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Commonalities and differences between production-related foreign direct investment and technology-related foreign direct investment in developed and emerging economies

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This paper investigates commonalities and differences in firm-level determinants of internationalization of production (production-related investments or PFDI) and innovation (technology-driven investments or TFDI) by multinational enterprises. Our database is based on a cross-country survey which includes firms within Automotive, Agro-processing, and Information and Communication Technology sectors from both developing and advanced economies. Our results show that despite some differences, most of the determinants affect in a similar manner both the PFDI and TFDI which rather contradicts recent arguments claiming significant differences between the two. More interestingly, however, we found that institutional determinants such as policies related to foreign direct investments play almost no role in internationalization process of firms while managerial (internal to the firm) determinants had a far greater impact.

Keywords: production-related foreign direct investment (PFDI); technology-related FDI (TFDI); multinational enterprises (MNEs)

1. Introduction

The issue of foreign direct investment (FDI) has long been studied by international business scholars who, by and large, have based their observations on the analysis of multinational enterprises (MNEs) from developed countries whose production activities are located in other developed or developing countries (Lall 1978; Saliola and Zanfei 2009). Within this stream of literature, Dunning (1981) pioneered the analysis of three advantages and conditions for foreign investment, typically referred to the ownership, location and internationalization (OLI) framework: ownership advantage, location advantage, and internalization advantage.

However, it has only been in the last two decades that scholars have started to pay attention to the internationalization not only of production activities, but also of knowledge-intensive activities such as R&D. In line with this new stream of literature, some authors have focused specifically on technology-related FDI (TFDI) (Blanc and Sierra 1999; Zanfei 2000; Cantwell and Piscitello 2002, 2005, 2007; Lai, Riezman, and Wang 2005; Acemoglu, Aghion, and Zilibotti 2006; Maskell et al. 2007; Dunning and Lundan 2009). These authors argue that FDI related to production (PFDI) entails different strategies and motivations compared to FDI related to innovation activities (TFDI).

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For the former, the *raison d'être* of investment is to exploit the ownership advantages already possessed by the firm in the new (offshore) location by, to name a few, tapping into natural resources, gaining proximity to suppliers and leading users, and gaining access to foreign markets, i.e. market, resource, and efficiency-seeking motivations¹ (Dunning 2001) resembling an asset-exploiting (Dunning and Narula 1995) or home-base-exploiting strategy (LeBas and Sierra 2002). Noteworthy is the role associated to internationalized R&D, which is believed to follow production to fulfil a support function such as adapting the products to the taste of the hosting market (Prahalad and Doz 1999) while the 'main' and bulk of R&D remains at the home base of the firms (Archibugi and Michie 1995; cf. Amighini et al. 2013).

For internationalization of innovative activities, however, proximity to certain knowledge sources such as innovative firms and their networks, highly skilled personnel, universities, and tapping into knowledge-intensive agglomerations can be seen as important motivations behind investments as they make up for asset-augmenting (Dunning and Narula 1995) or home-base-augmenting (LeBas and Sierra 2002) strategies of the firms. It should be noted that market-driven motivations remain the most common rationale behind FDI, even in the case of internationalizing innovation-related activities; however, knowledge-seeking motives are increasingly gaining importance (see Gammeltoft 2006; Wolfmayr et al. 2013).

Thus, although TFDI has traditionally been considered as an extension of production, recent evidence suggests that TFDI may be the result of a different strategy which, in turn, requires different competences and networks (Castellani and Zanfei 2006). Few studies have taken into account the differences between the two strategies from the perspective of firm characteristics. Moreover, there is a certain lack of focus on firms from emerging economies which, in a concurrent trend, are increasingly involved in asset-augmenting investments by internationalizing their R&D activities. The extent to which TFDI and PFDI differ in their characteristics and, more importantly, in the institutions that affect them will be investigated in this paper using a unique database of firms, from both developed and emerging nations, involved in PFDI and TFDI.

The paper is structured as follows. First, we review the literature on the commonalities and differences between PFDI and TFDI, paying particular attention to the determinants of the two. In Section 3, we introduce the data and the methodology of the empirical analysis. The next section presents the main results. The paper ends with conclusions.

2. Review of the literature

2.1. *Internationalization of production and innovation*

Since the 1980s, firms and, in particular, MNEs have increasingly internationalized not only sales and manufacturing, but also innovation-related activities (Gammeltoft 2006). In the early years, MNEs internationalized their R&D following other activities, such as production and sales, already set up abroad. Such a strategy was directed at exploiting firm-specific capabilities in foreign environments (Dunning, Van Hoesel, and Narula 1997), supporting foreign subsidiaries with complementary design and development capabilities (Gerybadze and Reger 1999), and adapting products and services to local requirements (Prahalad and Doz 1999), the motivations of which were referred to as 'strategic asset-exploiting' (Dunning and Narula 1995) and 'home-base-exploiting' (Kuemmerle 1997).

R&D operations are often accompanied by a manufacturing operation abroad for supporting the local adaption of products to local conditions (Doh et al. 2005). Defever (2006) finds a strong relation between the location of production and R&D, concluding that production and R&D are mutually attractive and that there are strong vertical linkages between these activities, generating cumulative effects as envisaged by the new economic geography theory (Krugman and Venables

1995). From the perspective of the firms' motivation for investing in R&D abroad, the early literature on R&D internationalization generally considers product adaptation as the main motivation and, as a consequence, assumes that R&D is a prolongation of the asset-exploiting strategy underlying the OLI model. This is particularly the case when demand and production conditions in the host country differ from those in the home country, or when the geographical proximity of R&D facilities to manufacturing facilities in the host country reduce the time lag in adjusting production techniques or product characteristics.

However, more recent studies indicate that the R&D function is more and more independent of production; we can say that TFDI shows a different nature with PFDI as it reflects a different strategy – asset seeking – rather than simply asset-exploiting or market adaptation. MNEs are currently moving their research centres abroad not only to attain proximity to local markets, but also to ensure that they are close to centres of scientific excellence and thus able to take advantage of the knowledge generated there and to participate in global knowledge networks (OECD 2004; Alcacer and Chung 2007; Chaminade and Vang 2008; Colovic 2011). This argument of the different nature of TFDI applies to MNEs from developed as well as developing countries. Firms from emerging economies have to adopt a relatively 'radical' strategy – skipping over the phase of international production and conducting TFDI directly (Hong and Sun 2006; Deng 2007, 2009; Rui and Yip 2008). They treat foreign R&D units as a 'springboard' to access advanced technology and tools to develop overseas markets (Luo and Tung 2007). The mission of knowledge-seeking R&D units is also to draw upon advanced technology in an attempt to preserve the technological lead of the MNEs or support the long-term evolution of the core technology of the MNE at the world technology frontier (Athukorala and Kohpaiboon 2010). Thus, R&D units set up at selected locations could serve as both stations for recruiting local scientists and technicians and as points of contact with the scientific community in the host country (OECD 1998).

Thus, although internationalization of R&D has traditionally been seen merely as an extension of production, recent evidence suggests that TFDI may be the result of a different strategy which, in turn, requires different competences and networks. In the next section, we review the literature to try to identify the most important determinants of PFDI and TFDI.

2.2. The determinants of PFDI and TFDI

Despite the different natures of production and innovation activities, most of the literature on internationalization tends to discuss the determinants of FDI in very general terms, that is, including both production and innovation. As discussed earlier, this reflects an implicit assumption that R&D is a support function of production aimed at adapting products to the new market (i.e. it is development more than research).

The literature identifies determinants of FDI at the firm, industry, and regional/country levels. Firm-level determinants include these competences: R&D, human resources, export, and international experience (Kumar 2007; Lin 2010), as well as the networks in which the firm is engaged; industry-level determinants include degree of competition, technological development of an industry, and network linkages (Yang et al. 2009); and country- and regional-level determinants include macroeconomic indicators, development-related indicators, import and export, the institutional environment, and natural resources (Zhang and Daly 2011; Kolstad and Wiig 2012).

2.2.1. Firm-level factors

Type of the firm: Size and ownership have traditionally been considered as important determinants of the degree of internationalization of a firm. Internationalization is believed to be a resource-intensive and rather risky process. Larger firms, compared to their smaller counterparts,

potentially have more resources to take on this process, which is evident as large multinational companies represent the usual suspects in internationalization studies. On the other hand, smaller firms have more organizational flexibility and are less dependent on their internal capabilities as sources of knowledge, which pushes them to look for external sources by, for instance, getting involved in offshoring activities (Fernhaber, Gilbert, and McDougall 2008; cf Herstad and Ebersberger 2013). Recent studies on ‘born global’ firms bear witness to this notion (Barnard and Chaminade 2011). Therefore, being a large firm could be seen as both increasing as well as reducing the tendency to get involved in the internationalization process. Moreover, a UNCTAD report (2006) indicated that it is not only the MNEs (and their subsidiaries), but also the stand-alone companies that are involved in globalization and, in particular, global innovation networks (GINs) (UNCTAD 2006) and should not be excluded when studying different forms of internationalization.

Global orientation: Global orientation has proved to be a determinant of international production. Dunning (1980) points out that international economic involvement is helpful to identify the determinants of whether foreign markets are exploited by trade or by direct investment. Many scholars find that for MNEs, there is a strong substitution between global trade and FDI (Horst 1974). The stages approach to internationalization (Johanson and Vahlne 1977) attributes export as a low-risk activity which firms engage in initially before they move on to perform more challenging tasks such as offshoring production (Wolfmayr et al. 2013). In this view, the internationalization of innovation-related activities such as R&D is to follow production, a notion shared by many OLI-based internationalization theories.

As for TFDI, global orientation is still an effective explaining factor. By defining strategic orientation as a construct consisting of underlying interaction of three subcomponents – aspiration level, mindset, and industry context – Kedia, Gaffney, and Clampit (2012) argue that the more global a firm’s aspiration level, the more externally focused a firm’s mindset, and the more dynamic the industry, the more likely the firm will conduct TFDI.

R&D intensity: Buckley and Mathew (1980) points out that R&D intensity is an important determinant on MNEs’ PFDI decision. Firms with high-level R&D intensity tend to internalize their R&D advantage when developing overseas markets. According to Dunning’s (1980) eclectic theory, R&D intensity is a kind of ownership advantage that firms with such advantage would like to exploit in foreign markets to adjust their products to satisfy the need of local customers.

R&D intensity is also an apparent predictor of TFDI. The reasons why MNEs conduct TFDI are mainly based on two aspects: technology exploitation and technology exploration (Gammeltoft 2006). On the one hand, for MNEs from advanced economies, if their R&D intensity is high, they can exploit such technology advantages to guarantee their market share in foreign markets. On the other hand, for MNEs from emerging economies, high-level R&D intensity means that they value knowledge and technology and can access qualified talent overseas to compensate for their R&D shortcomings through TFDI (Granstrand, Hakanson, and Sjolander 1992; Håkanson and Nobel 1993; Florida 1997; Reddy and Sigurdson 1997; Minin, Zhang, and Gammeltoft 2012).

Innovation: The degree of novelty is also an important determinant of PFDI, particularly if the firm is following an asset-exploiting strategy. Since the research and development of an innovation is a costly process, one may expect that the firm will try to exploit its innovation in different markets to increase the returns on its investment (Archibugi and Michie 1995). Thus, more innovative firms in terms of output will be more prone to internationalizing their products or services. Furthermore, precisely due to the increasing complexity of technology, we may also expect that firms need to increasingly draw on a variety of sources of knowledge beyond R&D, independent of their physical distance. Therefore, FDI may be a way of gaining proximity to otherwise distant sources of knowledge.

Innovation is considered as an important determinant of FDI for MNEs from emerging economies that have built up advantages from the adoption of innovative organizational forms (Mathews 2006). For example, Bonaglia, Goldstein, and Mathews (2006) describe in detail some of the organizational innovations adopted by three MNEs from emerging economies in the white goods sector. They notice that rather than adopting an organic pattern of development, these firms have focused their efforts on investing in strategic functions such as top-level human resources and R&D in order to be able to compete with global players either in their home markets or abroad.

Inter-firm links: Participation in networks is a crucial means for MNEs to complement their existing resources (Elango and Pattnaik 2007). However, of the early studies targeting FDI from advanced economies, very few investigated the phenomenon of linkages, which is of paramount importance for firms in emerging economies (Chen and Chen 1998; Makino, Lau, and Yeh 2002). Just as Mathews (2002, 2006) points out, MNEs from emerging economies could use the linkages with advanced companies as a leverage to overcome their disadvantages as ‘latecomers’. The experience of the Asian tigers shows that through their participation in networks, firms have improved their capabilities and learned how to enter into the international markets (OECD 2007). In a study of almost 800 Indian firms, Elango and Pattnaik (2007) conclude that firms more easily create their capabilities through learning within established networks rather than building them following a sequential process. Duysters et al. (2009) emphasize that the procession of dynamic capabilities at the entrepreneurship level, innovative management practices, and the ability to enter into new markets and sectors via strategic alliance and acquisitions have allowed two of the most successful MNEs from China and India, Haier and Tata, to grow very large and to be very successful. Besides inter-firm international connections, Buckley, Forsans, and Munjal (2012) also highlight the important role of home country–host country linkages, including both trade linkage and non-trade linkages, in determining FDI. They find that India’s North–South linkages within the G20 and the Commonwealth are significant in explaining foreign acquisitions by Indian MNEs.

Scholars pay much attention to the impact of links with universities on FDI when considering internationalization of R&D rather than internationalization of production. Referring to global R&D investment, a few studies have underlined the important role played by the existence of linkages between universities and firms in particular clusters (Audretsch and Feldman 1996; Thursby and Thursby 2006; Alcacer and Chung 2007). Knowledge clusters are often characterized by high-quality universities, which supply skilled labour as well as basic research. The opportunity to network with high-quality universities in the same region is considered as an important location factor because it facilitates knowledge transfer. The more tightly a firm can build linkages with universities and institutions in the host country, the more likely it would like to conduct TFDI there. More specifically, Liu and Chen (2012) find that in regions with strong knowledge exploration and exploitation subsystems, where local research centres, higher education institutes, and technology trading units play active and critical roles, MNEs’ local R&D units have a greater tendency to pursue technology-augmenting strategies.

2.2.2. *Industry-level factors*

Audretsch and Feldman (1996) had already by the mid-1990s linked the type of industry to the geography of production and innovation. They indicate that resource-based and science-based industries are geographically more concentrated than scale-intensive ones. Furthermore, in the case of science-based industries, they compare the geography of production to the geography of innovation and show that both production and innovation tend to be concentrated in high-

tech or R&D-intensive industries. They also indicate that the propensity to concentrate innovation activity cannot be completely explained by the propensity to concentrate manufacturing activity and that the concentration is higher in highly skilled industries (Audretsch and Feldman 1996). It has been found that there is always some innovation occurring in production and that there is a certain overlap between GINs and global production networks (GPNs)² (Verspagen and Schoenmakers 2004; Fifarek and Veloso 2010). In this line of research, Miriani (2002), using data on Japanese subsidiaries in Europe, suggests that innovation tends to follow production but that the more R&D intensive a firm is, the more likely it will be to establish R&D units independent of production. The higher the technology intensity of the firm or industry, the higher is the probability to have innovation independent from production. Moreover, firms from different industries are believed to have specific knowledge bases and innovation processes, as well as overall characteristics, that impact their involvement in globalization processes (Asheim and Gertler 2005).

2.2.3. *Institutional factors at regional and country levels: the role of policies*

Despite the importance of firm-level characteristics in the decision to locate production or innovation activities abroad, FDI is strongly influenced by the institutional environment. Institutions are defined here in broad terms, including policies, norms, rules, conventions, habits, values, and institutional arrangements (like corporate hierarchies or networks) (North 1990; Hollingsworth 2000).

In the case of TFDI, we might expect that the systems of innovation of both the host and the home countries of the MNE strongly influence TFDI. As Asheim and Gertler (2005) indicate for a proper understanding of the dynamic of technology-driven activities, it is necessary to look at the context in which firms are located. It is argued that the *local* environment and the social context in which firms are embedded create a favourable milieu for the transfer of tacit knowledge through direct face-to-face contacts, spontaneous mechanisms of learning, common cultural and traditional values, and interpretative schemes (Asheim and Cooke 1999; Maskell and Malmberg 1999; Bathelt, Malmberg, and Maskell 2004; Asheim and Gertler 2005; Asheim and Vang 2006). However, this rich stream of literature is quite limited when it comes to explaining how national or even international institutional frameworks shape TFDI strategies or the interplay between different levels of institutional frameworks (local, national, and international).

It is not at all evident whether the different policies and agreements genuinely provide institutional frameworks that stimulate these TFDI or whether, on the contrary, they are more a hindrance to these cross-national flows. Scholars attach a great deal of importance to country-level institutions; some examine the effect of institutional distance (Xu and Shenkar 2002; Barnard 2008), while a few others emphasize the influence of institutional quality (Zhang, Zhou, and Ebbers 2011). Industry-level institutional constraints come from industry regulatory standards, intellectual property protection, protection of local 'champion' firms from competitive disadvantage, regulated or sensitive industries, and so on. Other firm-level institutional factors include the culture and routines of the organization. Internal characteristics of the firm such as their organizational flexibility are important factors in the way they introduce changes in their routines and organization in order to cope with different environments such as that of their hosting location.

This paper will next investigate the extent to which there are differences between PFDI and TFDI in terms of the determinants in a variety of firms from both emerging and developed countries. It should be noted that this paper does not seek to investigate the co-occurrence of PFDI and TFDI or whether the former leads to or causes the latter (as the traditional literature suggests) but to examine the effect of firm characteristics on the propensity of being involved in one type of FDI or another.

3. Data and variables

3.1. The INGINEUS survey and the sample

The empirical analysis is based on unique cross-country, cross-industry data collected through a survey funded by the 7th Framework Program of the European Commission for the 2009–2011 period which focused on firm-level data on participation in GINs and internationalizing innovative activities to offshore locations. The survey was conducted in three specific industries (Information and Communication Technology [ICT], Automotive, and Agro-processing) across nine countries: Brazil, China, Denmark, Estonia, Germany, India, Norway, South Africa, and Sweden. A sample frame was established using existing databases in each country (see EU 2009 report for a detailed methodology report on data collection in INGINEUS database). All databases were filtered to ensure that only firms with five or more employees were contacted.

The information gathering also took place in a variety of different ways. In countries with a culture of participating in surveys, i.e. the Scandinavian countries, firms were sent a link to an online tool. In developing countries, i.e. China and India, data gathering was done either on the telephone or through face-to-face interviews. The survey, in general, provides a rather unique data set on firm-level innovation; however, non-response biases and other restrictions faced while gathering data within some countries pose some limitations on the database (EU 2009). This paper thus presents exploratory findings which in turn need to be interpreted as indications for further in-depth qualitative and quantitative research.

Table 1 offers a summary of the results received from each country.

3.2. Dependent variables

On the questionnaire, firms were asked whether they offshored production or innovation, which divided our sample into those involved in offshoring and those that are not. Variable *Offshore* has a value of 1 for firms that are involved in offshoring activities regardless of the type and 0 for firms that do not offshore at all. Firms that answered ‘yes’ to this question were asked to reflect on a series of important regional factors that affected their decision to offshore. Each factor could then be selected as important for their offshoring of production, offshoring of innovation, both, or neither.³ We combined the two questions to extract two dummy variables and one categorical variable. These variables categorize firms based on the type of offshoring they do: variable *PFDI* has a value of 1 for firms that are involved exclusively in offshoring of production and 0 for firms that are involved exclusively in offshoring of innovation. Variable *TFDI* is

Table 1. Sample by country and industry.

Country	Agro-processing	ICT	Automotive	Total
India	0	324	0	324
China	0	243	0	243
Sweden	0	171	24	195
Norway	2	179	0	181
South Africa	77	1	2	80
Brazil	0	0	69	69
Germany	0	0	53	53
Denmark	49	0	0	49
Estonia	0	17	0	17
Total	128	935	148	1211

similarly coded for offshoring of innovation. Besides the firms that were exclusively involved in offshoring of production or innovation, there were 168 firms that were engaged in both types, and we have included them both in the PFDI sample and in the TFDI sample. In order to account for this, we have created a categorical variable (PFDITFDI) where firms doing ‘only PFDI’ have a value of 0, firms doing ‘only TFDI’ have a value of 1, and firms doing both have a value of 2. This variable will be used in a multinomial logit analysis to check whether contaminating our variables with firms doing both has had a negative impact on our models. Table 2 presents a summary of these variables.

3.3. Independent and control variables

3.3.1. Organizational type of the firms

In order to reflect on the characteristics of the firms in our sample, the firms were asked to provide information on their organizational type. This will help us better understand their corporate strategy as well as, to some extent, their level of autonomy in carrying out offshoring activities. Firms in the sample belonged to three different organizational types, namely standalone, subsidiaries, and headquarters. This variable (*Type*) was entered into our analyses as a categorical variable and was given values 1, 2, and 3 for each type, respectively.

3.3.2. Size of the firm

Information was collected on the number of full-time employees for every firm. This was taken as a proxy for the size of the firms. In our analysis, we use a dummy variable (*Large*) that has a value 1 if the firm had more than 250 employees and has a value of 0 if less than 250. In accordance with the definition from Commission Recommendation of European Union 2003, this divides our database into small and medium size enterprises (SMEs) and large firms. We are interested to see whether being a large firm or being an SME makes any difference in the tendency to participate in a certain type of offshoring.

3.3.3. Experience of the firm in international markets (exports)

Firms in our database were asked whether they had a significant share of sales activities abroad. Those involved in exporting have a value of 1 and 0 otherwise in a dummy variable (*Export*). This was done in order to learn whether the firms had any previous experience with exploration of their products or services beyond their domestic market.

3.3.4. Research and development

Firms in our survey were asked whether they perform significant R&D. Dummy variable *RD* has a value of 1 if they answered ‘yes’ and 0 otherwise.

Table 2. Dependent variables.

Dependent variables	0	1	2
OFFSHORE	No offshoring <i>N</i> =909	All offshoring <i>N</i> =306	–
PFDI	Only TFDI <i>N</i> =50	All FDI <i>N</i> =256	–
TFDI	Only FDI <i>N</i> =88	All TFDI <i>N</i> =218	–
PFDITFDI	Only FDI <i>N</i> =88	Only TFDI <i>N</i> =50	Both PFDI and TFDI <i>N</i> =168

3.3.5. Innovation level

In the survey, we asked the firms whether they had experienced innovation in the past three years (2006–2008) in terms of products, services, and methods. Each firm had the ability to point out the degree of novelty of their innovation by choosing between ‘new to the world’, ‘new to the industry’, ‘new to the firm’, and an option for firms that had not experienced innovation in that period. Four dummy variables (*Inno_WORLD*, *Inno_INDUSTRY*, *Inno_FIRM*, *Inno_NONE*) were created to capture the innovativeness of the firms.

3.3.6. Inter-firm linkages

Sourcing of technology: We want to capture what the most important source of technology was for the firms in our sample. This gives us an idea whether they used internal resources within their organization or tried more to tap into sources external to them. Two dummy variables were created for this. *Source_internal* has a value of 1 if a firm produced technological inputs in-house or bought from any other unit within the organization, such as branches or subsidiaries, and 0 otherwise. *Source_external* represents firms that bought their inputs from either non-MNEs or firms to which they are not formally connected.

Link to universities: Universities and other research institutes are crucial sources of knowledge generation in every innovation system, and establishing linkages to these actors allows firms to tap into local and global pools of knowledge. To capture this, firms were asked whether they had established links to universities and research institutes, either local or foreign, along with the location of these entities. We have coded variable *link_UNIVERSITY* to have a value of 1 for firms that collaborated with foreign or local universities or research institutions for the development of their most important innovation in the previous three years, regardless of their location.

Foreign linkages: An interesting factor to capture is the linkages that firms establish with foreign actors and organizations. These linkages differ in nature as they are established either formally, with written contracts of the terms of the collaborations or projects, or informally, where there are no written contracts or no financial obligations involved. Firms in our survey answered whether they had formal, informal, or no linkages with foreign clients, suppliers, competitors, consultancy companies, and governments. Two dummy variables (*foreign_FORMAL* and *foreign_INFORMAL*) were extracted that captured whether the firms had formal or informal linkages with any of the foreign actors mentioned.⁴

3.3.7. Industry

The survey conducted in the INGINEUS project gathered data from three industries that differ in their research intensity: ICT as high research-intensive, Automotive as medium research-intensive, and Agro-processing as low medium research-intensive. More information on how the boundaries of each industry were defined by the project can be found in the project methodology report (EU 2009). Some countries in our sample provided the opportunity to collect from two industries, such as Sweden, where information was collected from the ICT as well as the automotive sector. But in most cases, each country represented only a single industry. Three dummy variables capture the three industries in our database and analysis.

3.3.8. Institutional factors

In the survey, we aimed to capture the importance of different institutional factors on PFDI and TFDI by asking the firms to what extent certain factors were a barrier in their internationalization

process. These barriers could be internal to the firm (e.g. lack of knowledge or managerial capabilities) or external (rules and regulations on intellectual property rights (IPR), trade and investments, or mobility of human capital). To capture the two dimensions, we asked the firms to choose which internal factors had affected their offshoring activities and to what extent – ranging from not a barrier at all to small, moderate, serious, or extreme. *BARRIER_1* has a value of 1 if a firm found ‘finding relevant new knowledge’ an extreme or serious barrier. *BARRIER_2* has a value of 1 if a firm found ‘managing globally dispersed projects and cultural differences’ an extreme or serious issue. These two barriers are used as proxies to capture the managerial barriers where the source of the hindrance comes from within the organization.

Firms were asked which institutional factors they found highly negative, moderately negative, highly positive, or moderately positive, or if they had not experienced that factor at all. In order to capture these factors as barriers (in line with the previous barrier variables), we coded three dummy variables that found these factors highly or moderately negative. *BARRIER_3* has a value of 1 for firms that found ‘the regulations, practice and jurisprudence around intellectual property rights’ to be a barrier and 0 otherwise. *BARRIER_4* has a value of 1 for firms that found ‘the rules and practice regarding FDI and trade policy’ to be a barrier. *BARRIER_5* represents firms that flagged ‘the rules and practices regarding migration policy regulations for employing foreign scientists/technicians/experts’ to be barrier. We use these three variables to capture the relevance of institutional barriers on firms’ offshoring activities (Table 3).

4. The econometric analysis

As mentioned before, our aim is to investigate whether there are differences between PFDI and TFDI. In order to do so, we ran two rounds of logistic regression and one multinomial logistic regression that each created a specific equation with the same set of regressors.⁵ The multinomial regression was performed as a robustness check for the logistic regression. Table A1 shows the bivariate correlations between the variables in the analysis.

5. Results

We started off by looking at a broader picture through examining the differences between firms that are involved in FDI, regardless of the type, and those that are not. This provided an equation including all the aforementioned independent variables in a logistic regression on our dependent variable *OFFSHORE*. Table 2 provides the results of the first round of logistic regression (Table 4).

The results of the logistic regression are in line with the existing literature. Being a subsidiary or a headquarter as opposed to being a standalone firm increases the likelihood of a firm offshoring its activities; being large as opposed to being an SME has a positive effect on the likelihood of offshoring; having prior experience in sales abroad has a positive effect on the likelihood of offshoring.

In terms of research and innovation capabilities, performing significant R&D and being linked to local as well as foreign universities and research institutes increases the likelihood for offshoring. Being innovative at the level of industry has a positive and significant effect on the likelihood of offshoring while, interestingly, being innovative at the level of the world and the firm has a negative effect, though insignificant.

As the next step, we ran two rounds of logistic regressions: once for firms involved in TFDI (model A) and once for those engaged in offshoring of production (model B). In model 1, we included only basic characteristics of the firms. In model 2, we added variables for micro characteristics of the firms. And in model 3, we added managerial and institutional barriers to the equation. Table 5 presents the findings from the two logistic regressions.

Table 3. Descriptive statistics of variables.

Variable	Type	Info	Total obs.	Mean	Std. dev.
OFFSHORE	Dummy	0 = no offshoring 1 = firms that are involved in any type of offshoring	1215	0.252	0.434
PFDI	Dummy	0 = only TFDI 1 = firms that are doing offshoring of production	306	0.837	0.370
TFDI	Dummy	0 = only PFDI 1 = firms that are doing offshoring of innovation	306	0.712	0.453
PFDITFDI	Categorical	0 = only PFDI 1 = only TFDI 2 = both PFDI and TFDI	306	1.261	0.878
ICT	Dummy	1 = ICT	1211	0.772	0.419
Agro-processing ^a	Dummy	1 = Agro-processing	1211	0.105	0.307
Auto	Dummy	1 = Automotive	1211	0.122	0.327
Large	Dummy	0 = SMEs 1 = Large firms	1061	0.2573	0.43735
Type	Categorical	1 = Standalone ^a 2 = Subsidiary 3 = HQ	1074	1.480	0.708
Export	Dummy	0 = No exports 1 = Export market	1114	0.406	0.491
RD	Dummy	0 = No 1 = Yes	1215	0.494	0.500
Source_internal ^a	Dummy	0 = No 1 = Yes	1028	0.706	0.456
Source_external	Dummy	0 = No 1 = Yes	1028	0.271	0.445
inno_WORLD	Dummy	0 = No 1 = Yes	1215	0.179	0.384
inno_INDUSTRY	Dummy	0 = No 1 = Yes	1215	0.462	0.499
inno_FIRM	Dummy	0 = No 1 = Yes	1215	0.579	0.494
inno_NONE ^a	Dummy	0 = No 1 = Yes	1215	0.573	0.495
link_UNIVERSITY	Dummy	0 = No 1 = Yes	1215	0.341	0.474
foreign_FORMAL	Dummy	0 = No 1 = Yes	1215	0.545	0.498
foreign_INFORMAL	Dummy	0 = No 1 = Yes	1215	0.305	0.460
BARRIER_1	Dummy	0 = No 1 = Yes	840	0.498	0.500
BARRIER_2	Dummy	0 = No 1 = Yes	802	0.540	0.499
BARRIER_3	Dummy	0 = No 1 = Yes	1215	0.128	0.335
BARRIER_4	Dummy	0 = No 1 = Yes	1215	0.138	0.345
BARRIER_5	Dummy	0 = No 1 = Yes	1215	0.121	0.326

Note: ^aIndicators taken as baseline in the analysis.

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Table 4. Logistic regression on all offshoring firms.

Variables	Coefficients (Std. error)
ICT	0.53 (0.40)
Automotive	0.30 (0.47)
Subsidiary	0.85*** (0.23)
HQ	0.63** (0.29)
Large	1.05*** (0.22)
Export	1.03*** (0.20)
RD	0.43** (0.22)
Source_external	-0.12 (0.23)
inno_WORLD	-0.10 (0.23)
inno_INDUSTRY	0.69*** (0.21)
inno_FIRM	-0.00 (0.22)
link_UNIVERSITY	0.78*** (0.20)
foreign_FORMAL	-0.00 (0.23)
foreign_INFORMAL	0.06 (0.20)
BARRIER_1	-0.07 (0.20)
BARRIER_2	(0.20)
BARRIER_3	0.10 (0.30)
BARRIER_4	-0.03 (0.29)
BARRIER_5	0.43 (0.29)
Constant	-3.54*** (0.50)
<i>N</i>	693
χ^2	216.50***

Note: Standard errors in parentheses.

**p* < .10.

***p* < .05.

****p* < .01.

The industry and organizational type of a firm did not have any effect on its FDI type. Being a large firm remained significant and positive for PFDI firms, but interestingly had no effect on firms involved in TFDI.

Having prior experience with exports is positively related to PFDI. This is perhaps not surprising since many firms start exporting their products or services first, and then they offshore their production. However, having prior experience in terms of formal or informal linkages with foreign entities (clients, suppliers, competitors, consultancy companies, and governments) had no relevance on the type of offshoring.

Being R&D-intensive was related positively to TFDI and negatively to PFDI. Thus, in contrast with the theories of the 1980s, we find that having significant R&D activity is a predictor not of PFDI but only of TFDI, which points to the first significant difference between the two types. Regarding the different levels of innovativeness, only being innovative at the level of the industry had a marginal effect on firms' offshoring innovation after accounting for managerial and institutional barriers. This could indicate that firms with certain innovative performance (already innovative at the level of the industry) would engage in innovation-related FDI in order to complement their existing advantages to become further innovative, perhaps at the level of the world.

Looking for external sources for its technological inputs increases the likelihood, though marginally, of a firm engaging in TFDI over PFDI. This is interesting since being R&D-intensive is also significant, so firms rely not only on their own R&D, but also on buying their inputs from other firms and MNEs. Not surprisingly, being linked to foreign and local universities and research institutes is positively related to offshoring of innovative activities. The combination of the two means that TFDI firms can in fact be attributed true knowledge-seeking characteristics

Table 5. Logistic regression PFDI vs. TFDI.

	TFDI			PFDI		
	A1	A2	A3	B1	B2	B3
ICT	0.44 (0.51)	0.53 (0.57)	-0.41 (0.75)	-0.19 (0.80)	-0.38 (0.88)	-1.02 (1.20)
Automotive	-0.23 (0.59)	0.14 (0.64)	-0.80 (0.84)	-0.64 (0.90)	-0.97 (0.98)	-2.16 (1.37)
Subsidiary	0.10 (0.30)	0.05 (0.33)	0.06 (0.37)	0.23 (0.39)	0.21 (0.43)	-0.33 (0.54)
HQ	0.48 (0.39)	0.21 (0.43)	0.24 (0.49)	-0.31 (0.43)	-0.22 (0.48)	-0.03 (0.66)
Large	0.50* (0.29)	0.29 (0.32)	0.37 (0.36)	1.40*** (0.40)	1.21*** (0.43)	1.81*** (0.60)
Export		0.14 (0.31)	0.33 (0.37)		1.24*** (0.38)	2.14*** (0.59)
RD		0.79** (0.34)	0.72* (0.38)		-0.93* (0.48)	-1.70** (0.69)
Source_		0.72* (0.37)	0.80* (0.43)		0.16 (0.44)	0.02 (0.58)
external						
inno_		0.24 (0.35)	0.06 (0.37)		0.23 (0.41)	0.61 (0.54)
WORLD						
inno_		0.39 (0.33)	0.65* (0.36)		-0.06 (0.43)	-0.51 (0.61)
INDUSTRY						
inno_		-0.05 (0.34)	-0.13 (0.37)		0.17 (0.39)	-0.23 (0.52)
FIRM						
link_		0.89*** (0.31)	0.87** (0.35)		0.37 (0.38)	0.19 (0.50)
UNIVERSITY						
foreign_		0.12 (0.36)	0.13 (0.41)		0.39 (0.42)	0.78 (0.55)
FORMAL						
foreign_		-0.30 (0.31)	-0.26 (0.35)		0.01 (0.39)	0.52 (0.52)
INFORMAL						
BARRIER_1			0.30 (0.34)			-1.03** (0.50)
BARRIER_2			-0.48 (0.36)			1.42*** (0.49)
BARRIER_3			0.65 (0.47)			-0.35 (0.63)
BARRIER_4			-0.27 (0.45)			-0.24 (0.63)
BARRIER_5			-0.03 (0.43)			-0.67 (0.60)
Constant	0.25 (0.51)	-1.31* (0.77)	-0.60 (0.91)	1.38* (0.79)	0.91 (1.08)	2.31 (1.48)
N	299	283	246	299	283	246
χ^2	8.69	38.16***	40.96***	17.28***	33.95***	49.97***
'LL'	-175.06	-150.36	-126.43	-124.73	-110.27	-70.10

Note: Standard errors in parentheses.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

as they actively look for different sources of knowledge, whether internally by performing in-house R&D, externally through links with universities and research institutes, or by purchasing technology from other firms.

For TFDI, none of the barriers were significant. For PFDI, however, having difficulties finding relevant new knowledge reduces the likelihood of offshoring production. On the other hand, difficulties in managing globally dispersed projects and cultural differences increases the likelihood of engaging in offshoring of production.

Interestingly, only managerial barriers were significant regarding firms that are engaged in PFDI, and none of the institutional barriers was considered important by the existing literature – such as IPR, standards, or migration policy – really mattered.

As noted before, firms categorized by the two dummy variables *PFDI* and *TFDI* are not exclusive in the type of offshoring they are involved in. Thus, in both models A and B, our sample is contaminated by those firms that are doing both types of offshoring. In order to account for this and make sure our two logistic regressions are robust, we ran a multinomial logistic regression

Table 6. Multinomial logit (only FDI is the base outcome).

	Only TFDI	PFDI and TFDI
ICT	0.74 (1.28)	-0.60 (0.79)
Automotive	1.53 (1.46)	-1.18 (0.89)
Subsidiary	0.38 (0.59)	0.02 (0.39)
HQ	0.19 (0.73)	0.20 (0.52)
Large	-1.37** (0.65)	0.65* (0.37)
Export	-1.59** (0.62)	0.86** (0.41)
RD	1.95*** (0.71)	0.48 (0.41)
Source_external	0.62 (0.66)	0.89** (0.45)
inno_WORLD	-0.46 (0.59)	0.22 (0.39)
inno_INDUSTRY	0.86 (0.64)	0.61 (0.39)
inno_FIRM	0.13 (0.57)	-0.16 (0.39)
link_UNIVERSITY	0.43 (0.54)	1.04*** (0.38)
foreign_FORMAL	-0.60 (0.59)	0.38 (0.44)
foreign_INFORMAL	-0.64 (0.56)	-0.19 (0.37)
BARRIER_1	1.08** (0.53)	0.05 (0.37)
BARRIER_2	-1.57*** (0.55)	-0.25 (0.38)
BARRIER_3	0.72 (0.68)	0.71 (0.51)
BARRIER_4	0.00 (0.67)	-0.44 (0.50)
BARRIER_5	0.59 (0.65)	-0.11 (0.46)
Constant	-2.36 (1.57)	-1.31 (0.96)
N		246
χ^2		101.70***
'LL'		-179.51

Note: Standard errors in parentheses.

* $p < .10$.

** $p < .05$.

*** $p < .01$.

based on firms that are exclusive in the type of offshoring they are engaged in. We forced the model to hold firms doing only PFDI as the base outcome so we could compare the results of doing PFDI exclusively to TFDI exclusively. The results point to the robustness of our two logit models as the coefficients are similar to the ones in the logistic regression but with different coefficient signs. The exceptions are the linkages with the university, source external, and innovativeness at the level of the industry which are only significant when the firm does both TFDI and PFDI simultaneously. Table 6 presents the results from the mlogit analysis.

6. Conclusions

While offshoring of production tends to negatively impact the home region in terms of productivity, offshoring of innovation does rather the opposite. R&D performed abroad tends to complement – rather than substitute – the research done at home, and the positive effects multiply (Castellani and Pieri 2013). Following this line of reasoning, it is important for policy-makers to promote TFDI while trying to control the negative impact of PFDI. Understanding the mechanisms that trigger both phenomena is the cornerstone of these policies.

This paper contributes to the current debate on the differences between the offshoring of production and innovation by providing evidence on the firm-based characteristics and barriers which affect both types of investments while considering firms from both developed as well as emerging economies. Using dedicated firm survey data of 1211 firms located in several European countries and emerging economies, we analysed the commonalities and differences between the

offshoring of innovation and the offshoring of production. In contrast to most recent literature on offshoring of R&D, which argue that offshoring of innovation-related activities requires difference capabilities, our results show that most of the firm characteristics, as well as institutional frameworks, affect both phenomena in a similar manner. But some differences do exist. Being R&D intensive is related positively to TFDI, in line with Audretsch and Feldman (1996), but negatively to PFDI. A key finding of our study is that none of the policies more closely related to the internationalization of production or innovation – such as IPRs, standards, trade policy, or migration policy – is significantly related to PFDI or TFDI either as an enhancer or as a barrier. In contrast, managerial constraints, like the lack of information or ability to cope with multicultural environments, seem to be significantly related. Increasing the direct support to the development of these managerial capabilities may provide better results in terms of stimulus to TFDI than the current focus on IPR or other policies traditionally being used to stimulate PFDI.

Some final cautionary notes are needed. Any analysis can only be as good as the data allows. The value of the data set used for this paper relies on its novelty and uniqueness as well as its broad national coverage. It is one of the few data sets (if not the sole one) with innovation data on firms and their involvement in GINs and internationalization of innovative activities that are comparable across countries and industries. However, the data do not allow for more sophisticated econometric analysis due to some of the limitations explained earlier. In this sense, this paper should be considered exploratory, pointing to areas where further research needs to be done in order to shed more light on the involvement of firms in TFDI and the different strategies they employ in order to do so. Our analysis does not imply that other factors may not also have a significant influence on TFDI or PFDI. It merely implies that these are the ones that we were able to capture on the basis of the available data.

Further research is needed to understand whether firms are internationalizing their R&D at an early stage to access knowledge and competences that they cannot find in their home country (asset seeking), whether they are mainly internationalizing development activities as an add-on function to production, or both. An interesting aspect to study in the future is the dynamics of the different investments and their relationship, which requires longitudinal data. This is specifically the case for firms that offshore both types of activities. With such information one can examine whether they started with offshoring of one type of activity and moved on to the other or, more interestingly, at what point in time this switch occurs, i.e. when firms move on to internationalize their innovative activities.

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Notes

1. In later versions of the OLI framework, ‘strategic asset seeking’ was added to account for investments motivated to augment already existing advantages of the firm (see Dunning, 2001). However, this notion is also overshadowed by the overemphasis on production-related activities and is seen rather as an inevitable by-product of offshoring production.
2. Understood as the geographical dispersion of production and innovation.
3. The questionnaire also provided an open-ended option to mention other factors affecting their offshoring decision. Only two firms used this option; they were deleted from the sample.

4. In an initial model, we tried to capture the linkages with specific actors such as clients or suppliers, but the model did not return any significant difference.
5. We tested whether using probit or mprobit instead makes any difference in the model. The predicted probabilities were highly and significantly correlated between the models, and no changes were seen except in variance of error, which was expected.

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Appendix

Table A1. Covariance between variables in the analysis.

	1	2	3	4	5	6	7	8
1 Large	1.0000							
2 Export	0.1640	1.0000						
3 RD	0.1504	0.2619	1.0000					
4 Source_external	0.0529	0.0080	-0.1225	1.0000				
5 inno_WORLD	0.0746	0.0981	0.1854	-0.0342	1.0000			
6 inno_INDUSTRY	0.1401	0.1201	0.3666	0.0542	0.1505	1.0000		
7 inno_FIRM	-0.0145	0.0042	0.0190	0.0495	-0.1265	0.0598	1.0000	
8 Link UNIVERSITY	0.1589	0.2266	0.2209	0.0555	0.1257	0.2693	0.1056	1.0000
9 Foreign_FORMAL	0.2173	0.2622	0.2391	-0.0282	0.1145	0.1911	-0.0801	0.2155
10 Foreign_INFORMAL	-0.0151	-0.0211	0.0460	-0.1126	0.0877	0.0600	0.1383	0.0569
11 BARRIER_1	0.0717	0.1273	0.0168	0.1851	0.0244	0.0667	0.0412	0.0626
12 BARRIER_2	0.1003	0.0829	0.0001	0.1100	0.0612	0.1125	0.0969	0.0882
13 BARRIER_3	0.0045	-0.0181	0.0728	-0.1387	0.0395	0.0233	-0.0047	-0.0120
14 BARRIER_4	-0.0050	0.0304	0.1037	-0.1177	0.0586	0.0017	-0.0360	-0.0234
15 BARRIER_5	0.0392	0.0437	0.1356	-0.1131	0.1485	0.0545	0.0119	0.0344
	9	10	11	12	13	14	15	
9 Foreign_FORMAL	1.0000							
10 Foreign_INFORMAL	-0.0088	1.0000						
11 BARRIER_1	0.0779	0.0085	1.0000					
12 BARRIER_2	0.0456	0.0314	0.3034	1.0000				
13 BARRIER_3	0.0602	0.0893	0.0431	0.0814	1.0000			
14 BARRIER_4	0.0974	0.0152	-0.0162	0.0424	0.5142	1.0000		
15 BARRIER_5	0.1504	-0.0062	0.0122	0.0659	0.3787	0.4746	1.0000	