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**Externalities from FDI on domestic firms' Productivity:
A Literature Review for Developed Countries**

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ABSTRACT

In this paper, we analyse the transmission mechanisms of externalities from FDI on the productivity of domestic firms, focusing on establishing the main linkages between them. Considering the complexity of the mechanisms involved, the analysis of the factors determining their effectiveness is far from being fully exploited. We expect to contribute to the existing literature by providing a broader picture of the determinant factors of externalities from FDI, through its classification, along the lines of the Theory of Heterogeneous Firms. This allows for a better understanding of the relevant variables to include in the empirical studies. Moreover, the transmission mechanisms of externalities from FDI are different according to the stage of development of the recipient countries. However, the existing literature reviews and meta-analysis include both Developed and Developing countries, hindering the learning process regarding the transmission mechanisms of externalities in the Developed Countries. We attempt to fill this gap by reviewing the empirical literature for five Western European countries and suggest some explanations for the mixed results.

Keywords: FDI, linkages, vertical externalities, Developed Countries.

JEL classification: F23

1. INTRODUCTION

Foreign Direct Investment (FDI) is generally considered by many international institutions, politicians and economists as a key generator of economic growth (Alfaro, 2017). This is due to the fact that FDI exerts direct and indirect effects on host economies. The first includes capital formation, job creation, increased tax revenue and shifts in the production and exports of host countries, while the latter mainly involves the access to Multinational Corporations' (MNCs) technology (Crespo and Fontoura, 2006; Cantwell, 2017).

The access to foreign technology is important because, according to the Theory of Industrial Organization, MNCs possess advanced technology (in the broad sense, e including marketing and knowledge management, etc) that makes them more efficient than their domestic counterparts (Dunning and Rugman, 1985). Moreover, empirical studies (e.g., Eaton and Kortum 1999, Keller, 2001) show that, in OECD countries, the main sources of technological changes leading to increases in the total factor productivity (TFP) come from abroad. The reason is that R&D is highly concentrated in a small number of Developed Countries (DCs) (Archibugia and Pietrobelli, 2003). As a result, the convergence of income between countries depends on the level of international technological diffusion (Keller, 2001). Indeed, technology can be transferred through voluntary agreements or through externalities from FD These consist of an increase in the productivity of domestic firms due to the presence of MNCs in the host economy (Leshner and Miroudot, 2008). Thus, one of the main motivations for policies that aim to attract FDI is the potential benefit of acquiring new technologies that may allow domestic firms to increase their productivity (Buckley et al., 2003).

Externalities from FDI may be horizontal or vertical. Horizontal externalities occur when the entry of the MNC generates positive externalities for local competitors. Vertical externalities arise from the linkages between MNCs and their local suppliers/customers (backward/forward linkages). The empirical evidence on externalities from FDI suggests that vertical externalities are more likely to occur than horizontal externalities. According to Kugler (2006) this happens for a number of reasons. First, it is easier to learn generic technologies than to absorb and adopt specific rivals' technologies; Second, horizontal externalities from FDI are more likely to generate losses of profits for MNCs than vertical externalities; third, if MNCs do not compete directly with domestic firms, then they will not have an incentive to prevent the spread of technology to domestic firms.

However, as de Mello (1997) points out, the role of FDI as a catalyst for output growth is a less controversial assumption in theory than in practice. Indeed, according to Hilvo and Scott-Kennel (2011), different contexts and approaches produce different results. For example, while studies in Developing or Transition Economies find that backward linkages are more likely to occur than forward linkages; research in small Developed Countries (Scott-Kennel & Enderwick, 2005) found that resource sharing via forward linkages may be more important, than via backward linkages, for instance, regarding product innovation through collaboration with foreign suppliers (Cuervo-Cazurra and Un, 2007). Consequently, our analysis focus on vertical externalities that might occur in DCs with an aim to ascertain whether there are positive and significant externalities from FDI on a small open economy that faces restrictions due to the economic crisis.

This paper reviews the literature on the impact of the FDI on the productivity of local manufacturing firms in DCs, in order to provide a description of what variables to include and the state of-art methodology to perform an empirical analysis for DCs. Bearing this in mind, this paper aims to accomplish three specific goals. Firstly, considering that the transmission mechanisms of externalities from FDI are complex, because the same mechanism may generate more than one type of externality; and the fact that empirical studies often fail to identify all possible benefits in one mechanism, we aim to describe the channels through which domestic firms can benefit from externalities from FD Secondly, as the analysis of the determinant factors of externalities from FDI has been relatively limited and ad hoc, we aim to identify the relevant determinant factors to include in empirical studies for DCs. In addition, empirical studies report a large amount of heterogeneity in the productivity of firms, within sectors. These results highlight the role of domestic firms' characteristics in the internalization of externalities from FD Thus, drawing upon the Theory of Heterogeneous Firms, we aim to classify the determinant factors of externalities from FDI into 'internal' and 'external' to the firms. Thirdly, considering that: a) the (macro) external conditions in the host economy are important for the generation of externalities and, thus, externality effects are different in Developed and Developing Countries; b) there is a lack of empirical research focusing on DCs; and c) empirical evidence finds mixed results and statistically insignificant externalities via forward linkages (Javorcik, 2004, Görg and Greenaway, 2004); we will analyse a set of 20 empirical studies with panel data at firm level for the manufacturing sector of five European economies, in order to draw some conclusions on the determinant factors of externalities and identify the key methodological issues.

We expect this article to contribute to the existing theoretical and empirical literature in two ways. Firstly, by drawing upon the theory of Heterogeneous Firms, we aim to provide a more complete picture of the determinant factors of vertical externalities by classifying them into internal and external and relating them. Secondly, with our review of empirical studies focused on DCs.

In what follows, Section 2 describes the transmission mechanisms of externalities from FDI, according to the Theory of Heterogeneous Firms; Section 3 classifies the determinant factors of externalities from FDI into internal and external to the firm, and analyses the relationship between them; Section 4 reviews a group of 20 empirical studies for DCS and, finally, section 5 concludes.

2. TECHNOLOGY TRANSFER, FDI AND PRODUCTIVITY EXTERNALITIES

In this section, we explain the role of FDI as a vehicle of technological diffusion and describe the mechanisms through which FDI exerts its impact on local firms' productivity. To this end, we start by arguing that FDI is the preferred channel of international dissemination of technology; then we describe the transmission mechanisms of externalities.

2.1. FDI AS CHANNEL OF INTERNATIONAL TECHNOLOGY DIFFUSION

The literature on International Technology Diffusion has emphasized three channels for technology transfer: international trade of intermediate goods, international dissemination of the results of research and development (R&D) and FDI (see e.g. Keller, 2004). However, international trade of intermediate goods is considered a weak source of international technological diffusion since the technology is not directly incorporated in the imported intermediate inputs (Keller, 2004). Thus, the larger the volume of tacit knowledge involved in the production of the intermediate goods, the greater the limitation because tacit knowledge is subjective and, thus, not measurable.¹ Moreover, according to Coe and Helpman (1995), the majority of high technological content goods are imported by the MNCs. Therefore, the empirical results about the importance of international trade on the technological diffusion can be misleading if there is no distinction between the effect of the activities of MNCs and International Trade. The second channel seems to be a stronger source of international technological diffusion. The reason is that the disclosure of R&D results suggests a complete domain of the technology as opposed to the ability to use only the incorporated technology. However, since in this second case, the technology is not tied to any particular form, externalities seem to be more difficult to measure. As a result, FDI is considered the main channel of international technological diffusion and contributes to the creation of new knowledge or the adaptation of foreign technology (Lim, 2001).

¹ According to Polanyi (1983), tacit knowledge (embodied and therefore requiring absorptive capacity) is easy to transfer but difficult to appropriate. However, while codified knowledge (formulas, blueprints, drawings, and patent applications) can be transferred, the process is slow.

According to the literature, technology diffusion occurs in two stages. Firstly, MNCs transfer technology to their subsidiaries in the host country. In the next stage, technology diffusion to local firms may occur via externalities, through different channels. The occurrence of externalities depends on the assumptions of the early 1990's Endogenous Growth Theory (Aghion and Howitt 1992, Grossman and Helpman 1991 a,b, Romer 1990, Segerstrom et al., 1990). According to this theory, technology has, to some extent, the nature of a public non-rival good. A key assumption is that the production of knowledge does not take the form of a physical device, being instead usually incorporated (a patent, a software program, etc.). Therefore, the marginal cost of its exploitation by an additional agent is negligible and its returns cannot be fully appropriated by the owner and, thus, knowledge externalities arise.

However, because technology cannot be transferred at zero cost, the technological diffusion is likely to be incomplete and vary geographically. Indeed, the high cost of coding the technology motivates innovative firms to ensure that only its contours are encoded, leaving the rest as "tacit" (Polanyi, 1958). Part of that tacit knowledge is often transferred through contacts and personal instructions (David, 1992). Since FDI provides contacts between local and foreign individuals, then technology diffusion may inadvertently occur. In addition to this involuntary transmission of knowledge, recent literature has focused on the possible voluntary transmission of knowledge from MNCs to local customers and suppliers. In this case, the diffusion of knowledge may assume the form of acquisition of skills, training and the introduction of management practices that are likely to increase the TFP of local firms (Borensztein et al, 1998; Mastromarco and Ghosh, 2009).

2.2. TRANSMISSION MECHANISMS OF EXTERNALITIES

In this section, we describe the channels by which domestic firms can appropriate knowledge from foreign firms operating in the host economy. This appropriation may take the form of utilization of foreign knowledge or the recombination of foreign and internal knowledge into a new kind of knowledge. This process may require absorptive capacity, which according to Narula and Marin (2003) “includes the ability to internalize knowledge created by others and modifying it to fit their own specific applications, processes and routines” [Narula and Marin (2003), p 23].²

The theoretical literature on technology transfer (e.g., Görg and Greenaway, 2004) considers that technology diffusion from MNCs to local firms may occur at two levels: the horizontal technology transfer that occurs through contacts with local competitors (via demonstration/imitation, labour mobility, exports, competition, consulting and specialized services and coordination with local institutions); and the vertical technology transfer that occurs through linkages with local suppliers (backward linkages) or local customers (forward linkages).

Regarding the horizontal level, the entry of the MNCs may provide externalities to the local competitors through various channels. The demonstration / imitation (for local firms) is probably the most obvious channel (Das, 1987, Wang and Blomström, 1992).

Concerning demonstration, the introduction of a new technology in a given market may be costly and risky for local firms to perform due to the uncertainty of the results. However, if the technology is successfully used by a MNC, it encourages local firms to adopt it, if the goods produced are similar (Barrios and Ströbl, 2002).

Geographical proximity can lead to externalities through imitation or demonstration effects, especially in industrial clusters. Domestic firms may be able to learn and copy by simply observing, or through reverse engineering, personal contacts and industrial espionage. Additionally, when subsidiaries introduce innovations, they may be demonstrating to their competitors how to deal with the technology and thus the efficiency of the later may increase.

Labour mobility occurs if local firms hire former MNCs’ employees and are able to learn from them in order to implement their technology, or if MNCs’ former employees

² One aspect that we do not discuss in this section, but that is implicit, is the geographical proximity between MNCs and local firms. Several authors argue that the transmission mechanisms of externalities from FDI are reinforced when a smaller geographical area is considered (Aitken and Harrison, 1999; Jordaan, 2008 a, b). See Crespo and Fontoura (2010) for a review. We will focus this issue on section 3 when we discuss the determinant factors of vertical externalities.

create their own firms and apply the acquired knowledge for their own benefit (Glass and Saggi 2002; and Pesola, 2006). However, the effects of labour mobility on the productivity of local firms are difficult to measure because it involves the monitoring of workers and estimating the impact on the productivity of other workers (Saggi, 2001).

Exports are viewed by some authors as another channel through which knowledge externalities to local firms can take place (Kokko et al, 2001; Greenaway et al, 2004). According to those authors, the export activity involves costs of studying foreign markets, establishing distribution networks and transport infrastructure. MNCs can meet these costs in a easier way due to their greater experience in foreign markets and financial capacity (Greenaway et al., 2004). Imitation or collaboration with MNCs in order to learn the export process allows local firms to reduce the costs of internationalization and have a positive impact on their productivity. However, in our opinion, this is a particular case of the imitation/demonstration channel.

The increased competition induced by the entry of MNCs is another channel of externalities from FDI (Wang and Blomström, 1992; Markusen and Venables, 1999). The higher competitive pressure, particularly in highly competitive sectors with low barriers to entry, induces technological change and learning. Indeed, competition may lead to the rationalization of resources, the adoption of new technologies and the introduction of new products by local firms to protect their market share (Blomstrom and Kokko, 1998).

However, at an early stage, the presence of the MNCs may imply significant losses of market shares for the local firms, forcing them to operate on a less efficient scale and, thus, increasing their average costs (Aitken and Harrison, 1991; Harrison, 1994). In the next stage, however, the entry of a MNC creates a selection effect, where the competitive pressure drives the least efficient firms out of the market, increasing the average productivity of the survival local firms.

The entry of the MNCs may also be accompanied by foreign consulting and specialized services (trade brokers, accounting firms and consulting, etc.) that may be available for local firms and hence may contribute to the increase of their performance.

Regarding the coordination with local institutions, the diffusion of knowledge is possible in two ways: partnerships between firms, universities and institutes, as well as the leakage of technological content from the original recipient to his local rivals.

Concerning vertical technology transfer, the use of more specialized inputs generates a positive social value in the form of increased productivity for the local firm, that is not appropriated by the MNCs. In certain circumstances (e, increased returns in the production of inputs, transportation costs and benefits of specialization), backward

externalities occur when a MNC, by increasing its demand for inputs, leads to the introduction of new varieties of inputs. The introduction of these specialized inputs reduces the cost of production of the final goods, making the production more profitable. This mechanism is modelled, for example, in Rodriguez-Clare (1996), Markusen and Venables (1999) and Lin and Saggi (2005).

Relating to the backward linkages, the presence of the MNCs may benefit local suppliers if they are interested in guaranteeing a certain quality standard. In this context, MNCs can provide technical support to local suppliers in order to improve the quality of inputs or to assist their suppliers in the introduction of innovations, training, creation of productive infrastructure, procurement of raw materials, as well as the introduction of new management techniques, among others (Lall, 1980).

Several case studies (see Moran, 2001) show that MNCs often provide technical assistance to its suppliers in order to raise the quality of its products and facilitate innovation. As a result, FDI in downstream sectors induces greater competition, lower prices and increased production and value added in upstream sectors. Moreover, while the technological gap between local and foreign firms may limit the transfer of technology in the sector, MNCs probably purchase less sophisticated inputs in order to narrow the gap. The competition among local firms to supply MNCs is also likely to generate an increase in their efficiency.

Regarding forward linkages, externalities arise when MNCs provide higher quality and /or cheaper inputs to local producers of final goods (Markusen and Venables, 1999). Meyer (2004) argues that 'FDI in infrastructure and business services directly influences productivity of its customers if services required by businesses improve, or are newly introduced.' (Op cit., p. 11).

Downstream effects of FDI are generally more beneficial than the upstream effects (Blomström and Kokko, 1998). Indeed, local firms may be able to compete in world markets with technical expertise based on the industrial application of the MNCs' technology. This provides opportunities for countries to remain competitive in various "niches" of high technology (Blomström, 1991). However, there are few studies addressing the importance of forward linkages. Aitken and Harrison (1991) is one of these studies. Another example is Zysman et al. (1996). The authors find that, in the 1980s, US electronics firms gradually deepened the technological capacity and autonomy of their Asian subsidiaries, largely in response to the competitive challenge represented by their Japanese competitors. The transfer of higher value-added production from the U.S. to Asia allowed subsidiaries to produce more sophisticated electronic parts.

3. DETERMINANT FACTORS OF VERTICAL EXTERNALITIES

3. 1. INTRODUCTION

In section 2 we concluded that vertical externalities are more likely to occur than horizontal externalities. We identified (backward and forward) linkages as the main transmission mechanism of vertical externalities and we highlighted that forward linkages are especially relevant, not only to the increase of local firms' productivity but also to enhance countries' competitiveness. The implications for the economic growth are obvious.

While most Endogenous Growth Models focus on the role of R&D in the technological diffusion, in the early 2000s, a new approach, triggered by Bernard and Jensen (1995) has introduced firm heterogeneity in the analysis of how technology diffusion influences economic growth. Similarly, the more recent empirical studies take into account the heterogeneity of subsidiaries' performance, in addition to domestic firms' characteristics, in the analysis of the determinants of FD For example, Görg et al. (2009) conclude that the larger, more productive and more experienced firms are more likely to invest in the Czech Republic. Hence, in spite of sharing many characteristics of the monopolistic competition models from New Trade Theory, this approach assumes differences in firms' characteristics within a sector, especially with regard to productivity (Ciuriak et al, 2011). This trend of incorporating heterogeneity into the analysis have also influenced the most recent theoretical models of technology transfer (Driffield and Love, 2007; Marin and Sasidharan, 2010). A key assumption of this new approach is that the decisions on where MNCs locate the production and the extent of control over these activities is part of their global sourcing strategies (Antràs and Helpman, 2008) and cannot be analysed in a framework of International Trade theories (Coase, 1937; Williamson, 1975; Grossman and Hart, 1986). Hence, the core model of Melitz (2003), based on Krugman (1980), is being developed in several ways. One dimension of this literature is using the interaction of sunk costs and heterogeneous firm level productivity to determine the reason why some firms invest abroad while others stay in the domestic market (Helpman et al., 2004). Other extensions include models of firm decision on: how many products to produce and in which international markets to sell (Bernard et al., 2010); imports of inputs (Kasahara and Lapham, 2013); and international outsourcing (Antràs and Helpman, 2008; Caliendo and Rossi-Hansberg, 2012). Hence, along the lines of the Theory of Heterogeneous Firms, we identify and classify the determinant factors of vertical externalities.

3.2. DETERMINANT FACTORS

We focus on vertical externalities because empirical studies suggest they are more likely to occur than horizontal externalities. In particular, downstream effects of FDI provide opportunities for countries to remain competitive in various "niches" of high technology, as domestic firms may be able to compete in world markets with technical expertise based on the industrial application of the MNCs' technology (Blomström, 1991). Crespo and Fontoura (2007) remark that there has been an effort to research the factors that determine the existence, sign and magnitude of externalities from FDI. Yet, the literature does not present clear-cut evidence on which factors impact on their existence and/or magnitude. Thus, along the lines of the Theory of Heterogeneous Firms we suggest the following classification into 'internal' and 'external' factors in Table 1.

Table 1-Determinant factors of externalities from FDI

Internal	Domestic Firms	Firm size
		Financial capacity
		Age of firms
		Age of managers
		Age of workers
		absorptive capacity
	Foreign Firms	Origin of FDI
		Politics on the value of the technology
		Intensive use of intermediate inputs
		FDI motive
		Entry mode (Greenfield/ M&As)
		Age of the subsidiary
		Level of autonomy of the subsidiary
		Size of the subsidiary
External	Industry Specific	Specialization
		Agglomeration economies
		Characteristics of the industry (export-oriented/ local market-oriented, market concentration, capital intensity)
	Symbiotic	Technological Gap
		Geographical proximity
		Cooperation

Source: own analysis

The 'internal' determinant factors are those related to firms' characteristics; whether they are domestic (size, financial capacity, age of firms and employees including

managers, and the absorptive capacity) or foreign (home Country, value of the technology, intensive use of intermediate inputs, FDI motive; entry mode, and age, level of autonomy and size of the subsidiary); whereas the 'external' determinant factors are those that firms cannot control through their behaviour, and are specific of a certain industry (level of specialization, existence of agglomeration economies; export or domestic market-orientation, market concentration and capital intensity); or is an outcome of the interaction between domestic and foreign firms (symbiotic), such as the technological gap, the geographical proximity or cooperation between domestic and foreign firms.

We now describe the mechanism through which those determinants impact on the existence of linkages, and therefore, on the occurrence of vertical externalities.

Individual -Domestic Firms

The size of domestic firms is important for benefits associated with the presence of MNCs to occur, because small firms may not operate in an enough large scale to deal with some of the technologies introduced by the MNCs (Ngo and Conklin, 1996).

Similarly, the lack of financial capability makes it very hard to achieve a production scale enough to handle with some of the technologies introduced by the MNCs (Cline, 1987).

The age of the firms is likely to determine the occurrence of externalities from FDI to domestic firms (Suyanto and Salim, 2010). Older firms have served the market for longer time and may have a larger network of contacts and information on the markets. Therefore, the probability of vertical externalities to occur is higher.

Regarding the age of managers, in our opinion youth brings energy to innovate and to overcome the difficulties, but it may also mean less experience. Therefore, managers must not be too young to allow some market experience and the establishment of a network of contacts with suppliers and local clients for vertical externalities to occur.

Concerning the age of the employees, FDI flows are sensitive to the health of the workforce (Globerman and Shapiro, 2002), Since, *coeteris paribus*, younger workers are healthier than older workers, and firms with younger employees attract more foreign investors, then firms with younger employees are more likely to benefit from vertical externalities (Liu and Zou, 2008; Stancik, 2009).

The absorptive capacity is often proxied by the human capital which have an impact on FDI flows. Indeed, MNCs tend to acquire firms with a higher level of human

capital (Teixeira and Tavares-Lemhann, 2007) and M&As are more likely to generate vertical externalities.

Individual- Foreign firms

The origin of the FDI is a determinant factor of externalities from FDI (Karpaty and Lundberg, 2004; Javorcik et al. 2004; Takii, 2011). In fact, the origin of the FDI may be expressed by many factors such as culture, language, the level of development of the country, among others. Foreign investors coming from countries with a culture characterized by multiculturalism, are more likely to mingle with the locals and make efforts to learn the local language, and thus, to establish contacts with local suppliers and customers. Moreover, if the language of investing and host countries is the same or similar, the probability of contacts between suppliers/customers may be higher. Also, the degree of development of the country of origin may influence the type of FDI and, therefore, it may influence the occurrence of vertical externalities.

The technological strategy of MNCs is also a determinant factor of vertical externalities. Indeed, the degree of technological expertise of the subsidiaries determines the existence of externalities from FDI (Marin and Sasidharan, 2010; Narula and Dunning, 2010). Subsidiaries that are an important source of technological knowledge and perform their own R&D and innovation are more prone to establish linkages with domestic firms (Jindra et al., 2009). If subsidiaries have superior technology comparing to their domestic counterparts, they will require more specialized and complex inputs and may not be able to get them in the host country. However, this problem can be solved by providing technical assistance to their potential suppliers. On the other hand, If MNCs have much more sophisticated technology than their domestic clients, and they are the leading suppliers of those domestic firms, then it is likely that forward linkages occur.

An additional determinant factor is the intensive use of intermediate inputs by MNCs. Local sourcing depends positively on the transport costs (and therefore on distance) between the MNCs home country and the host country (Rodriguez-Clare, 1996). If transport costs are high enough, the MNCs may have an incentive to buy inputs locally. Then, the occurrence of backward linkages is likely.

The motivation of FDI is another determinant factor of vertical externalities (Driffield and Love 2006). Local market-oriented MNCs, measured in terms of share of domestic sales in total sales, are likely to establish backward linkages (Jordaan, 2011 and Giroud et al., 2012). Indeed, In this case, MNCs will need to tailor products to local market specific needs. Engaging with domestic suppliers will facilitate the process of

adapting the products to local taste and may provide MNCs with reliable information about domestic customer preferences. If MNCs are export-oriented and domestic firms produce for the domestic market, the potential for externalities increases if the requests imposed by the MNCs, by serving foreign markets, are largely dependent on local suppliers to make the necessary adjustments (Moran, 2001). If the FDI is motivated by the access to specific items which are not available in the country of origin and are not easy to transfer, the probability for backward externalities is high. If FDI is related to the existence of tariffs and other trade barriers that prevent MNCs to export to the host country, MNCs try to jump barriers by establishing a subsidiary in the host economy to gain access to the local market (Chrysochoidis et al., 1997). The local presence need only be enough to circumvent the trade barriers, since the MNC wants to keep the maximum added value in its domestic economy. Therefore, in this case, the probability of occurrence of backward linkages is low. The internationalization strategies allow MNCs to increase their potential for absorbing external knowledge; and influence their supply mode (Figueiredo, 2011). Externalities from FDI are expected to be higher when the FDI is technology sourcing because the entry of the MNCs can lead to the process of technological development and competition that can generate externalities for domestic firms (Driffield and Love 2003). In addition, scale economies and transaction costs of outsourcing seem to be forcing MNCs to consolidate their supply relationships with a smaller number of major suppliers, for example in the automotive and electronics industries (Ernst, 2002).

The entry mode also influences the existence of externalities (Javorcik, 2004 and Merlevede and Schoors, 2005; Jabbour and Mucchielli, 2007). Subsidiaries with higher degree of local participation (M&As) facilitate access to foreign technology by local firms and are expected to create more vertical linkages with the host economy (Crespo and Fontoura, 2007; Liu and Zou, 2008 and Stancik 2009). In contrast, wholly-owned foreign projects are unlikely to generate positive vertical externalities. Also, in greenfield projects, we expect that foreign wholly-owned subsidiaries rely more on imported inputs.

The age of subsidiaries also may influence the sourcing decisions (Zhang et al, 2010; Suyanto and Salim, 2010) as older subsidiaries are probably more independent from the headquarters and may take their own decisions about local sourcing.

Indeed, strategic decisions by MNCs in terms of supply and linkages are related to their degree of autonomy and have an impact on the existence of externalities from FDI (Jordaan, 2011). A subsidiary with a high degree of autonomy is more likely to supply

locally; while less autonomy means that the subsidiary may rely more on imports (Holm and Pedersen, 2000).

The size of the subsidiaries determines the occurrence and magnitude of externalities from FD. Smaller subsidiaries are probably more adaptable to the external environment than larger firms. Therefore, smaller subsidiaries are more likely to establish linkages with domestic firms (McCann, 1997). Furthermore, it is probable that smaller subsidiaries need more local support because of their organization fragilities (Chen and Chen, 1998). In contrast, larger subsidiaries are probably more able to find niches in the highly internationalized networks and therefore source on a global basis (Barkely and McNamara, 1994). In addition, smaller subsidiaries with little international experience will less likely choose Greenfield projects because of the lack of knowledge about the host market; and many smaller subsidiaries assign less weight to the disadvantages associated with any strategic incoherence resulting from the acquisition (Mendes, 2002). Thus, there is more likelihood of vertical externalities to occur.

External- Industry specific

Regarding specialization, an initially high level of expertise in certain activities may attract more investments and generate agglomeration economies (Barrell and Pain, 1999). Since physical proximity facilitates the flow of knowledge, agglomeration economies may facilitate the occurrence of vertical externalities. As a result, areas of high productivity tend to be geographically clustered, creating strong linkages (Anselin, 2001).

Firms in export-oriented industries are already accustomed to meet the superior quality required in export markets and adapt more easily to foreign firms demand in downstream sectors. This mechanism is especially effective when there is high sectoral competition. In fact, it is claimed that the industries that export a significant part of their production face greater competition than those market-oriented (Barrios and Strobl, 2002; Bekes et al., 2006), hence, it is more likely that vertical externalities occur.

In our view, firms in concentrated markets are likely to have market power that can facilitate linkages with foreign clients/suppliers, and thus vertical externalities may arise. For example, domestic firms with market power can beat their rivals (if there are any, since, in these markets, competition is low) more easily, when competing to become suppliers of a MNC. Moreover, stronger industry concentration generates larger profits that can be re-invested, for example, in new technologies or in the production of more sophisticated products that can be more appealing to foreign firms.

Capital intensity represents a firm's commitment to modernization and upgrading of its productive capacity. In the long run, capital expenditures typically have a positive impact on firms' performance (Lee & Blevins, 1990; Lee and Xiao, 2011). Thus, more productive firms can lower the price of the goods sold. If this is the case, then, it is our opinion that firms in capital intensive industries are more prone to establish linkages, for example, with foreign clients, and vertical externalities are more likely to arise.

External- Symbiotic

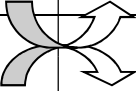
It is argued that there must be some difference between the technologies of the two types of firms (foreign and domestic) for externalities from FDI to occur. Hence, the higher the technological gap the greater the potential magnitude of vertical externalities. If the technology gap is large, it implies that MNCs have much more sophisticated technology than their domestic counterparts; and if they establish linkages with domestic firms, then it is likely that vertical externalities occur.

The geographical proximity facilitates relationships between foreign and domestic firms and the flow of knowledge from the first to the later. Therefore, it favors the occurrence of vertical externalities.

Finally, the propensity to establish technological cooperation is a key determinant of the existence of externalities from FDI (Dunning and Lundan, 2008; Narula and Dunning, 2010). This propensity for establishing technological cooperation will be greater if the FDI is technology sourcing since MNCs opt for less stringent appropriability strategies in order to facilitate the exchange of knowledge in the host country, demonstrating reciprocity (Faria and Sofka, 2008). The higher this propensity the greater the potential for the occurrence of vertical externalities.

Crespo and Fontoura (2007) remark that empirical studies do not specify the mechanisms by which the determinant factors of vertical externalities neither are effective nor distinguish between factors of occurrence and factors of magnitude. The first are factors that cause the externalities and the second are factors susceptible to intensify the extent of externalities. Hence, based on the several authors referred above in this section, Table 2 shows the possible connections between the several determinant factors of occurrence.

Table 2- Factors of occurrence of externalities from FDI

Primary	Secondary	Tertiary	Fuse
Specialization	Geographical Proximity	Agglomeration	Cooperation
Age of Managers			
Origin of FDI			
Market concentration			
Capital intensity			
Absorptive capacity	FDI motive/ Entry Mode		Intensive Use of Inputs
Size of the subsidiary			
Age of Workers			
Politics on Technology			
Level of autonomy of the Subsidiary			
Age of the Subsidiary			
Age of firms			

Source: own analysis

According to our analysis, factors of occurrence are classified into primary, secondary and tertiary, and emerge respectively in the first, second and third column. The primary factors are those that do not depend on other factors; the secondary factors depend, at least at some level, on the primary factors, and the tertiary factors depend on secondary and, ultimately, on the primary factors. In our opinion, because ‘FDI motive’ and ‘entry mode’ are related to both factors on the fourth column, the propensity to establish cooperation and the intensive use of local inputs, we label it ‘factors of liaison’.

The fourth column contains what we label ‘fuse factors’, e., factors that trigger externalities from FD In other words, ‘cooperation’ between domestic and foreign firms, and the ‘intensive use of local inputs’ by foreign firms most probably lead to external economies and, ultimately, vertical externalities arise.

We will now describe how primary, secondary, tertiary and liaison determinant factors are related and contribute to the occurrence of ‘fuse factors’.

Technological specialization promotes the learning effect between firms. Cantner and Graf (2004) provide empirical evidence concerning specialization and cooperation. The higher a region’s specialization, the more cooperatives are formed between partners outside that region. Taking cooperatives as a proxy for knowledge externalities, this result may show that the exchange of knowledge is highest in a specialized cluster (Dawid and Wersching, 2007). In addition, the geographical proximity may lead to agglomeration (industrial clusters) which is important for establishing contacts, cooperate and supply locally. As a result, cooperation between MNCs and local firms may occur when a high level of expertise (specialization) in some activities attract

more investments to a certain location, creating geographical proximity between firms (Anselin, 2001).

The age of the managers can also influence the propensity to establish technological cooperation. In our opinion, the youth of managers may imply propensity to innovate, but it also means less experience. Therefore, linkages are more likely to occur if the managers are not too young, to allow for market experience and a network of contacts with foreign firms.

Foreign investors coming from multicultural countries probably are more prone to establish contacts with local suppliers and customers. Also, the degree of development of the country of origin may influence the type of FDI projects and, thus, have an influence on the occurrence of vertical externalities.

The propensity to establish technological cooperation is a key ingredient for the existence of linkages (Jindra, 2010) and depends on the origin of the FDI (Javorcik et al, 2004; Wei and Liu, 2004; Takii, 2011).

Both market concentration and capital intensity contribute to provide market power and resources to domestic firms and, thus, the probability of cooperation between these firms and foreign firms is higher, in our view.

Assuming that human capital (as proxy for the absorptive capacity) is important to attract FDI inflows (Teixeira and Tavares-Lemhann, 2007), then the greater the level of human capital, the greater the likelihood of MNCs chose Mergers and Acquisitions (M & As) and source locally.

The size of the subsidiary may also impact on local sourcing. Small firms with less experience of international markets are likely to enter the domestic market through M&As to minimize the risks associated with the lack of knowledge about local tastes and overcome the weaknesses of their organization (Chen and Chen, 1998). In our opinion, FDI projects via M&As are more likely to source locally than Greenfield projects because in the former type of firms the sourcing decisions may be attributed to nationals as they be included in the board of directors. In contrast, larger firms are probably more capable to find niches in the highly internationalized networks and therefore usually supply in the international markets (Barkely and McNamara, 1994).

Regarding the age of workers, because younger employees are probably healthier than the older ones, and MNCs are sensitive to the health of the workforce regarding their M&A projects (Globerman and Shapiro, 2002), the age of employees impacts on the entry mode. In addition, in foreign projects via M&As, the sourcing decisions are more likely to be established by the previous firm owners. In this case, the

subsidiary management team is more likely to be an advocate of local sourcing (Tavares and Young, 2002)

The FDI motive may contribute to cooperation and to the intensive use of local inputs (Driffield and Love, 2006). According to Belderbos et al. (2001) if the subsidiaries are market driven, then they will adapt their products to local tastes, which may involve local supply and probably will cooperate with local firms. In addition, local sourcing of components and parts is a priority for international subcontractors that place great emphasis on flexibility (Chen et al, 2004).

On the other hand, high levels of investment on incorporated technology by the MNCs require more specialized and complex inputs that can be more expensive through imports. The solution would be to provide technical assistance to potential domestic suppliers (Driffield and Love, 2007; Marin and Sasidharan, 2010).

The sourcing decisions are also related to the level of autonomy of the subsidiary. The higher the autonomy, the more likely is local sourcing (Holm and Pedersen, 2000; Jordaan, 2011). For example, McAleese and McDonald (1978) have shown that purchases of local inputs tend to increase as the subsidiaries become more mature.

In this context, the age of subsidiaries also may have an impact on sourcing decisions (Zhang et al, 2010; Suyanto and Salim, 2010). In our opinion, older firms are likely to have gained more autonomy over time, and thus the likelihood of local sourcing is higher. On the other hand, we hypothesise that older domestic firms are more likely to be more integrated in the market and, thus, have more probabilities to have sourcing contracts with MNCs.

The intensive use of local inputs is related to FDI motive. If the MNC is motivated by the access to specific items that are either not available or not easy to transfer from the host country, the probability of local sourcing is higher. On contrary, if the FDI motive is to overcome tariffs or other trade barriers that prevent MNCs to export to the host country, the probability of local sourcing is low (Chryssochoidis et al., 1997). The entry mode also influences the local supply (Jabbour and Mucchielli, 2007). Greenfield projects are expected to rely more on imported inputs. However, when the FDI is via M&As, it is expected that domestic suppliers of the acquired firm will continue to supply the firm (Stancik 2009).

In our view, both determinant factors of occurrence and magnitude depend on firm behaviour (foreign and domestic). However, foreign firms' behaviour is crucial for vertical externalities to occur, in the sense that it is ultimately their choice whether to

establish cooperation and/or source locally; that can cause vertical externalities. In other words, the determinant factors related to foreign firms are relatively more important for the occurrence of vertical externalities than those factors related to domestic firms' characteristics. In Table 2 we present 5 primary internal factors related to foreign firms (origin of FDI, size, politics on the value of the technology, level of autonomy and age of the subsidiary) and 2 factors of liaison (FDI motive and entry mode) also related to foreign firm's characteristics, while internal factors related to domestic firms are only 4 and all are primary (age of managers, absorptive capacity, age of workers and age of firms).

Conversely, the determinant factors related to domestic firms' characteristics are relatively more important for the magnitude of vertical externalities. In other words, depending on domestic firms' characteristics, the intensity of vertical externalities can be higher or lower. Table 3 shows the determinant factors of magnitude of vertical externalities.

Table 3- Factors of magnitude of externalities from FDI

		Vertical externalities
FDI motive		depend
Entry Mode		-
Absorptive capacity		+
Age of Workers		-
Age of firms	Financial Capacity	+
Firm size		+
Characteristics of the sector (Export-oriented/domestic market)		(-/+)
Technological Gap		depend

Notes: +Positive; - Negative. Source: own analysis

Indeed, Table 3 shows 5 domestic firms characteristics as internal determinant factors of magnitude (absorptive capacity, age of workers, age of firms, firm size, and financial capacity) and just 2 related to foreign firm's characteristics (FDI motive and entry mode).

The joint analysis of tables 2 and 3 shows that the determinant factors of occurrence related to domestic firms' characteristics (absorptive capacity, age of workers and age of firms) are also determinant factors of magnitude. The magnitude of vertical externalities will be higher if the absorptive capacity is higher too. The same reasoning applies for the age of workers and the age and size of firms. Younger workers, in principle

are more receptive to foreign ideas, older and larger firms are likely to possess more resources to implement foreign knowledge. In addition, small firms may not be able to operate on a scale large enough to handle some of the foreign technology (Ngo and Conklin, 1996). However, we do not find convincing evidence that support the idea that the remaining determinant factors, domestic firms' size and financial capacity, can generate vertical externalities. In our view, these characteristics can only impact on the intensity of vertical externalities, once they occur.

Regarding foreign firms' characteristics as determinant factors of magnitude, as Moran (2001) stresses, the magnitude of linkages increases if the MNCs are largely dependent on local suppliers and impose high quality inputs. On the other hand, the share of foreign capital can be regarded as a proxy of the entry mode, and several studies (Javorcik, and Spatareanu, 2003; Javorcik, 2004b; Merlevede and Schoors, 2005) report the influence of the share of foreign capital on externalities from FD. Indeed, MNCs with higher local participation will not only facilitate access to foreign technology to local firms but also will probably create more linkages (Merlevede and Schoors, 2005). On the other hand, local producers of final products in export-oriented sectors usually face greater competition when compared to firms that supply the local market (Blomström and Sjöholm, 1999). Hence, these firms probably are familiar with the imposition of high quality to their products and were already forced to import inputs if the local inputs do not meet the quality requirements. Thus, these firms can at best benefit marginally from the improved quality of local inputs and therefore, the magnitude of vertical externalities will be lower. However, if these firms produce for the local market, then the magnitude of vertical externalities will be greater. Finally, we find that benefits arising from linkages will be greater if the technological gap is not too low, because in this case local firms will have (potentially) more to learn with the MNCs. However, if the technological gap is too high, local firms may not have the necessary absorptive capacity to implement foreign innovations.

4. EMPIRICAL STUDIES

4.1. INTRODUCTION

In Section 2, we discussed the transmission mechanisms of externalities from FDI on the productivity of domestic firms, to assist the analysis of empirical literature, regarding the type of estimating equations and variables aiming to capture the externality effects. Section 3 provided a set of determinant factors of vertical externalities that can be included in the empirical studies. However, researchers acknowledge that empirical studies should account for firm heterogeneity and, therefore, they must be carried out at firm level. Indeed, domestic firms' (heterogeneous) characteristics, influencing, for example, the absorptive capacity, are not only important to capture certain types of FDI projects that are likely to generate vertical externalities, but also may enhance the magnitude of the externalities from FD

We will now analyse a set of empirical studies for DCs regarding the type of the estimated equation, variables, proxies, determinant factors, and results, to draw some conclusions regarding the direction of future empirical research on externalities from FDI for DCs. The empirical literature review is motivated by two main reasons. First, there is a lack of empirical research that seeks to explain the impact and policy implications of externalities from FDI specifically in DCs; second, empirical evidence has shown mixed results for the same country and time period. Thus, this section addresses the former and tries to explain the later. We are the first to confine such analysis to the DCs, in particular to five Western European Countries. Previous literature reviews had focused only in the Least Developed Countries (LDCs); or in a mix of countries with different levels of development; or just in one country (DC or LDC). Although our analysis is not a meta-analysis, we expect that our group of studies is large enough to provide a more comprehensive explanation for the different results for the same country. In order to do so, we selected a group of five Developed western European countries.

The empirical literature on the impact of FDI on the productivity of local firms (e.g., Haddad and Harrison, 1993 and Harrison and Aitken, 1999) is mostly derived from association studies. According to Keller (2004): "This approach is based on economic theory in the following sense. Often, there are several models that have been proposed to explain, in this case, FDI spillovers, while model-specific evidence does often not yet exist. Association studies try to shed light on the most interesting models by proposing what might be the common reduced-form equation of all these FDI externality models.

In order to accommodate several models, the framework cannot be very specific.” (Op cit, p. 760).

The approach starts by a neoclassical production function³:

$$Y_{ijt} = A_{ijt} K_{ijt}^{\beta_k} L_{ijt}^{\beta_l} M_{ijt}^{\beta_m} \quad (1)$$

where Y_{ijt} represents physical output of firm i in sector j and period t , K_{ijt} , L_{ijt} and M_{ijt} are the inputs (capital, labour and materials, respectively). A_{ijt} is the Hicksian neutral efficiency level (our concept of total factor productivity – TFP) of firm i in sector j and period t . For a given level of A , higher output levels demand higher levels of inputs (K , L and M).

Taking natural logs of (1) and since the firm-level productivity is $\ln tfp_{ijt} = \beta_0 + \varepsilon_{ijt}$, we obtain a linear production function

$$\ln y_{ijt} = \beta_0 + \beta_k \ln k_{ijt} + \beta_l \ln l_{ijt} + \beta_m \ln m_{ijt} + \varepsilon_{ijt} \quad (2)$$

where lower cases refer to natural logarithms. Defining the value added as $va_{ijt} = y_{ijt} - \beta_m m_{ijt}$ and assuming that $L = L^P + L^{NP}$, where L^P stands for production worker (unskilled) labour and L^{NP} stands for non-production worker (skilled) labour.

Then, from equation (2), the productivity is estimated as a residual

$$\widehat{tfp}_{ijt}^v = va_{ijt} - (\widehat{\varepsilon}_{j^P}^v L_{ijt}^P + \widehat{\varepsilon}_{j^{NP}}^v L_{ijt}^{NP} + \widehat{\varepsilon}_{j^K}^v k_{ijt}) \quad (3)$$

Following Haddad and Harrison (1993), equation (3) is expressed as a augmented-solow type of equation, in order that the productivity growth can be expressed as a function of externalities from FDI and other control variables⁴

$$d\widehat{tfp}_{ijt}^v / \widehat{tfp}_{ijt}^v = f(F_{jt}, X) \quad (4)$$

³ The specification is slightly different from the Cobb Douglas used in the Solow model since in Solow model technology is labour augmenting and the equation assumes the form of $Y_{ijt} = f(K_{ijt}, A_{ijt} L_{ijt})$.

The use of a production function is along the lines of the New Growth Theory. This theory approaches knowledge externalities under the assumption of a spontaneous, automatic and free transmission mechanism (Romer, 1986, 1990 and 1994, Lucas, 2009). However, firms are mostly knowledge integrators, combining different sources of knowledge in order to generate new knowledge (Weitzman, 1996 and 1998). Hence, the production function is not the most adequate function to explain the generation of knowledge externalities. Instead, it is necessary to specify a knowledge generation function (Nelson and Winters, 1982 and Weitzman, 1996 and 1998) where internal and external knowledge are complementary inputs.

⁴ Where the human capital is the L^{NP} , i.e, the non-production worker (skilled) labour.

where F_{jt} is the measure of foreign presence in a certain industry j and X is a set of control variables. In particular, our estimating model is

$$dtfp_{ijt}^v / tfp_{ijt}^v = \beta_0 + \beta_1 tfp_{ijt-1}^v + \beta_2 \sum_{t=2}^0 f_{jt} + \beta_3 x_{ijt} + \gamma_t + \mu_{it} \quad (5)$$

Where the growth of TFP depends on the previous level of TFP, the foreign presence and other control variables. We also include year dummies γ_t that account for possible changes in the growth of TFP due to stochastic shocks at firm or sectoral level over time and an error term μ_{it} .

However, early studies, including those reviewed here for Developed Countries, used labour productivity (Y/L) instead of the estimated TFP (\widehat{tfp}_{ijt}^v), due to data limitations and less sophisticated econometric methodologies.⁵ Therefore, under the assumption of perfect competition, taking logs and computing total differentials, the augmented Cobb-Douglas type equation in those studies is

$$(y/l)_{ijt} = \beta_0 + \beta_1(f_{jt}) + \beta_2 x_{ijt} + \varepsilon_{ijt} \quad (6)$$

where again lower-case letters refer to natural logarithms, the coefficients β are the factor elasticities of product and f represents the measures of foreign presence (at horizontal and/or vertical level), x is a set of control variables and ε_{it} is the error term.

The analysis of our group of econometric studies, in the next section, regarding the type of equation, variables and proxies to include in the estimating equations will help us to establish the best practices regarding the empirical research.

⁵ The labour productivity (Y/L), in spite of being often used in the literature (eg, Kokko, 1994, Barrios and Strobl, 2002), captures only one aspect of the productivity improvement.

4.2. THE SELECTED STUDIES

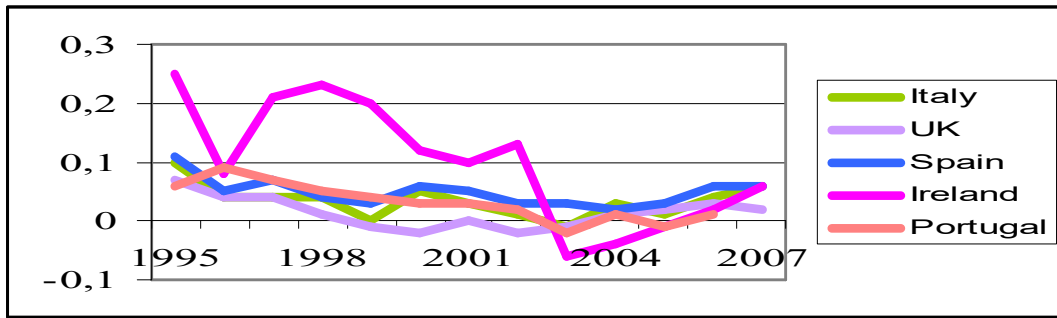
We analyse 20 empirical studies that test the effects of FDI on the productivity of domestic manufacturing firms for 5 countries of Western Europe, with panel data at firm level.⁶ The sample contains only DCs because the extent to which externalities occur is not the same for DCs and LDCs (Roording and Vaal, 2010). In fact, studies on DCs document positive productivity externalities even after controlling for industry and regional fixed effects (Hale and Long, 2006).⁷ This occurs for several reasons. First, FDI projects in DCs are mainly market-driven (Roording and Vaal, 2010). Thus, according to what was said in section 3.2, market-oriented MNCs are likely to establish backward linkages; and the potential for vertical externalities is increased. Second, because labour market is more restrictive in LDCs, it does not work as well, and it is not as regulated as in DCs, the potential for vertical externalities is lower. Third, in countries with developed financial markets, the access to credit for investment is facilitated, favouring the occurrence of linkages (Alfaro et al. 2004).

However, while all our selected studies investigate the existence of horizontal externalities, only 35% investigate the existence of vertical externalities. The choice of the countries is related to the number of studies produced for comparison purposes. Nevertheless, despite the research on vertical externalities, the number of such studies for DCs is still scarce. Most of the studies (35%) are for the UK, 20% refer to Portugal and the other countries represent a share of 15 % each. As Figure 1 shows, in all countries, except for Ireland, the growth rate of the manufacturing Gross Value Added has been relatively constant over the period 1995-2007.

⁶ The choice of studies for these 5 countries is related to many reasons. First, our purpose is to analyse the effects of FDI in a small developed and open economy (Portugal). Second, we want to analyse the impact of FDI in the manufacturing sector only. Third, Countries should be from Western Europe and we need at least 3 studies to compare results. Empirical research on externalities from FDI in Western Europe Countries had its apogee from the early 2000s to 2010, coinciding with the introduction of Input-Output tables in the analysis and the development of databases and estimation methods. Having exhausted the enthusiasm for these countries, researchers started to focus on transition economies and then in developing countries. The fact that FDI inflows into Western Europe have declined since the 2008 crisis may also, at least in part, explain the absence of more recent studies with the characteristics we want to analyse. One exception is the recent study Barge-Gil et al. (2017) for Spain but the authors include the services sector in their analysis, and not just the manufacturing sector. Other examples of more recent studies that do not comply entirely with our requirements are Barrios et al (2012) that focus on knowledge externalities for Ireland; Del Bo (2014) that analyses externalities from FDI on the productivity of electricity sector for EU countries; and Mariotti et al (2011, 2014) that focus on the productivity externalities from MNCs to Italian firms in the services sector.

⁷ See for example, Girma, et al. (2001) and Haskel et al. (2007).

Figure 1- Growth Rate of Manufacturing Gross Value Added (%)



Source: author's calculations based on EUKlems database

According to Inklaar and Timmer (2008), these countries shared the average weight of manufacturing in the overall economy of approximately 22%, in 1997. We focus on the manufacturing sector because, being a major producer of tradables, it potentially generates high rates of innovation and drag capabilities to other sectors of the economy. In other words, the manufacturing sector is a driver of technological change (Andreoni and Gregory, 2013).

Estimated Equation, Variables and Proxies in selected studies

Table 4 shows the empirical studies in our group of studies regarding the country, period, estimator, dependent variable, proxy for foreign presence and results.

Table 4-Empirical studies on FDI Externalities

Study	Pubdate	Country	Period	Methodology	Dependent Variable	Proxy for FDI	Horizontal	Backward	Forward
Ruane and Ugur	2005	Ireland	1991-1998	OLS	Labour Productivity	Employment	Ns +		
Barry et al	2005	Ireland	1990-1998	Fixed Effects	Labour Productivity	Employment	-		
Barrios et al.	2012	Ireland	1990-1995	2SLS	TFP	R&D	+		
Imbriani and Reganati	2004	Italy	1994-1996	Fixed Effects	Value Added	Employment	Ns -		
Reganati and Sica	2007	Italy	1997-2002	Fixed Effects	Value Added	Employment	Ns +	+	+
Albanese et al	2008	Italy	1999-2005	Fixed Effects	TFP	No. of Firms	+		
Farinha and Mata	1996	Portugal	1986-1992	Random	Labour Productivity	Employment	Ns		
Proenca et al.	2002	Portugal	1996-1998	GMM	Labour Productivity	Capital Stock	Ns		
Crespo et al. ^a	2009	Portugal	1996-2000	GMM	Labour Productivity	Employment	-	+	Ns +
Crespo et al. ^a	2012	Portugal	1996-2001	GMM	Labour Productivity	Employment	Ns-	+	Ns +
Barrios and Ströbl	2002	Spain	1990-1994	Fixed Effects	Output	Capital Stock	Ns		
Alvarez and Molero	2005	Spain	1991-1999	GMM	Growth of Productivity	Capital Stock	+		
Jabbour and Mucchielli	2007	Spain	1990-2000	OLS	Output	Capital Stock	-	+	+
Girma	2005	U.K.	1989-1999	GLS	TFP	Employment	Ns +		
Girma and Wakelin	2002	U.K.	1988-1996	GMM	Output	Employment	+		
Driffield	2004	U.K.	1983-1997	GMM	Value Added	Capital Stock	-		
Harris and Robinson	2004	U.K.	1974-1995	GMM	Value Added	Capital Stock	+	Und.	Und.
De Propis and Driffield	2006	U.K.	1993-1998	3SLS	Value Added	Capital Stock	-		
Haskel et al.	2007	U.K.	1973-1992	OLS	Output	Employment	+	+	+
Girma et al.	2008	U.K.	1992-1999	OLS	Output	Output	+	+	-

Notes: ^a Results at regional level. Pubdate- Date of Publication, +Positive; - Negative; Ns- Non Significant, Und- Undetermined. OLS- Ordinary Least Squares; 2SLS- Two-stage Least Squares; 3SLS- Three-stage Least Squares; GMM-Generalized Method of Moments. Source- Own Analysis.

With reference to equation (6), two studies (Ruane and Uğur, 2005 and Albanese et al, 2008) use the functional form of the type,

$$d\ln(Y/L)_{ijt} = \beta_0 + \beta_1 d \ln F_{ijt} + \beta_2 \ln X_{ijt} + \varepsilon_{ijt} \quad (7)$$

while 4 studies (Driffield, 2004; Haskel et al, 2007.; de Propis and Driffield, 2006 and Reganati and Sica, 2007) use an empirical model of the type:

$$d\ln(Y/L)_{ijt} = \beta_0 + \beta_1 \ln F_{ijt} + \beta_2 \ln X_{ijt} + \varepsilon_{ijt} \quad (8)$$

and the remaining studies use an empirical model such as,

$$\ln(Y/L)_{ijt} = \beta_0 + \beta_1 \ln F_{ijt} + \beta_2 \ln X_{ijt} + \varepsilon_{ijt} \quad (9)$$

Both specifications in (7) and (8) assume that FDI have a permanent effect on labour productivity; while specification (9) assumes that FDI only impacts on the level of the labour productivity.

The group of variables X include interaction variables that may be determinant factors of externalities from FD The most used variables in these studies are the absorptive capacity and the geographical proximity. Tables 5 (a and b) show the proxies used for the dependent and independent variables and for the measures of foreign presence, respectively.

Table 5a-Variables and Proxies used in empirical studies of externalities from FDI

Variable		Proxies
Dependent	Output	Value of sales less the change in inventories, deflated
		Nominal value of production output
		Real gross output deflated by annual output price deflators
		Sales for changes in inventories of finished goods deflated by Producer Price Index
	Labour Productivity	Ratio of output to labour
	Value Added	Difference between the value of output and the intermediate inputs
Independent	Capitalistic Intensity	Total fixed assets divided by the number of workers
		Total value added divided by the number of workers
	Concentration	Total number of employees i to total employment in the sector
		Concentration is the sectoral Herfindahl concentration index.
	Human Capital	Ratio of white collar to blue collar employees
		Wage bill by the minimum wage
		Human resources devoted to science and technology activities
		Share of management personnel in total firm's employment
		Electricity consumption per employee
	Scale	Percentage of population in the region with at least secondary
		Average output of domestic firms to the average output of firms
	Tg	Establishment nominal gross output as a share of industry nominal gross output.
Ratio of domestic firms to foreign firms' productivity		
		Ratio of value added by all foreign firms to total value added

Note-TG is the technological gap. Source-Own analysis

Table 5b-Measures of foreign presence

Variable	Proxies
Foreign presence	Change in employment in a foreign-owned plant as a share of total employment
	Dummy equals 1 if foreign ownership is higher than 50%.
	Dummy equals 1 if foreign ownership is between 10% and 50%.
	Foreign equity participation averaged over all firms in the sector, weighted by each firm's share in sectoral output.
	Ratio of turnover of foreign-owned firms to total turnover in the sector.
	Sectoral FDI flows
	Share of all foreign firms in the total output of sector
	Share of employment in sector accounted for by foreign-owned plants.
	Foreign equity participation of foreign firms
	Share of total employment in region accounted for by foreign-owned plants.
Value of sectoral FDI flows	
Ratio of value added by all foreign firms to total value added in the sector	

Source-Own analysis

Sales are used in 85% of the studies; whether as a proxy of output, or entering the formula of labour productivity (output/labour) or value added (sales less the intermediate inputs); while the share of foreign employment is used in 50% of studies as proxy for foreign presence.

Only two studies refer the robustness check of measures for foreign presence. Indeed, Haskell et al (2007) use the employment and the capital of foreign firms as alternative measures; while Jabbour and Mucchielli (2007) test the magnitude of backward externalities by using the average foreign equity participation in manufacturing weighted by each firm's share in the total employment of the sector; and the the share of foreign firms in manufacturing. Both studies conclude that the results are similar regardless the proxy used for foreign presence.

Determinant Factors in selected studies

Considering our classification of the determinant factors in section 3, we now analyse how the authors of the selected studies have tested the determinant factors of externalities from FD

For the UK, while De Propis and Driffield (2006) and Driffield (2004) find negative horizontal externalities, due to agglomeration economies and government policies, Girma and Wakelin (2002) and Haskel et al. (2007) find positive horizontal externalities via competition and the level of development, respectively. The effect of the agglomeration economies on vertical externalities is indeterminate in Harris and Robinson (2004); whilst Haskel et al. (2007) and Girma et al. (2008) find that the level of development and the FDI motive give rise to positive externalities via backward linkages. In contrast, externalities via forward linkages are positively affected by the level of development; while the impact of the FDI motive is negative.

For Portugal, Farinha and Mata (1996) and Proença et al. (2002) find non-significant horizontal externalities, due to firm size and technological gap; while Crespo et al. (2009, 2012) find a negative effect on horizontal externalities. Crespo et al. (2012) find positive externalities via backward linkages and positive but non-significant externalities via forward linkages, due to geographic proximity.

For Ireland, Barrios et al. (2012) and Ruane and Uğur (2005) test the absorptive capacity and find non-significant and positive results, respectively. Barry et al (2005) find that firm size and the capitalistic intensity impact negatively on horizontal externalities.

For Italy, Imbriani & Reganati (1999) and Reganati and Sica (2007) test the impact of the geographical proximity and the absorptive capacity on horizontal externalities and find non-significant results; while Albanese et al (2008) find a positive influence of geographical proximity on horizontal externalities. Reganati and Sica (2007) also find a non-significant impact of the absorptive capacity on externalities via backward linkages, but positive for externalities via forward linkages.

Finally, for Spain, Jabbour and Mucchielli (2007) find that technological gap impact negatively on horizontal externalities and positively on vertical externalities. Barrios and Ströbl (2002) test the absorptive capacity and find a non-significant effect on horizontal externalities; whilst Alvarez and Molero (2005) conclude that the share of foreign capital has a positive effect on horizontal externalities.

Thus, while the absorptive capacity is tested in 24% of studies, the share of foreign capital and the geographical proximity are tested in 15% of studies, and the firm size and the FDI motive are tested only in 9% of the studies, followed by the agglomeration economies, export capacity and technological gap (6%). Finally, the level of development of the host country, the FDI policies adopted, the market size and the competition are analysed in 3 % of the studies.

The meta-analysis of Havranec and Irsova (2010) includes 4 of our 20 studies. However, our analysis provides different insights. We focus on findings for five developed Western European countries and we focus on the determinants factors of externalities from FDI, included in these studies. Comparing our analysis with the findings of Havranec and Irsova (2010) and the study of Javorcik (2002), we conclude the following. Our analysis of the determinant factors confirms to some extent the study of Havranec and Irsova (2010). The authors claim that the most used determinants of horizontal externalities are the technological gap, trade openness, IPR protection, human capital and FDI penetration (measured by the ratio of inward FDI stock to GDP). Moreover, our results confirm the findings of Javorcik (2002) that the determinants used to explain vertical externalities are mostly competition, FDI motive, the share of foreign capital and technological gap.

Results in selected studies

Table 6 compares the results of Havranec and Irsova (2010) with the results of our selected studies. The sample of Havranec and Irsova (2010) contains 4 studies, 1 for each of the selected countries, except for Ireland. In what follows, our results are shown in parentheses. The results analysed by Havranec and Irsova (2010) include 75% (55%) of studies with positive horizontal externalities, 100% (100%) show positive externalities via backward linkages; and 33% (67%) show positive externalities via forward linkages.

Table 6- Results of empirical Studies of externalities from FDI

	Havranec and Irsova (2010)			Our group of studies		
	sample =4			sample =20		
	Positive	Negative	N.S.	Positive	Negative	N.S.
Horizontal	3	1		11	6	3
Backward	4			6		
Forward	1	2		4	2	

Notes- N.S. is non-significant. Source: own elaboration based on Table A1 from Havranec e Irsova (2010)

The results are mixed and sometimes indeterminate. In fact, the years of 1993-1996 showed controversial results for the UK and Ireland; as well as the years 1995 and 2000 for Portugal; and 1998 for Spain. In contrast, it seems consistent to assume that, according to the sample of studies, the results are positive for horizontal externalities in the UK for 1974-1988; and negative for 1997. However, for Portugal, horizontal externalities appear to be non-significant for 1989-1992; positive in 1999; and negative in 2001; while in Spain, horizontal externalities seem to be non-significant in 1991-1992; positive in 1999; and negative in 2000. Regarding Ireland, horizontal externalities appear to be non-significant in 1991 and 1998-1999; while in Italy, horizontal externalities seem to be non-significant in 1994-1998; and positive in 2003-2005. Though mixed results may be a consequence of different data sources and methodologies, positive and negative results may also be affected by business cycles, and, the amount of inward FDI flows targeting the manufacturing sector in those periods.

Comparing the results for each country, considering the methodologies and variables used, we highlight the following aspects, drawn from Table 4.

For Ireland, the 3 studies analyse the period 1991-1995, where both studies of Ruane and Ugur (2005) and Barry et al. (2005) use the same dependent variables and proxies for the foreign presence; and Barrios et al (2012) use the TFP as dependent

variable, and the R&D stocks of foreign firms as a proxy for foreign presence. While Ruane and Ugur (2005) find positive but non-significant results for horizontal externalities, Barry et al. (2005) find negative results and Barrios et al (2012) find positive results. The explanation for different results, especially between the studies of Ruane and Ugur (2005) and Barry et al. (2005), since they have several common characteristics, may be attributed to different econometric techniques. Indeed, while the first use OLS, the second use fixed effects and Barrios et al. (2012) use 2SLS.

In the case of Italy, studies by Reganati and Sica (2007) and Albanese et al. (2008) analyse the common period of 1999-2002; and the studies of Imbriani and Reganati (2004) and Reganati and Sica (2007) use the same dependent variable and the same proxy for foreign presence. However, Imbriani and Reganati (2004) find negative but non-significant results and Reganati and Sica (2007) find positive but non-significant results. Albanese et al. (2008) share the same econometric technique with the other two studies, but the authors use the TFP as the dependent variable and the number of firms as proxy for foreign presence and find positive horizontal externalities.

Regarding Portugal, Farinha and Mata (1996) analyse the 1986-1992 period while Proença et al. (2002) focus their analysis between 1996 and 1998 and Crespo et al. (2009, 2012) analyse the period 1996-2001. The common period is 1996-1998 for the last 3 studies. Except for Farinha and Mata (1996), that use a random effects model, all authors use the system GMM to estimate an equation where the dependent variable is the labour productivity which depends on variables of foreign presence in level (whose proxy is the employment in foreign firms, except Proença et al. that use the capital stock). Results for horizontal externalities are controversial. Indeed, while Crespo et al. (2009, 2012) find negative results; Farinha and Mata (1996) and Proença et al. (2002) find non-significant results. Regarding Vertical externalities, Crespo et al (2009, 2012) find positive and positive but non-significant results via backward and forward linkages, respectively. One possible cause for these controversial results may be the underestimation of the real externality effects due to econometric problems associated with traditional panel data estimation methods.

Concerning Spain, Barrios and Strobl (2002), Jabbour and Mucchielli (2007) and Alvarez and Molero (2005) analyse the common time span of 1991-1994 and the authors use the capital stock as a proxy for foreign presence. However, even though both Barrios and Strobl (2002) and Jabbour and Mucchielli (2007) use the output as the dependent variable; the first use fixed effects; while the second use OLS, and find non-

significant and negative horizontal externalities, respectively. Alvarez and Molero (2005) find positive results by regressing the labour productivity using the GMM estimator.

In the case of the UK, studies that found positive results use the output or value added as the dependent variable; while studies with negative results use the capital stock as a proxy for foreign presence. It is interesting to note that the studies of Driffield (2004) and Harris and Robinson (2004) share the date of publication and the same period of analysis of 1983-1995. They also use the capital stock as a proxy for foreign presence and the output as the dependent variable and find opposite results (negative and positive, respectively) for horizontal externalities. In this case, we believe that the methodology and the fact that the data source is not the same may have influenced the results. Indeed, while Driffield (2004) apply the econometric approach of Griliches and Lichtenberg (1984) to ONS, ANBERD (Analytical Business Enterprise Research and Development) and STAN OECD data; Harris and Robinson (2004) use weighted panels with DPD algorithm in PcGive with data from ARD (Annual Census of Production Respondents). Regarding the results for vertical externalities, externalities via backward linkages are positive using output as dependent variable and Levhinson and Petrin (2003) econometric procedure; and are undetermined in the studies where the proxy of foreign presence is the capital stock and the methodology is the weighted panels in the DPD algorithm. We cannot arrive to a conclusion about the presence of forward externalities in the UK since the result is positive, undetermined or negative depending on the use of employment, capital stock or output as the proxy for foreign presence.

5. CONCLUSION

According to some authors, externalities are more likely to occur at vertical level (Kugler, 2006). Vertical externalities (especially via forward linkages) seem to exert a significant influence on the competitiveness of countries and stimulate economic growth via increased exports (Freund and Moran, 2017).

Overall, internal characteristics of firms (local and foreign) appear to be more important for the occurrence and magnitude of vertical externalities than external factors.

In this context, empirical studies at firm level report that firms are strongly heterogeneous in various performance measures, namely size and productivity (Melitz, 2003). Thus, domestic firms' characteristics that enhance the absorptive capacity (such as firm size) may be key contributors to the magnitude of externalities from FD. Hence, there is scope for further analysis on the transmission mechanisms of externalities from FDI considering firms' heterogeneity.

Some conclusions can be drawn from the analysis of the empirical studies on Western European Countries. First, there is a lack of evidence of externalities via forward linkages when compared with those arising from backward linkages; second, researchers traditionally regress the output on foreign presence and control variables that are efficiency measures (capital intensity, economies of scale and sectoral concentration); third, the impact of the FDI motive has not been fully exploited in the empirical literature perhaps due to the difficulty to disentangle all possible effects; and finally, the share of statistically non-significant results is high.

Hence, up to now, the empirical literature has not contributed to an unambiguous explanation of the transmission mechanism of externalities from FDI, and, therefore, the link between theoretical and empirical literature is missing (Lautier and Moreau, 2012).

We expect to contribute for the existent literature in two ways. Firstly, we present a new classification on the determinant factors of vertical externalities; secondly, we are the first to review the literature focusing on a set of developed European countries. This is of crucial importance regarding the choice of variables to include in empirical models to evaluate the existence of externalities from FDI in Developed Countries.

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