects. Since signs and significance levels remain uniform across the models, with minor exceptions being the coefficient of inward licensing when lagged three years (dependent variable = number of innovative products), this corroborates the robustness and consistency of our results.

Before examining the coefficients of our models, we revise the Sargan test of over-identifying restrictions where the null hypothesis is that all instruments are valid. We cannot reject this H_o as our p-values go from 0.182 to 0.939 (well above 0.05), so our model is well specified. Similarly, serial correlation tests show the expected behavior as M1's p-values are significant (p-values<0.05), so we cannot reject the null; and the expected behavior of M2 (p-values>0.05)[6]. Overall, the tests assess the validity of the same set of instruments, thereby confirming that our models are correctly specified and consistent.

INSERT TABLE III ABOUT HERE

Regarding the impact of these inward flows on the number on innovative products, as displayed in Models LFM1–LFM3, all three lags of the imports have significant and positive coefficients. The results suggest a positive impact of importing on new innovative product levels and this effect persists over time. These results support our H1, and our findings are also consistent with those of most previous studies (Almodóvar et al., 2014; Şeker, 2012; Shepherd & Stone, 2012).

Table III also shows the results for inward FDI and, in line with our prediction in H2, the coefficients are positive and significant. We can compare our results with findings in prior studies on Spain using the same database. Our findings appear to be in line with Guadalupe et al. (2012), who found a positive relationship, but less so with García et al. (2013). The latter authors generated two competing hypotheses regarding the impact of inward FDI on innovative outputs and used negative binomial regressions for testing their hypotheses; they concluded that the effect was negative. However, their research did not find a significant relationship when the dependent variable was measured by NIP at the firm level (only at the industry level). Furthermore, when checking the robustness of their results, García et al.

(2013) used the LFM as well: under this specification, the sign of inward FDI turns positive, although their coefficients are non-significant. We therefore do not view our results as contradictory with prior work, especially since our research goals and panel data lengths are different. Garcia *et al*. (2013) focused on inward FDI related to the firm- and industry- levels, while we conducted a more comprehensive analysis, including imports, inward FDI and inward licensing. Their models used data from 1990 to 2002, while we used panel data for the period 1994-2015.

Table III displays the results for inward licensing. Models LFM1 and LFM2 indicate that inward licensing has a positive and significant effect on innovation (all p-values=0.000). This supports our H3 and suggests that inward licensing has positive effects on firms' innovativeness, at least, for the subsequent two years.

In our case, the positive and significant results for all three independent variables support our hypotheses. Because of the inclusion of the three lags, it is reasonable to suggest that the positive impact on innovation is significant for the subsequent three years in the case of imports and inward FDI, and, at least for the following two years in the case of inward licensing.

Finally, our control variables measuring firm size and R&D intensity behave as predicted in every model (LFM0-LFM4). They are significant (all p-values=0.000; p-value(Firm Size)$_{LFM0}$=0.010) and positively related to the number of innovative products, which implies that larger firms with more R&D investments are also more innovative. However, the control variables 'age' and 'industry' did not appear to have a significant effect[7].

Regarding the impact of these inward knowledge-containing flows on the number of patents, the lagged values of imports are all positive and significant (all p-values=0.000). These results provide full support for the predicted outcome according to H1.

Regarding inward FDI, we find a robust and significant impact (all p-values=0.000), but this impact is negative on firm-level patents. This negative impact is consistent with previous research of García et al. (2013). The negative impact observed is in line with Hall, Helmers, Rogers, & Sena (2014) who viewed patents as expensive to enforce because firms need to monitor actively any potential violation and then go to court. Especially companies engaged in knowledge exploitation rather than knowledge exploration will be reluctant to go to court in Spain for products that may be new to the firm in Spain but not to the international market.

Finally, inward licensing has a positive and significant impact on patenting. These results provide additional support for the predicted outcome according to H3.[8]

Most control variables behave in the same manner as in the previous model specifications. The effects of both size and R&D are positive and significant (all p-values=0.000). Age has no significant impact on patents. However, 'industry' appears to affect in a significant manner the number of patents that are registered in a given year[9].

DISCUSSION AND CONCLUSIONS

Our study contributes to the literature on the linkages between inward, knowledge-containing flows and the innovativeness of host-country firms. We have extended the mainstream, more piecemeal research on this subject matter. We enrich internalization theory by emphasizing the importance of combining extant FSAs with new knowledge embedded in international inbound sources, in order to develop a higher-level FSA in innovation. We show that domestic firms can acquire new knowledge through international sources (imports, inward FDI and licensing) and that they combine this new knowledge with existing FSAs in order to enhance their product innovation and patents.

We have also used more appropriate statistical methods to assess the above linkages. Our analysis offers a systematic and comprehensive view of the simultaneous effects of imports, inward FDI and inbound-licensing on domestic firms' product innovation levels. We have also included the effects on domestic patenting. We have shown that imports, inward FDI and inward licensing represent distinct ways in which inward, knowledge-containing flows into a host country can stimulate domestic firms' innovativeness.

Our analysis leads to three main conclusions. *First*, domestic firms that import intermediate and capital goods tend to develop a higher number of innovative products than those that source their inputs mostly from the local market. Prior studies have mainly investigated the role of imports on productivity in host countries at the industry-level or macro-level. However, there has been a paucity of research on the impacts of importing intermediate and capital goods on domestic firms' innovation outputs. These imported goods appear instrumental to new knowledge combination.

Second, our study confirms that inward FDI, through foreign ownership participation in local firms, has also had a positive impact on product innovation. Our research outcomes improve on the inconclusive results from the existing literature, where some studies have identified a positive effect, while other ones found a negative one. We built a dynamic model that does not require the exogeneity assumption (LFM). However, inward FDI appears to affect the number of registered patents negatively by the host country companies, thus suggesting a substitution effect between internationally sourced knowledge and domestically registered patents. This may be due to the fact that much FDI in Spain has knowledge exploiting, rather than knowledge exploring characteristics.

Third, the prior literature on IB has not paid much attention to licensing and has not theorized, nor provided any empirical evidence on the direct effects of licensing on local firms' product innovation levels and patenting. Our research suggests exciting avenues for future research in this realm. Licensing appears to be a relevant avenue for accessing foreign firms' technological knowledge so as to support host-country firms innovativeness. Our results suggest that inward licensing has indeed led to a positive effect on local firms' product innovation.

Our study has significant implications for managerial practice and public policy. Given that each of the three alternatives studied, namely imports, inward FDI and inward licensing, is associated with an increase in product innovation, managers should be cognizant of these likely, beneficial effects. In an era characterized by increasing calls for protectionism and de-globalization, our findings also suggest that government agencies interested in boosting local product innovation levels, should, as a rule of thumb, facilitate freer trade and investment liberalization, which in turn will help local firms develop further their knowledge base through novel resource combinations.

Prior industrial organization research has often focused on supposed crowding-out effects and other negative spill-overs, but we have demonstrated in the present paper that entrepreneurship and new resource combinations matter: Importing, foreign equity participation and licensing all result from joint entrepreneurial actions by domestic firms and their foreign partners. Once policymakers are aware of the resulting increases in innovativeness of host-country firms, this insight should systematically outweigh concerns about the domestic, non-entrepreneurial 'losers' of this process, being crowded out for lack of innovativeness. Concerns about alleged crowding out effects typically disregard the importance of entrepreneurial action and novel resource combinations, in spite of their contributions to national competitiveness. In the Spanish context, Guimón (2009) has suggested that the Spanish Government should implement dedicated policies to attract foreign direct investment, precisely because many Spanish manufacturing firms have lost their former low-cost status (as compared to Eastern European and Asian manufacturers), while at the same time lacking international technological leadership.

Our study is subject to the following limitations. First, the SBS survey includes a genuinely representative sample, meaning that our results can be extrapolated to the entire Spanish manufacturing sector. However, this does not mean that our conclusions are fully generalizable to other countries. Even when developed countries share some similarities (for example, economic convergence criteria among EU countries), the situation is far different with emerging economies as they are characterized by weaker innovation systems (Rui, Cuervo-Cazurra, & Un, 2016) and their formal and informal institutions affect their firms in significantly different ways (Peng, Wang, & Jiang, 2008). Hence, further research applied to leading emerging economies, such as India, would be highly recommended. In the same vein, this subject matter may be of special interest to the case of China, because it has been labelled an "aspirant economy" having moved beyond the features of a typical emerging economy (Bruton, Ahlstrom, & Chen, 2019). "

Second, as regards the variable' imports,' the SBS survey does not distinguish between intermediate and capital goods. The novel resource combination processes may be different in each instance. In the case of intermediate goods, these will typically be used as an 'ingredient' in novel resource combinations. In the case of capital goods, these will be deployed to 'craft' new resource combinations that may then lead to new products in the marketplace. Additionally, a higher-level analysis focused on "learning-by-importing" could be highly relevant, especially as to its role in 'copycat' strategies (Shenkar, 2010). This issue is particularly relevant if institutional transitions towards a system punishing intellectual property rights violations, de facto make this copycat strategy obsolete (Peng, Ahlstrom, Carraher, & Shi, 2017a). Peng and his co-authors' studies highlight the relevance of intellectual property rights and explain how countries that become sufficiently innovation-driven, historically have agreed to voluntarily strengthen their intellectual property protection (Peng, 2013; Peng et al., 2017a; Peng, Ahlstrom, Carraher, & Shi, 2017b). Hence, it would appear important to study whether more stringent intellectual property protection policies might diminish the positive effect of imports on innovation.

Third, for the variable 'inward FDI,' the SBS survey does not provide information on the nationality of the foreign investor. Further research about the investor's home country and how this feature might affect innovation outcomes is recommended (Zhu, Ma, Sauerwald, & Peng, 2019). Recently, Deng, Delios, & Peng (2020) highlighted the upward trend in outward FDI from emerging market firms, and how different these firms are from developed market firms. Thus, understanding the effect of inward FDI received from emerging market firms and how this impact might be different from developed market ones would be a promising avenue for future research. For policymakers, it is vital to know which tools can promote not only firms' competitiveness and survival, but also freer trade and cross border activity. Thus, further research on the nationality of investing foreign companies is relevant to policymakers, especially when trying to negotiate agreements with other countries.

Nevertheless, our measures and quantitative analyses are aligned with several prior studies. There is now an urgent need to complement this quantitative work, building upon large samples, with qualitative research (including, *inter alia*, in-depth interviews conducted with managers and development of case studies) to analyze in a more fine-grained fashion the precise mechanisms through which imports, FDI and licensing improve firm-level innovativeness.

Extending our study to include specific types of firms and distinct institutional settings could be highly enriching. For example, as noted by Deng, Huang, Carraher, & Duan (2009), the acceleration of technology diffusion has forced traditional family firms to embark on trajectories of international expansion. These authors studied the impact of FDI on family-firm performance. Following the reasoning used in our research, we recommend conducting studies on how different international activities could affect the innovativeness of traditional family firms. As far as we know, there have not yet been any studies in this realm.

Similarly, there is a line of research that studies the determining factors of new product innovation acceptance in the market (Huang & Hsieh, 2012). Here, an improved understanding as to which international sources of knowledge promote not only new products but also enhance their market acceptance, could be highly beneficial to managers. To the best of our knowledge, such studies are also lacking at present.

Finally, our findings suggest that new knowledge from international sources (imports, inward FDI and licensing) combined with extant FSAs, is important for domestic firms to enhance their product innovation and patentable innovations. Part of these novel resource combination processes might result on the one hand from entrepreneurial (managerial) skills, and on the other hand from supportive macro-level institutions. Thus, future research could examine the relationship between entrepreneurship, innovation and institutions, especially those that protect intellectual property rights and contractual rights and also those that encourage competition and can provide legitimacy (Peng et al., 2017a, 2017b; Tomizawa, Zhao, Bassellier, & Ahlstrom, 2020).

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[1] Griffith, Huergo, Mairesse, & Peters (2006) compared productivity and innovation across Spain, France, the UK, and Germany by using firm-level data from the Community Innovation Surveys for the period 1998-2000. They concluded that the drivers of productivity and innovation are largely similar and that higher productivity is typically associated with higher product innovation. Hall, Lotti, & Mairesse (2009) found similar results for Italian manufacturing firms for the 1995–2003 period. For a comprehensive review of the literature that supports this positive connection between productivity and product innovation levels, see Hall (2011) and Mohnen & Hall (2013).

[2] We use ExpEnd, a specific GAUSS program developed by Frank Windmeijer for the purpose of explicitly analyzing innovation (counts of patents and innovations, as we do). He prescribes how to use his software in several papers (Blundell et al., 2002; Windmeijer, 2002, 2006). Among the ExpEnd requirements, it does not allow for missing data in any of the variables. If there is a missing value in the dataset, the ExpEnd program cannot be applied. Because we lag our independent variables one-, two- and three-years, plus we use a one-extra-year lag of our independent variables as instruments, we need to sacrifice 4 years of data (from 1994-1997) because we cannot have any "gaps" in the individual time series. As our panel data set is long enough (from 1998 to 2015), this does not pose a problem for our analysis.

[3] As an example, the standardization of *lnImports* is calculated as follows: $standardised\ Imports_{it} = \frac{Imports_{it} - \mu_t}{\sigma_t}$, where μ_t is the mean value for $Imports_{it}$ in year t, and σ_t is the standard deviation for Imports_{it} in year t. Thus, the standardized value of $Imports_{it}$ has a mean of 0 and a standard deviation of 1. The other independent variables were constructed analogously.

[4] We should note that the usage of VIFs in international busines research has recently been criticized in a methodological paper, see Lindner, Puck, & Verbeke (2020).

[5] We lagged our dependent variable by one period (NIP_lag1) to build our dynamic panel data. In this way, we controlled for the firm's behavior by considering its degree of habituation because the past might have a direct impact on the present. However, other researchers, in their prior work, introduced not only a one-period lag but also two- and three-period lags when performing similar analyses (Almodóvar et al., 2014; García et al., 2013; Salomon & Jin, 2010; Salomon & Shaver, 2005). We have replicated all our models introducing NIP_lag2 and NIP_lag3, and the results (signs and significance levels) remain uniform across the models. We decided to introduce only NIP_lag1 for the sake of easier interpretation and simplicity.

[6] We observe one discording value (M1:p-value$_{LFM4}$=0.165) that would query its results, but LFM4 only contains the control variables, once the independent variables are included, the consistency of the full model can be assured.

[7] We also incorporated a one-year lag of the number of innovative products to measure the firm's knowledge stock. In Table III we observe that NIP_lag1 enters positively and significantly in models LFM0 and LFM2.

[8] Because of the small sample of firms that use simultaneously two or three inward flows, we remained focused on main effects. Nevertheless, we also conducted an exploratory analysis of the potential interactions among imports, inward FDI, and inward licensing, and their impact on firms' innovativeness. The main effects that support our hypotheses remain the same. Regarding the number of innovative products, we find significant two-way interactions where we observe a complementarity between inward licensing and inward FDI, but a substitutive effect between imports and both inward FDI and inward licensing. Regarding the number of patents, we found a significant three-way interaction that might indicate that licensing plays a relevant role in the decision to patent because, under any level of inward FDI, the highest impact on patenting occurs when the company increases imports and has purchased a high volume of foreign licenses. Further research is recommended to fully understand the potential interactions that these international flows may have.

[9] The lagged value of the number of patents has uneven impact. LFM5 shows that, the number of patents registered one year before has a significant (p-value=0.000) and positive effect on the number of patents that will be registered in the current year; however, the remainder models display a significant effect, but it is negative. This may indicate that the investment (time, money and disclosure risk) undertaken in the last year, will discourage the firm to register more patents during the current year. Thus, more research should be done regarding the impact that investing in patenting has on future patents, as our results do not allow untangling this aspect.