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Impact of Multinational Enterprises on Competition, Productivity and Trade Spillovers across European Firms*

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Abstract

We analyze the impact of multinational enterprises (MNEs), via their foreign direct investment, on domestic firms in 30 European host economies, from 2001 to 2013. We incorporate international industrial and trade linkages into a standard theoretical framework and test them empirically on a unique dataset compiled from the Amadeus, Eurostat, UNComtrade and BACI data sources, aggregated at industry level. While controlling for horizontal, vertical, and export channels at the upstream and downstream levels, we show that the presence of MNEs significantly affects domestic firms by changing the degree of competition and improving productivity. The impact is not always positive, as domestic firms are often crowded-out, but the negative effect for an average firm is mostly small.

1. Introduction

Governments often try to attract foreign direct investment (FDI) with costly economic incentives (Meyer, 2004)[1], motivated by a strong belief that multinational enterprises (MNEs) bring, via their FDI, substantial external benefits to a host country. These benefits materialize through various spillovers that impact domestic firms, as documented by a vast, yet fragmented, extant academic literature. There are three distinct perspectives from which existing studies analyze the impact of MNEs and FDI on domestic firms: 1) productivity, 2) market conditions and 3) international

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[1] Foreign direct investment (FDI) is an operation through which a multinational enterprise (MNE) acquires control over a domestic firm in a host economy by obtaining not less than 10% of voting rights (OECD, 2008). This happens either by investing in an existing company (brownfield) or by founding a new subsidiary (greenfield) in the host country.

activities. All three of these aspects can be studied either (i) at the intra-industry level, where the MNEs and local firms are competitors within the same industry (horizontal linkage) or (ii) within the inter-industry relationship, where both types of firms are partners in the vertical chain of production (vertical linkage). Within the vertical interaction, an MNE, as an upstream industry entity, provides intermediate goods for other firms in a host economy (forward linkage), or, as a downstream industry entity, an MNE uses intermediate goods provided by domestic firms (backward linkage).

All the above-mentioned research perspectives understand the potential of MNEs to significantly impact domestic firms as stemming from the underlying assumption that firms which are able to engage in FDI have to be highly efficient (Melitz, 2003). From the productivity perspective, researchers focus on potential productivity and technology spillovers, a positive externality stemming from an MNE towards its local competitors on the horizontal level, and customers or suppliers on the vertical level (Bodman and Le, 2013; Görg and Strobl, 2001). From the perspective of changing market conditions, MNEs may increase competition on the horizontal level, which prompts crowding-out of those domestic firms who are unable to withstand the new environment, while on the vertical level, increasing demand for intermediate goods may provide more room for competent domestic firms (Kosová, 2010). From the international perspective, researchers stress that MNEs' export activity is often substantial and significantly affects domestic firms via the trade/export spillover effect, a positive externality that lowers costs of trade and helps to increase the export activities of domestic firms (Aitken et al., 1997; Greenaway et al., 2004).

Accurately assessing the impact of entry of MNEs on the host country is essential both for governments, which decide whether or not to promote FDI, and for MNEs, which need to know their bargaining power in negotiations over the conditions of the investment (Dunning and Lundan, 2008; Jones, 2014). The multifaceted nature of the MNEs' impact on domestic firms (and host economies in general), along with the fragmented approach to its analysis, are the most likely reasons the related empirical literature has so far failed to provide accurate estimates that would combine the above-mentioned implications of FDI and account for relevant interactions. Despite their importance, market condition implications are much less researched than traditional productivity spillovers and both these phenomena are rarely analyzed in relation to export spillovers. Hence, the existing literature fails to take into account important domestic and international trade links, probably due to obstacles imposed by the availability of data.

We manage to overcome the data issue by assembling a dataset that allows for a much less fragmented assessment. We empirically assess the role of FDI in Europe, where a positive and robust correlation between trade integration and FDI activity has been identified for both old and new EU countries (Martínez-San Román et al., 2016). Specifically, our unique database, which covers the production-trade linkages across industries in 30 European countries from 2001 to 2013 is constructed using the Amadeus, Eurostat, UN Comtrade and BACI databases. Such a large geographical coverage of firms' performance, inter-industry interactions and international trade flows allows us to incorporate the effect of international industrial linkages while analyzing the sourcing and supply patterns of MNEs in Europe, along with their

interaction with domestic competitors. Our empirical analysis reflects spillovers, competition and sourcing patterns, while also capturing international trade linkages. Our identification strategy allows us to investigate the impact of FDI on the host economy, both along the vertical linkage (between industries) and the horizontal linkage (within industry), in greater detail than any of the existing empirical studies to date. Our empirical analysis disentangles various channels through which the impact is propagated, and provides researchers, as well as potential policy makers, with a more granular view on this complex issue.

Our results do not show significant (positive) interactions of domestic firms with MNEs operating in the downstream sector, which would suggest desirable productivity spillovers. Rather, the findings show that the presence of MNEs in the downstream sector is associated with changes in the extent of competition in the sector of intermediate goods, where domestic producers are being replaced by other MNEs or by imports. Hence, domestic producers do not benefit to the full extent from the fact that FDI is related to increased production in the downstream sector (a finding that we confirm) and hence the demand for intermediate goods increases. On the other hand, we find a clearly positive trade (export) spillover linked to MNEs' presence in an industry: we show that the production of domestic firms is higher when exports by MNEs present in the sector increase.

The rest of the paper is structured as follows. In Section 2, we review the literature. In Section 3, we describe the theoretical model and potential channels of the FDI effects, and also present the econometric specifications. Section 4 describes the data and Section 5 presents the results separately for the upstream and downstream analyses. Section 6 concludes.

2. Literature Review

Since the literature on the effects of FDI has grown substantially, we focus only on that directly related to our analysis. We also provide relevant references, primarily to surveys and meta-analyses.

As explained in the previous section, two key dimensions of the impact of FDIs have been studied in academic literature. The first is the intra-industry (or horizontal) level, that concerns the interaction between an MNE and its local competitors within the same industry. The second link is the inter-industry relationship (also called vertical linkage), that characterizes interactions between an MNE and its customers (forward vertical linkage) or between an MNE and its suppliers (backward vertical linkage). Markusen and Venables (1999) provide a theoretical model of the impact of FDI on domestic firms on the vertical level, in which they describe the market structure change and the productivity spillovers arising from the entry of a highly efficient MNE in the domestic market, and how these affect domestic producers of intermediate goods.[2] The model also takes into

[2] Markusen and Venables (1999) model is one of the two theoretical models that study the impact of MNEs on the local suppliers of intermediate goods. Another model, by Rodriguez (1996), is not very suitable for our study, since it is tailored to the situation in underdeveloped countries. In this model, domestic firms and MNEs produce different types of goods because there are not enough suppliers of sophisticated intermediate goods in the country, and domestic firms cannot import them. We do not think such assumptions are realistic in EU countries.

account changes that take place on the horizontal level within the sector that MNEs enter, since these inter-industry changes also impact downstream industries along the vertical axis. The authors conclude that the entry of an MNE increases competition on the horizontal level, and may thus threaten domestic firms, but on the vertical level the increased demand for intermediate goods across industries may bring profits to domestic suppliers. In addition, in Markusen and Venables' (1999) model, FDI provides scope for productivity spillovers, assuming that these need a face-to-face interaction between the two parties (domestic firms and MNEs). This hypothesis is also supported by Ethier (1986).

Markusen and Venable's (1999) model implicitly describes only the so called "market-seeking" type of FDI, where the MNEs enter the domestic market in order to serve their customers there. We are aware of the fact that this is not the only motivation of MNEs to engage in FDI; however, we believe that in the context of the European countries that we study it is, along with efficiency seeking, one of the most common reasons to establish a subsidiary, especially when we consider the local market to comprise not only the target country, but rather the whole geographical region. Also, we think that even if the motivation of MNEs was rather due to efficiency seeking, the only way it would affect our results would be "just" underestimating some of them (the competition effect would not be that strong); hence, if we find any significant effect, we can be sure of its existence, if not of its magnitude, which may be larger than we claim.

Anyway, the empirical papers to which we compare our analysis deal mostly only with market seeking FDI as well. They also recognize the two dimensions of interactions between the MNE and other firms in the economy, both in terms of the degree of competition as well as technological transfers (Blalock and Gertler, 2008). The entry of a highly efficient MNE significantly changes the competition environment and market conditions for domestic firms – the increase of competition on the horizontal level is potentially offset by a higher demand for intermediate goods on the vertical level. At the same time, domestic firms can potentially benefit from productivity spillovers, which are externalities created by the presence of MNEs in the market (Meyer and Sinani, 2009). Researchers assume that more technologically advanced MNEs represent a positive example that domestic firms can follow – examples include copying new technologies, and/or hiring workers or managers who have experience in foreign companies (Xu and Sheng, 2012). Alternatively, the entry of MNEs may represent a threat that motivates domestic firms to try to innovate their production methods in order to withstand the increased competition (Aghion et al., 2004). To do so, the domestic firms might sometime benefit from engaging with suppliers used by MNEs, who may provide intermediate goods of better quality than are otherwise available locally (Kee, 2014). These productivity spillovers are a highly desired externality emanating from MNEs' activities (see UNCTAD, 2001) and as such, they are widely studied in the current empirical literature related to FDI (Havranek and Irsova, 2012).

In addition, the empirical literature also stresses another channel of the impact of FDI on domestic firms – change in trade patterns driven by MNEs. FDIs are closely related to inter-sectoral trade and the vertical integration of production chains, as has been shown theoretically (e.g. Helpman, 1985) and documented empirically (see Lanz, 2011). The potential increase in demand for intermediate

goods due to the inflow of FDI and related enhanced industrial activity is not always covered by domestic firms. MNEs may prefer to purchase the intermediate goods from abroad, which can also lead to a crowding-out effect in the upstream sector, where domestic suppliers would, in such a case, compete with importers. At the same time, MNEs can be very large exporters and their export activities may have consequences for domestic firms as well. In this respect, Uzagalieva et al. (2012) show that local firms in the new EU markets experience efficiency gains if they supply industries with a higher share of foreign firms or if foreign firms sell to them.

Whether foreign subsidiaries use domestic suppliers more, or less than domestic firms has not often been tested empirically, but the general perception is that the share of domestically sourced goods is lower in the case of foreign subsidiaries (Jordaan, 2011). There is some mixed evidence on this issue, which seems to depend on the country in question. While Jordaan (2011) finds, for Mexico, that foreign subsidiaries use local suppliers to the same extent as domestic firms, Javorcik and Spatareanu (2005) find the opposite in the case of the Czech Republic and Lithuania. Further, Javorcik and Spatareanu (2005) claim that the insufficient quality of locally supplied intermediate goods is the main reason why MNEs source from abroad. In contrast, Jindra et al. (2009) explain that the choice of a local or foreign supplier depends also, to a great extent, on the type of foreign subsidiary.

With regard to the impact of MNEs' exporting activities on domestic firms, the seminal works of Aitken et al. (1997) and Greenaway et al. (2004) show that the presence of MNEs produces an export spillover - a positive externality that lowers the costs of trade and helps to increase the export activities of domestic firms.

Unfortunately, the empirical literature fails to reflect the complexity of the issue of the impact of MNEs on domestic firms. First, there is the issue of spillovers, which is probably studied most often. Smeets (2008) revises the empirical evidence of the impact of FDI and clearly illustrates that the majority of studies published in this field concern technological transfers. A detailed survey of these papers is presented in Hanousek et al. (2011), who show that horizontal spillovers are often found to be insignificant or negative, whereas vertical spillovers are found to be significant and rather positive. However, this evidence is very mixed and usually depends on the country and time period over which the analysis was performed. Some studies suggest that an important factor for observing a positive spillover effect is the initial efficiency of domestic firms, arguing that if these are technologically too far behind the MNEs, they will not be able to absorb any positive spillovers (Sabirianova et al., 2005). Unfortunately, many of the papers are limited by their geographical and industrial scope, focusing on one country and/or one industry only (see Dries et al., 2004), which certainly provides an interesting insight, but from which it is hard to generalize further. Greater consensus exists for the question of export spillover, analyzed by a more limited number of papers, in which a positive effect is prevalently found. In Figure 1, we summarize the key approaches to the issue of spillovers from the existing empirical literature[3]. In three columns, we

[3] The table obviously cannot summarize the whole literature on the topic, which is extremely rich. We display only a few typical papers to give a reader the idea of what the literature usually focuses on and namely, how inconclusive the results are. It shows a great sensitivity to the model specification used by particular studies. For more detailed overviews, see e.g., Smeets (2008) or Hanousek, at al. (2011).

indicate whether the particular study examines horizontal, vertical, or export spillovers, and in the relevant rows we indicate whether the empirically found relationship is positive or negative.

Figure 1 This Figure Summarizes the Existing Empirical Literature Directly Relevant to Our Analysis

	Horizontal spillovers		Vertical spillovers		Export spillovers	
	Positive	***Negative***	***Positive***	***Negative***	***Positive***	***Negative***
Aitken et al. (1997)					yes	
Aitken & Harrison (1999)		yes				
Alvarez & López (2008)	yes		yes		yes	
Bernard & Jensen (2004)					Tested for, not found	
Blalock & Gertler (2008)			yes			
Clerides et al. (1998)					yes	
Damijan et al. (2003)	yes	yes				
Djankov & Hoekman (2000)		yes				
Dries & Swinnen (2004)			yes			
Gorodnichenko et al. (2015)	yes					
Greenaway et al. (2004)					yes	
Javorcik (2004)		yes	yes			
Javorcik & Spatareanu (2009)			yes			
Jordaan (2011)			yes			
Jurajda & Stančík (2012)	yes					
Koenig et al. (2010)					yes	
Kokko et al. (2001)	yes	yes			yes	yes
Konings (2001)		yes				
Lesher & Miroudot (2008)			yes		yes	
Stančík (2010)		yes	yes	yes		

Notes: The columns indicate whether the particular study examines horizontal, vertical, or export spillover and whether the relationship is positive or negative (or not found).

In Figure 1, we can clearly see that for the horizontal spillover especially, the evidence is mixed. In our opinion, this is due to the fact that existing empirical literature usually omits the issue of a changing degree of competition (Peretto, 2003). On the horizontal level, a potential positive spillover may be offset by the crowding out effect, which results in observation of an overall negative impact of FDI. On the vertical level, on the other hand, the potentially increased demand may imply a positive impact, which could be incorrectly attributed to vertical spillover, and the question is thus to what extent the consensus that seems to be reached about positive vertical spillovers should be trusted.

Figure 1 also shows us that few studies manage to analyze productivity spillovers and trade related questions at the same time. Alas, the existing empirical

literature usually ignores, or at least underestimates, the role of international trade and its interaction with FDI activities.[4]

Keller (2010) shows that although there are studies of the impact of international trade, as well as that of FDI, no study focuses on both aspects at the same time with the same intensity. For example, Jurajda and Stančík (2012) perform their analysis of horizontal and vertical FDI spillovers separately for import oriented and export-oriented industries, and Lesher and Miroudot (2008) include trade variables at the country level in their sectoral regressions. Nevertheless, these approaches, even if they confirm that international trade flows matter for the impact of FDI, still do not fully exploit their variation at a sectoral level. Hence, there is a large gap in the existing empirical literature, probably related to the fact that it is not very easy to link data on firms or industries with data on international trade, at least not at a sufficiently disaggregated level. Traded goods are classified under different coding than is used for classification of industries, and no direct correspondence table is available.

Let us note that even the most recent comprehensive review of the literature provided by Rojec and Knell (2018), concludes that empirical analyses of the various FDI spillovers offer mixed results, ranging from positive and neutral to negative FDI spillover effects. Thus, we have endeavored to propose an improvement in analyzing the impact of FDI, by taking into account changing market conditions (crowding-out effects and changes in sourcing patterns) and by considering this issue in a broader context of international trade flows. Such an approach allows us to shed more light on the issue of productivity and export spillovers, while evaluating the other effects separately, which leads to a more complex assessment of how MNEs entering a local market may affect domestic producers.

3. Methodology

3.1 Model Assumptions

We construct an estimable econometric specification by relying on predictions of the Markusen and Venables (1999) model, as well as on arguments provided by empirical studies summarized in the previous section. We consider (i) the vertical impact of MNEs entering the downstream sector on domestic firms in the upstream sector, while (ii) taking into account changes that occur on the horizontal level as well as (iii) considering international industrial linkages and resulting changes in trade flows. In line with the above, we formulate five channels through which downstream FDI potentially affects the position of domestic suppliers of intermediate goods. One, the FDI presence generates productivity spillover; this is a pure spillover effect. Two, sourcing patterns do change as domestic firms are potentially replaced by FDI entering the upstream industry. Three, the change in sourcing patterns when domestic suppliers may be replaced by imports of upstream goods. Four, increased exports of intermediate goods. Five, increased production stimulates more intermediate goods being demanded – as such increased production in the

[4] Lu et alL (2017) use plausibly exogenous change of the FDI regulations associated with China's World Trade Organization accession to identify various spillover effects.

downstream sector increases production in the upstream sector. We provide further details on the five channels along with their effects in Section 5.

The specification of our model is defined on the sectoral level and not on the firm level; as such it differs from several previous studies for multiple reasons. First, the question we ask is how the level of FDI in one sector affects inter-sectoral trade along with sectoral productivity and competition levels in its corresponding upstream sectors. Hence, in our opinion, the effects that we want to analyze are naturally defined on the sectoral level. Second, when appropriately using aggregates and fixed effects, sectoral analysis should capture general trends and macro-type relationships; it should also limit possible endogeneity on the firm-level basis. Third, a study based on firm-level data is highly unrealistic on the scale we cover, due to unavailability of all data items and severe data limitations for a large number of countries we deal with. Fourth, due to the nature of the data we have at our disposal, the vertical production chain relations can be defined only at the sectoral level.

Before we introduce our model formally, we outline several issues that our model is intended to capture. Initially, we define *downstream* and *upstream* sectors to establish the vertical linkages, *Downstream* sectors use intermediate goods provided by the *upstream* sectors. Obviously, all industries can play a downstream and upstream role: as upstream industries they provide intermediate goods for other sectors, as downstream industries they use intermediate goods provided by other sectors.

Since we are interested in analyzing how domestic producers of upstream goods are affected by downstream FDI, our explanatory variable captures sales by domestic firms in the upstream sector. We assume these sales to be a function of the FDI presence in the downstream sector and we model different channels through which this FDI can affect them.

In line with the above-mentioned literature, MNEs entering the downstream sector are usually more efficient. This means that the MNEs will produce more goods and sell them at lower prices, while crowding-out domestic firms from the downstream sector. This may have a positive effect on domestic producers in the upstream sector, because of the increased downstream production and therefore increased demand for intermediate goods. On the other hand, there is no certainty that MNEs will actually source from domestic producers, who were hitherto selling their goods to firms that are now being crowded out. As we explained in the previous sections, MNEs in the downstream sector may prefer to source their inputs either from abroad or from other MNEs, rather than from domestic producers - this would change imports and FDI levels in the upstream sector. Increased imports and FDI in the upstream sector will then have a negative crowding-out effect on domestic producers.

At the same time, change in imports of intermediate goods is not the only aspect in which the MNEs' activities might change trade patterns affecting the domestic market and domestic producers. Even if domestic firms lose some of their previous customers within the domestic market, they may try to search for new customers abroad. This is because once international presence is established in a country, export spillovers materialize and open the possibility for more goods to be exported by all firms, including the domestic ones. On a large sample of 25 origin countries, 91 destination countries and 57 manufacturing industries over 1994-2004,

Pietrovito et al. (2016) show that that sectors characterized by larger firms and more dispersed firm sales show a higher probability of internationalization, through both exports and FDI.

Further, it is widely assumed that MNEs create positive productivity spillovers towards their local suppliers. Consequently, in the upstream sector, domestic producers could benefit by this externality that comes directly from downstream FDI.

Finally, downstream FDI is not the only factor that influences sales by the upstream sector. These sales respond to the overall demand for intermediate goods that also varies for reasons other than the FDI inflow. Naturally, we want our model to capture this slightly elusive feature as well. We present our model formally in the next section.

3.2 Econometric Specification

Based on a theoretical framework and empirical observations discussed in Section 3.1, we formulate specification (1) that accounts for all effects we want to estimate. These are: the productivity spillover effect, impact through changing level of production in the downstream industry, impact through changing upstream imports and FDI levels, and the export spillover effect. Further, we control for potentially changing demand in the downstream industry. Our proposed specification takes the following form:

$$\begin{aligned} ln\left(DSales_{ict}\right) = {} & \beta_0 + \beta_1 FDI_{ict}^{Down} + \beta_2 FDI_{ict} FDI_{ict}^{Down} \\ & + \beta_3 ln\left(Imports_{ict}\right) + \beta_4 ln\left(Imports_{ict}\right) \cdot FDI_{ict}^{Down} + \\ & + \beta_5 ln\left(Exports_{ict}\right) + \beta_6 ln\left(Exports_{ict}\right) \cdot FDI_{ict}^{Down} + \\ & + \beta_7 ln(Sales_{ict}^{Down}) + \beta_8 ln\left(FSales_{ict}\right) + \beta_9 noFDI_{ict} \\ & + \beta_{10} ln(Exports_{ict}^{Down}) + \beta_{11} ln(Imports_{ict}^{Down}) + \vartheta_{ict} \end{aligned} \quad (1)$$

and hence it is based on log-log as well as semi-log transformations, allowing us to interpret the analyzed effects as elasticities for all variables that are not measured in percent and semi-elasticities.

In specification (1), *Sales*, *Imports* and *Exports* denote overall sales, imports and exports in the given industry. *DSales* denotes sales by domestic firms only, whereas *FSales* denotes sales by MNEs. *FDI* denotes the share of foreign firms in the given industry. The upper index *Down* denotes variables that characterize downstream industries, while variables without an upper index are measured within the (upstream) industry analyzed. Since we observe industries over time, a panel is the natural structure of our data and therefore (1) is a panel specification with index *t* denoting time, index *i* denoting a specific industry, index *c* denoting a specific country, and ϑ_{ict} being the structured error term comprising fixed effects and idiosyncratic error. The choice of the fixed effects will be described later, in Section 3.4.

The interpretation of our econometric specification is as follows. The variable explained is sales by domestic producers in the upstream sector (*DSales*). According to our assumptions, described in Section 3.1, these are driven by sales in the downstream sector ($Sales^{Down}$), into which these domestic producers supply.

Further, domestic sales are subject to competition from MNEs operating within the upstream sector (*FSales*) or from importers (*Imports*), and they are related to overall exports from the upstream sector (*Exports*). Both the competition and export effects can be affected by the presence of MNEs in the downstream industry (FDI^{Down}). These MNEs can prefer to source their inputs from other MNEs in the upstream industry or to import them, which is why we include the interaction between FDI levels in upstream and downstream industries ($FDI \cdot FDI^{Down}$) in our specification, as well as the interaction between FDI in downstream industry and upstream imports ($ln(Imports) \cdot FDI^{Down}$). On the other hand, the presence of MNEs may facilitate trade in general and affect the potential of domestic producers to export, which is why we also include the interaction between upstream exports and downstream FDI ($ln(Exports) \cdot FDI^{Down}$).

Finally, we are also interested in knowing whether there may be some productivity spillover towards domestic producers of upstream goods, stemming from downstream FDI; thus we also include this variable without interaction (FDI^{Down}) in the equation. According to our assumptions presented in Section 3.1, the corresponding coefficient should represent the pure spillover effect, since all other channels through which downstream FDI influences the upstream sector of intermediate goods are controlled for.

Along with these effects, we also want to control for potentially changing demand for downstream goods. We believe that in open economies, as the countries in our sample are, this demand is directly reflected by international trade flows. Hence, we also include in our specification variables representing imports and exports of downstream goods ($Imports^{Down}$ and $Exports^{Down}$).

In addition to the above explanatory variables, which are derived from theoretical assumptions presented in Section 3.1, we also include a dummy variable *noFDI* equal to 1 when there is no FDI in the upstream sector and 0 otherwise. This approach allows us to increase the number of our observations, by including those sectors with negligible foreign presence in the upstream sector (for which $FSales=0$). The dummy also provides an informative interpretation: its coefficient is the mean effect of missing foreign firms in the industry. Foreign firms might be missing in a sector for different reasons, ranging from local regulations/restrictions to low attractiveness of the underlying sector.

All variables in the model are in logarithms, which allows us to interpret their coefficients as elasticities. Exceptions are the *noFDI* dummy variable and the FDI variables that represent shares.

Our model is intentionally defined in a way that differs from the traditional total factor productivity (TFP) approach (see for example Aitken and Harrison, 1999; Javorcik, 2004). We have opted for an alternative approach for the following key reasons. The TFP is the residual from productivity (production) equation. To account for the different use of labor and capital across different industrial sectors, we should either estimate it by sector and/or use sectoral dummies for labor and capital variables, along with a constant term. Since we use sectoral aggregation and the TFP is the residual from production equation, the aggregation (sum) over the sector should be close to zero.

Further, our model is purposefully not parsimonious because we aim to disentangle several different effects through which downstream FDI may influence upstream domestic producers (explained in section 3.1). However, the model set-up enables us to clearly assess the effects and to interpret our results in a comprehensive way. We acknowledge that some of these effects may be composed from various partial influences. For example, competition that increases due to the MNEs' presence may affect both the market with final products as well as the market for production factors. Even though we are aware of this issue, we do not consider it feasible to analyze all these effects within one general framework. In addition, since we are interested in effects at the sectoral level, we also believe that many of the detailed influences are canceled out as individual firms are affected in differing ways and to a varying extent.

Finally, the complexity of our model does not come from a large number of explanatory variables, but rather due to the use of interaction terms. The presence and necessity of these interaction terms was explained earlier. We accentuate that we use them to see how downstream FDI affects domestic producers of upstream goods by modifying the dependence on the main independent variables.

3.3 Extension – Complementary Analysis of the Downstream Sector

The treatment of the linkages from the perspective of the upstream sector introduced in the previous two sections represents the key objective of our analysis. As a complement to the main research question we also analyze the impact of upstream FDI on sales by domestic firms in the downstream sector. The reason for including this complementary analysis is to see whether the supplier-customer vertical relations between industries are affected by FDI in the opposite direction than that presented above. In other words, so far, we have asked how domestic firms are affected by MNEs among their customers; now we ask how they are affected by FDI activity in the sector from which they source their supplies. Such a perspective contributes to a better understanding of sourcing patterns affected by FDI. There is no theoretical model on which we could rely here, but in principle we are estimating the links that are complementary for the estimated links of the upstream sector.

Hence, our complementary specification captures the impact of downstream FDI on sales by domestic firms in the upstream sector in the following form:

$$\begin{aligned} ln(DSales_{ict}) = {} & \beta_0 + \beta_1 FDI_{ict}^{Up} + \beta_2 FDI_{it}\, FDI_{ict}^{Up} \\ & + \beta_3 ln(Imports_{ict}) + \beta_4 ln(Imports_{ict}) \cdot FDI_{ict}^{Up} + \\ & + \beta_5 ln(Exports_{ict}) + \beta_6 ln(Exports_{ict}) \cdot FDI_{ict}^{Up} + \\ & + \beta_7 ln(Sales_{ict}^{Up}) + \beta_8 ln(FSales_{ict}) + \beta_9 noFDI_{ict} + \\ & + \beta_{10} ln(Exports_{ict}^{Up}) + \beta_{11} ln(Imports_{ict}^{Up}) + \vartheta_{ict}. \end{aligned} \tag{2}$$

All variables and indices in specification (2) are denoted in the same way as in model (1) presented in Section 3.2. The upper index *Up* denotes variables that characterize upstream industries, while variables without the upper index are measured within the (downstream) industry analyzed.

In this specification, we study the effect of FDI in the upstream industry (FDI^{Up}) on domestic producers of downstream goods. In other words, we assess the effect of multinational producers of intermediate goods on their domestic customers. Similarly as in the previous section, we assume that the sales of domestic producers of downstream goods are driven by demand and by competition within the industry.

Assuming that higher demand for final goods increases demand for intermediate goods, we proxy the demand in the downstream industry by sales, exports, and imports in the upstream industry ($Sales^{Up}$, $Exports^{Up}$ and $Imports^{Up}$). We further include exports of downstream goods (*Exports*) in the model as a proxy for demand. We also add an interaction term with upstream FDI ($ln(Exports) \cdot FDI^{Up}$) since, in line with the theory of export spillovers, we believe that domestic producers may have different opportunities to export if MNEs are present in the host country.

The competition is represented in our model by imports and foreign sales of downstream goods (*Imports* and *FSales*). We believe that the competition driven by imports can be different in industries that use multinational suppliers more intensively. Accordingly, we interact imports of downstream goods with upstream FDI ($ln(Imports) \cdot FDI^{Up}$).

We further include the upstream FDI variable (FDI^{Up}) to capture the backwards productivity spillover effect stemming from the MNEs' presence in the industries supplying intermediate goods. At the same time, we believe that in industries with a higher share of MNEs, the effect of upstream FDI on domestic producers of downstream goods may be different if MNEs tend to cooperate between sectors, and to capture this link we add the interaction between upstream and downstream foreign presence ($FDI \cdot FDI^{Up}$).

Finally, we also use a dummy *noFDI* equal to 1 when there is no FDI in the downstream sector and 0 otherwise. Similarly to the upstream model, the coefficient on the dummy *noFDI* contains the mean effect of a missing foreign presence in the industrial sector.

3.4 Structure of the Error Term and Possible Endogeneity Issues

In models (1) and (2), we use a general notation ϑ_{ict} to denote the error term. Here, we would like to specify its precise composition. In fact, for both models, we propose two different specifications of the error term. In the main specification, the structure of the error term is $\vartheta_{ict} = \alpha_{ic} + \eta_t + \varepsilon_{ict}$, where α_{ic} captures the interacting country-industry specific fixed effect, η_t is the time specific fixed effect and ε_{ict} is the idiosyncratic error term. In this case, the interacting country-industry specific fixed effect denotes a specific industry sector *i* in an individual country *c*. Thus, in this setting, the countries are assumed to represent separate markets within the specific industry.[5]

As an extension and robustness check, we also provide results of the estimation that allows for separate industry, individual country and time specific fixed effects. In this case, the structure of the error term is slightly modified: $\vartheta_{ict} = \theta_i + \delta_c + \eta_t + \varepsilon_{ict}$, where θ_i is the industry specific fixed effect, δ_c is an

[5] Country-industry fixed effects allow us to consider each industry in each country as an autonomous unit with its own specific attributes – this represents industries as separate markets.

individual country specific fixed effect, η_t is the time specific fixed effect and ε_{ict} is the idiosyncratic error term. In this modification, individual countries are assumed to behave as common markets for specific industries.[6]

Which of the two error structure specifications (separate markets or a common market) reflects reality in a better way? Within the EU, there are no legally based trade barriers between countries. However, countries are still more or less geographically distant and consumers may still have specific local preferences. Thus, we believe that the reality lies in fact somewhere in between our two error structures and therefore we estimate and present both of them.

Technically, the first specification uses many more fixed effects (number of countries multiplied by number of industries) than the second specification (number of countries added to number of industries). This means that in fact, within the first specification, we include in our model more variables and much more of the variation is filtered out by fixed effects. As a result, we may expect to encounter more issues with coefficient significance under the first specification, which is another reason for believing it is useful to provide results for both specifications. We return to this issue once more when discussing our results.

In terms of endogeneity, for both model specifications it holds that the use of cross-section fixed effects allows us to eliminate potential time-invariant endogeneity on industry-country or industry and country levels (Greene, 2003, p. 291; Wooldridge, 2002, p. 248). Inclusion of the period fixed effects further controls for any common time trend (Wooldridge, 2002, p. 278). Even though we believe that these fixed effects allow us to control for most macroeconomic factors (economic performance of the leading world economies, economic and monetary policies of governments and central banks, international political situation, etc.), we acknowledge that other sources of time-variant and cross-country endogeneity may still be present (reversed causality or omitted variable bias). Therefore, we do not claim that the observed effects of FDI are causal in all cases. Rather, we prefer to consider our findings as classification of different outcomes that are associated with the FDI presence.

4. Data Description

4.1 Geographic and Time Coverage

Our analysis covers 30 European countries and spans from 2001 to 2013. The European countries are further divided into two groups that are, for the convenience of exposition, labelled as Western and Eastern countries. The Western countries are (alphabetically): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Hence, the Western countries include the Eurostat-coded EU15 plus Iceland, Norway and Switzerland. The Eastern countries are the Eurostat-coded EA27 countries that joined the EU in 2004, 2010 and 2015. Hence, the Eastern

[6] Industry fixed effects allow different industries to have their specific character, but since only one fixed effect corresponds to the given industry across all countries, we assume that this industry behaves in a similar way everywhere – this would represent the common market. The country fixed effect still accounts for specificities of different countries other than those that are industry-related.

countries include Bulgaria, Cyprus, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Malta, Poland, Romania, Slovenia and Slovakia. The analysis is performed separately for both groups, in order to observe the differences between fully developed countries and those who underwent the transition period and/or EU-accession-screening.[7] The comparison of these two groups allows us to draw additional insights about the issue under study.

4.2 Data Sources

We use the Amadeus database to obtain the level of sales and FDI presence in given industries. This database contains information about firms operating in the chosen countries: their performance, financial and organizational characteristics, industry classification expressed by the three-digit NACE code (Rev. 1.1 or, after 2008 Rev. 2), and their ownership structure, allowing us to differentiate between domestic and foreign owners.

Further, we link the data from Amadeus with the BACI data based on the UN COMTRADE data.[8] BACI provides information on bilateral values and quantities of exports at the Harmonized System (HS) 6-digit product disaggregation. Using correspondence tables, we therefore have detailed information on international trade flows disaggregated to the four- and five-digits SITC level (Rev. 3).

Finally, we use the EUROSTAT database to obtain detailed input-output tables of industries (at two-digits NACE, Rev. 1.1 or Rev. 2) constructed separately for groups of Western and Eastern countries. The following subsection provides details of data linkages and variable definitions.

4.3 Data Harmonization

Since our main research question concerns the interaction between upstream and downstream industries in terms of both production and trade, we first need to establish links between these industries. For this purpose, we use the input-output (I-O) tables from the EUROSTAT database for 2001-2013. Specifically, we use aggregated I-O tables for EU27 or EA17 countries[9], since they are available from EUROSTAT for the whole period of interest. The I-O tables reflect well the inter-country inter-industry relations that we are interested in, because the markets consisting of EU27 or EA17 countries are homogenous enough to minimize differences in vertical linkages between industries within different countries. Moreover, the above strategy enables us to use the best existing information because national I-O tables are often not provided on an annual basis and/or are sparse. In sum, the aggregated I-O tables allow us to construct a matrix with coefficients representing the share of output supplied to different downstream industries, which

[7] Estrin and Uvalic (2014) show that Western Balkan countries receive less FDI than other transition countries. For our analysis this evidence applies to Bulgaria, Croatia and Romania (in our analysis we do not cover Albania, Bosnia and Herzegovina, Macedonia, Montenegro, and Serbia).

[8] The BACI dataset is developed by the CEPII (Gaulier and Zignago, 2010); it is constructed using COMTRADE data and reconciles the declarations of the exporter and the importer. It considerably extends the number of countries, as well as convenience of use.

[9] The EU27 group covers the whole European Union and we use the I-O tables available for this group for Eastern European countries. The EA17 group consists of the Euro area and we use the I-O tables available for this group for Western European countries.

will be used for definition of variables used in our analysis in a way that we describe later.[10]

The I-O tables are available in two different NACE revisions – revision 1.1 for 2001-2007 and revision 2 for 2008-2013.[11] The same division holds for the NACE classification provided by Amadeus. We decided to transform all our data to be coded as under NACE revision 1.1, which implied the use of correspondence tables provided by Eurostat. Note that the I-O tables are available at the aggregated two-digit NACE level, which is why we set this aggregation as the baseline industry level of our analysis. This means that we aggregate all data from Amadeus and BACI databases to this level. Let us note that the data sample of the firms from Amadeus is not a representative sample, but it serves very well the purpose of our analysis. Amadeus database tends to overstate large firms (Klapper at al., 2006), and since we also remove very small and micro firms before the aggregation, we believe that our data construction constitutes the vast majority of economic activities on country/sectoral level.

The only technical problem is that the BACI database is coded under the SITC classification system, and so first we needed to harmonize the SITC Rev. 3 codes with the NACE Rev. 1.1 codes, and then to transform the trade database into the NACE coding.[12] Unfortunately, there is no direct correspondence between the NACE and SITC coding systems, and hence, for the purposes of harmonizing the BACI trade data with the rest of our dataset, we manually created a link between them, using other coding systems for which the correspondence tables are available from the United Nations Statistics Division. Finally, we linked the data using the following set of transformations:

SITC Rev. 3 → CPC Ver. 2 → ISIC Rev. 4 → ISIC Rev. 3 → NACE Rev. 1.1.

The above link was prepared using VBA programming. In addition, the final verification of all corresponding links (in a table of some 4000 rows) was done manually especially in cases where the automatic software-based solution did not provide the required n-to-1 correspondence; additional details on these technical issues can be provided upon request. The final result is schematically presented in the *Appendix*, where we display the lists of NACE Rev. 1.1 industries and SITC Rev. 4 types of goods aggregated at the two-digit level, as well as a table representing what SITC types of goods fall into what NACE Rev. 1.1 categories.[13]

Data from Amadeus are transformed to be measured in millions of euros, and imports and exports are measured in thousands of US dollars, all in current prices. In

[10] We acknowledge that there exist IO tables for multiple countriesas well as general IO tables. The reason we applied our strategy was primarily motivated by a comparison of the new and old EU members. As we checked the annual country IO tables, especially those for new EU members were constructed on bi-annual basis and represent rather sparse matrices. Hence, the aggregation and methodology we applied is preferred because of limited information for EU17.

[11] Precisely speaking, as tables for years 2012 and 2013 are not available, we use tables for 2011 to proxy for 2012 and 2013.

[12] Let us note that the result might differ from national statistics compiled directly.

[13] Let us note that correspondence table provided in the *Appendix* depicts the main associations, since we were linking SITC goods at five- or four-digits level. In this table it may seem that several SITC goods fall into more than one NACE categories, but this is due solely to the fact that goods with the same SITC two-digits representation fall into different NACE industries when considered at a more disaggregated level.

the main specification we use logarithmic transformation and ratios, and hence the interpretation of our empirical models is independent of currencies and units used. We also always use time fixed effects, which spare us the need to transform nominal values into real ones.[14]

4.4 Definition of Variables and Resulting Dataset

In Section 3.1, we explained the mechanisms through which FDI in the sector of consumer goods (downstream sector) influences sales in the sector of intermediate goods (upstream sector). In sections 3.2 and 3.3, we presented the regression specifications that we use for the analysis of downstream and upstream sectors, respectively. This division between consumer and intermediate goods is suitable for the presentation of the theoretical model, but in reality the industry structure is much more complex, and each sector can produce goods that are used either as intermediaries for another sector or as final goods. Therefore, in our analysis we consider all sectors to be potential producers of intermediate goods, and we link them to their corresponding downstream sectors which they supply.

One of the most important tools for this construction is the input-output matrix $\boldsymbol{A}_t$ which is constructed from the Eurostat input-output tables. The row elements of this matrix represent shares with which the given upstream industry supplies all its upstream industries other than the given industry itself. Since we do not want to include within-industry sourcing patterns, the diagonal of this matrix is by definition equal to zero. Such a use of the input-output tables is in line with the standard approach set by Javorcik (2004, p. 612). The matrix $\boldsymbol{A}_t$ is used for the construction of variables in the downstream analysis (Section 4.2), while for the upstream analysis (Section 4.3) we use the transpose of $\boldsymbol{A}_t$.

Another crucial element of our data construction is the definition of a foreign firm that determines the measure of FDI within each sector. This definition is based on the principle of control (La Porta et al., 1999). By a foreign firm, we understand a *foreign controlled* firm, i.e., the firm in which the main foreign owner controls more than the sum of remaining ownership rights of all known shareholders. This definition of control is standard and circumvents the issue of dispersed ownership that has been shown to play no role with respect to firms' efficiency, specifically in the European context (Hanousek et al., 2015).

The construction of all key variables used in our regressions that characterize potential effects of the FDI in the upstream and downstream sectors is explained in *Appendix* Tables A1 and A2, respectively. Both tables also contain precise information on the sources and units used. The key variable representing the FDI presence was computed as a ratio of foreign sales (defined according to the previous paragraph) over total sales. This is a prevalent approach in the literature and allows

[14] In the present paper we opted for less detailed, yet maybe more accurate precision for the IO tables, and for the associated NACE2 link primarily because the Amadeus database provides information on the main industry, and sometimes the list of secondary industrial classification. To avoid misclassification bias, we use a broader classification of industries and corresponding IO tables. Comparison of different aggregation level(s) along with different sources of the IO tables would be an interesting robustness check, but it is beyond the scope of the paper.

us to provide similar results to alternative measures based on, for example, employment, as in Javorcik (2004).

By combining and aggregating all available information on economic activity of firms, their ownership structure, links between industries and trade flows, we obtain a unique dataset of approximatively 5 000 observations. The dataset has the structure of a panel of industries in the European countries over the period 2001-2013. Descriptive statistics of relevant variables are provided in Table 1.

Table 1 Descriptive Statistics

Panel A. Western countries

Country	Upstream sectors			Downstream sectors		
	mean	*std. deviation*	*maximum*	*mean*	*std. deviation*	*maximum*
AT	0.008	0.043	0.475	0.012	0.044	0.245
BE	0.017	0.076	0.566	0.015	0.054	0.281
DE	0.008	0.053	0.843	0.033	0.121	0.563
DK	0.011	0.057	0.89	0.01	0.037	0.18
ES	0.018	0.078	0.58	0.021	0.075	0.324
FI	0.018	0.075	0.709	0.02	0.072	0.416
FR	0.018	0.081	0.866	0.016	0.053	0.292
GB	0.005	0.015	0.086	0.002	0.007	0.044
GR	0.027	0.132	1	0.013	0.048	0.25
IE	0.005	0.029	0.401	0.002	0.005	0.028
IS	0.009	0.048	0.596	0.024	0.056	0.25
IT	0.025	0.104	0.854	0.021	0.077	0.334
NO	0.013	0.052	0.324	0.01	0.036	0.182
PT	0.009	0.047	0.495	0.011	0.042	0.195
SE	0.012	0.068	0.77	0.03	0.111	0.553

Panel B. Eastern Countries

Country	Upstream sectors			Downstream sectors		
	mean	*std. deviation*	*maximum*	*mean*	*std. deviation*	*maximum*
BG	0.057	0.191	0.959	0.054	0.166	0.748
CZ	0.028	0.127	0.913	0.036	0.13	0.585
EE	0.023	0.129	0.994	0.038	0.133	0.576
HR	0.03	0.117	0.932	0.026	0.095	0.454
HU	0.002	0.029	0.509	0.001	0.007	0.118
LT	0.015	0.067	0.501	0.017	0.059	0.274
LV	0.022	0.111	0.88	0.027	0.098	0.444
PL	0.022	0.082	0.532	0.019	0.067	0.392
RO	0.027	0.112	1	0.024	0.083	0.384
SI	0.016	0.086	0.746	0.025	0.09	0.445
SK	0.031	0.145	0.999	0.024	0.09	0.486

Notes: Descriptive statistics of the variable FDI in the upstream and downstream sectors. The FDI presence is measured as a share of foreign sales over total sales (see Table A1 in *Appendix*). The variable in this table is averaged over years and sectors.

5. Results

5.1 Results for Upstream Analysis

In this section, we present the results of our main specification described in Section 3.2, i.e., the analysis of the upstream industry, in which we study how this industry is affected by FDI in the corresponding downstream industry, with a special focus on changes in sourcing patterns.

Our key results for the upstream analysis are based on specification (1) where the error term contains interacting country-industry specific fixed effects representing countries as separate markets (see section 3.4). The panel regression estimates are presented in Tables 2 and 3 for Western and Eastern European countries, respectively. Each table has three column sections: in the first, the results originate from the estimation performed over the whole time period 2001-2013, in the second, only the pre-financial crisis years are taken into account, and the third focuses on the post-crisis period.

As an extension and robustness check, we also present results of the estimation that allows for separate industry and individual country fixed effects, where individual countries are assumed to behave as common markets for specific industries (see section 3.4). We present the results for this specification in *Appendix* Tables A3 and A4 for Western and Eastern European countries, respectively. For reasons explained above, we believe that both approaches have their validity, and therefore we present both sets of results and compare them.

Table 2 Sourcing Effects of FDI Activity: Upstream Sector, Western Countries

Interacting country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Down}	β_1	-0.162	-0.112	0.718	0.882	-0.333	-0.243
		(0.575)	(0.573)	(3.813)	(3.786)	(0.653)	(0.705)
FDI .FDI^{Down}	β_2	-1.449[a]	-1.474[a]	-37.375[b]	-40.235[b]	-1.598[a]	-1.579[a]
		(0.478)	(0.480)	(16.651)	(17.527)	(0.325)	(0.307)
ln(Imports)	β_3	0.134[b]	0.134[b]	0.126	0.127	0.194[a]	0.197[a]
		(0.066)	(0.066)	(0.090)	(0.090)	(0.062)	(0.062)
ln(Imports). FDI^{Down}	β_4	-0.036	-0.042	-0.391	-0.398	-0.012	0.003
		(0.147)	(0.147)	(0.339)	(0.339)	(0.148)	(0.149)
ln(Exports)	β_5	0.042	0.042	0.071	0.069	-0.049	-0.052
		(0.069)	(0.069)	(0.098)	(0.097)	(0.067)	(0.068)
ln(Exports). FDI^{Down}	β_6	0.057	0.060	0.365	0.361	0.042	0.022
		(0.139)	(0.139)	(0.372)	(0.374)	(0.147)	(0.149)
ln($Sales^{Down}$)	β_7	-0.054[b]	-0.053[b]	-0.077[b]	-0.075[b]	-0.096	-0.085
		(0.021)	(0.022)	(0.031)	(0.032)	(0.073)	(0.070)
ln(FSales)	β_8	-0.061[a]	-0.061[a]	-0.059[a]	-0.059[a]	-0.059[b]	-0.059[b]
		(0.015)	(0.015)	(0.016)	(0.016)	(0.025)	(0.026)
noFDI	β_9	-1.329[a]	-1.331[a]	-1.262[a]	-1.254[a]	-1.291[b]	-1.302[b]
		(0.305)	(0.304)	(0.311)	(0.313)	(0.507)	(0.513)
ln($Exports^{Down}$)	β_{10}		0.032		0.051		0.206
			(0.063)		(0.136)		(0.384)
ln($Imports^{Down}$)	β_{11}		-0.063		-0.145		0.360[c]
			(0.066)		(0.122)		(0.218)
Constant	β_0	22.486[a]	22.986[a]	22.747[a]	24.284[a]	24.033[a]	13.777[c]
		(0.898)	(1.140)	(1.198)	(1.764)	(2.102)	(8.104)
Country*Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Within R^2		0.031	0.031	0.028	0.029	0.041	0.044
Between R^2		0.111	0.093	0.098	0.052	0.017	0.302
Overall R^2		0.092	0.077	0.086	0.046	0.013	0.258
N (observations)		5903	5903	3780	3780	2123	2123

Notes: The estimation is based on the specification (1), where we treated each country (within the group of Western countries) as a "separated", not fully integrated market. This approach means that we consider interaction between country and industry fixed effects. The dependent variable is *ln(DSales)*, logarithm of sales of domestic companies in the upstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table 3 Sourcing Effects of FDI Activity: Upstream Sector, Eastern Countries

Interacting country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Down}	β_1	0.014	0.030	2.424	2.531	0.149	0.208
		(0.368)	(0.375)	(9.846)	(9.878)	(0.395)	(0.423)
FDI .FDI^{Down}	β_2	-0.136[a]	-0.137[a]	-4.064[a]	-4.087[a]	-0.129[a]	-0.138[a]
		(0.022)	(0.023)	(1.120)	(1.181)	(0.023)	(0.023)
ln(Imports)	β_3	0.284[a]	0.284[a]	0.312[a]	0.312[a]	0.247[b]	0.237[b]
		(0.088)	(0.088)	(0.095)	(0.096)	(0.110)	(0.110)
ln(Imports). FDI^{Down}	β_4	-0.023	-0.022	-1.342	-1.335	-0.001	-0.009
		(0.059)	(0.059)	(1.646)	(1.645)	(0.059)	(0.060)
ln(Exports)	β_5	0.052	0.051	0.031	0.031	0.105	0.118
		(0.074)	(0.075)	(0.087)	(0.087)	(0.095)	(0.094)
ln(Exports). FDI^{Down}	β_6	0.030	0.028	1.288	1.257	-0.002	0.002
		(0.051)	(0.050)	(2.388)	(2.390)	(0.051)	(0.051)
ln($Sales^{Down}$)	β_7	0.061	0.062	0.128[c]	0.129[c]	-0.054	-0.033
		(0.055)	(0.056)	(0.068)	(0.069)	(0.113)	(0.111)
ln(FSales)	β_8	-0.061[a]	-0.062[a]	-0.069[a]	-0.069[a]	-0.041[b]	-0.041[b]
		(0.010)	(0.010)	(0.014)	(0.014)	(0.016)	(0.016)
noFDI	β_9	-0.994[a]	-0.997[a]	-1.115[a]	-1.113[a]	-0.627[b]	-0.641[b]
		(0.182)	(0.182)	(0.253)	(0.253)	(0.266)	(0.280)
ln($Exports^{Down}$)	β_{10}		0.019		-0.061		0.764[c]
			(0.072)		(0.102)		(0.394)
ln($Imports^{Down}$)	β_{11}		-0.040		0.020		-0.360
			(0.089)		(0.122)		(0.364)
Constant	β_0	15.084[a]	15.377[a]	13.579[a]	14.133[a]	17.382[a]	10.760[c]
		(1.645)	(1.520)	(1.847)	(1.980)	(3.188)	(5.590)
Country*Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Within R^2		0.043	0.043	0.051	0.051	0.049	0.055
Between R^2		0.222	0.219	0.235	0.227	0.157	0.213
Overall R^2		0.207	0.205	0.226	0.221	0.154	0.203
N (observations)		4018	4018	2591	2591	1427	1427

Notes: The estimation is based on the specification (1), where we treated each country (within the group of Eastern countries) as a "separated", not fully integrated market. This approach means that we consider interaction between country and industry fixed effects. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the upstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

As our specification (1) is quite complex, a detailed discussion of the results becomes rather lengthy. Thus, we present our main findings about the impact of FDI in a simplified way in Table 4, where we show quantitatively what the mean effect of the change of FDI in the downstream industry by one percentage point is on upstream sales by domestic producers; the results are shown separately for Western and Eastern countries, and before and after the crisis. Since the outcome variable is in logarithm, the final effect is a percentage change. Most of the effects are evaluated

using interaction terms, where for quantification we use the mean value of the interaction variable, i.e., the mean of downstream FDI.

Table 4 Simplified Presentation of Quantitative Results - Main Specification (1)

Dependent variable: (log of) upstream sales of domestic firms				
Channels of FDI impact	**Western countries**		**Eastern countries**	
	Before crisis	***After crisis***	***Before crisis***	***After crisis***
Pure backward spillover effect	none		none	
Crowding-out by MNEs	-0.068%	-0.033%	-0.005%	-0.025%
Crowding-out by imports	-0.001%	none	-0.002%	-0.002%
Enhanced exports	0.001%	none	0.001%	none %
Increased demand	not confirmed		confirmed (not quantified)	

Notes: The table presents percentage change of upstream sales by domestic producers associated with the increase of the corresponding explanatory variable by a percentage point in case of spillover effect and crowding-out by MNEs (where the corresponding variables are downstream FDI and upstream FDI respectively) and by one percent in case of crowding-out by imports and enhanced exports (where the corresponding variables are upstream imports and upstream exports, respectively). The effect of increased demand is only qualitative. In the specification (1) we assume that the FDI effects are primarily interacting and affecting domestic firms of the target country FDI. (We use country-industry specific fixed effects representing each country as separate market). Let us note that similar results are obtained when a single market behavior is assumed.

The table summarizes the five channels that we disentangle in our analysis (see Section 3.1) and it is based on detailed results presented in Tables 2 and 3. We have to admit that in some cases, these results are not statistically significant, but we have strong reasons to believe that this is due rather to inflated standard errors than to the size of the coefficients. We imply this from the fact that the analysis for Western and Eastern countries delivers very similar results both here and in alternative specification presented in the *Appendix* (Tables A3 and A4), except for the standard errors. Hence, we decided to present the quantitative results in all cases in which at least one of the specifications shows a significant coefficient.

Table 4 shows that we do not find any significant technological spillover, which would be the first channel of the impact of FDI that we discuss in Section 3.1. This result is in line with Meyer (2004) and Görg and Greenaway (2004), who show that support for positive spillovers is not easy to find, and it contradicts some empirical studies that find a positive spillover effect of such backward linkages. Our explanation is that in reality, these studies do not properly disentangle the different channels of the influence of FDI, and take what may be simply an effect of increasing demand, due to the activity of MNEs in the downstream sector, for a positive technological transfer.

This positive effect of increasing demand is the fifth and final channel of the impact of FDI discussed in Section 3.1. and it is based on two priors. First, the presence of MNEs in a specific sector boosts the production in that very sector, and second, increased production in the downstream sector increases production in the upstream sector. The first premise is consistently confirmed by our results for both types of estimation, albeit indirectly: we observe that the coefficient of the dummy indicating no-FDI-presence in the upstream sector (β_9) is always negative. A negative coefficient means that the production of domestic firms is higher in sectors where

MNEs operate (not to mention that the production of these MNEs should be added here), and hence, the overall sales in the sector increase. The second prior states that increased production in the downstream sector implies increased production in the upstream sector (β_7). However, this prior is confirmed only for Eastern countries, for which the coefficient on downstream sales is positive, albeit with low economic importance. A plausible explanation is that the higher proportional presence of the FDI in the new-EU (East) than in the old-EU (West) countries and corresponding ownership effects documented in Hanousek et al. (2015) are likely drivers behind the results.

Table 4 further shows that even if the demand for intermediary goods increases, domestic producers do not always benefit from it, since they are crowded out either by multinational suppliers or by imports of these goods. These effects would be the second and third channels of the impact of downstream FDI discussed in Section 3.1 and, as we can see in Table 4, they are really confirmed in our analysis, especially in the pre-crisis period, and they are much stronger for Eastern countries. Yet, these results are in line with results from papers summarized in our literature review section, e.g. Javorcik and Spatareanu (2005) or Jordaan (2011), the overall mean effect is rather small compared to the widely expected results.

Finally, Table 4 also shows that these negative effects are offset by positive export spillovers, which are discussed as the fourth channel of the impact of downstream FDI in Section 3.1. Exports may increase due to new trade channels that are opened, thanks to the presence of MNEs in the country. Alternatively, they may be caused by the simple necessity of targeting new foreign markets when a domestic market shrinks after domestic producers are crowded-out by MNEs and by importers. Nevertheless, the observed mean (negative) effect of enhanced imports and (positive) exports effect are both negligible. Hence, we can confirm the existence of export spillovers presented by Aitken et al (1997), among others, but when controlling for complexity of channels, the export spillovers effects of the FDI are marginal.

Overall, we can say that the impact of downstream FDI on domestic producers of intermediary goods is definitely composed of very heterogeneous effects. In our analysis, we manage to disentangle the negative crowding-out effect from positive export spillovers, and we provide some evidence of the effect of increasing demand. When we employ a complex specification allowing several channels to be analyzed simultaneously, we identify that these (mean) effects are much smaller then presented in a channel-by-channel estimation. Similarly, we do not manage to find evidence of technological spillovers. One can speculate, that the evidence of the technological spillovers found in the other papers could be caused by omitting other channels controlled for in our specifications.

5.2 Results for Downstream Analysis

In this section, we present the results of our complementary specification (2) described in Section 3.3. In the analysis of the downstream industry, we study how it is affected by FDI in the corresponding upstream industry. Similarly, as in Section 5.1, we report results separately for Western and Eastern European countries, based on two sets of estimates.

Table 5 Sourcing Effects of FDI Activity: Downstream Sector, Western Countries

Interacting country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Up}	β_1	-0.673	-0.690	-4.691	-4.878	-0.743	-0.776
		(0.560)	(0.561)	(8.494)	(8.565)	(0.734)	(0.733)
FDI^{Up}. FDI	β_2	-1.504[a]	-1.512[a]	-1.259	-1.195	-1.374[a]	-1.362[a]
		(0.228)	(0.227)	(2.405)	(2.440)	(0.238)	(0.242)
ln(Imports)	β_3	0.073	0.073	0.110[b]	0.111[b]	0.014	0.014
		(0.053)	(0.053)	(0.049)	(0.049)	(0.114)	(0.114)
ln(Imports).FDI^{Up}	β_4	0.208[b]	0.212[b]	-0.172	-0.124	0.203	0.204
		(0.105)	(0.105)	(1.133)	(1.140)	(0.126)	(0.127)
ln(Exports)	β_5	0.080	0.080	0.048	0.047	0.130	0.130
		(0.063)	(0.063)	(0.052)	(0.052)	(0.137)	(0.136)
ln(Exports). FDI^{Up}	β_6	-0.165[c]	-0.169[c]	0.823	0.811	-0.165	-0.163
		(0.092)	(0.092)	(0.829)	(0.831)	(0.113)	(0.113)
ln($Sales^{Up}$)	β_7	0.006	0.006	-0.004	-0.008	0.005	0.003
		(0.022)	(0.023)	(0.032)	(0.033)	(0.069)	(0.068)
ln(FSales)	β_8	-0.057[a]	-0.057[a]	-0.064[a]	-0.064[a]	-0.059[a]	-0.060[a]
		(0.015)	(0.015)	(0.022)	(0.022)	(0.014)	(0.014)
noFDI	β_9	-1.250[a]	-1.252[a]	-1.401[a]	-1.401[a]	-1.258[a]	-1.265[a]
		(0.305)	(0.305)	(0.446)	(0.445)	(0.278)	(0.280)
ln($Exports^{Up}$)	β_{10}		-0.040		0.101		-0.173
			(0.072)		(0.162)		(0.271)
ln($Imports^{Up}$)	β_{11}		0.046		-0.078		0.244
			(0.079)		(0.165)		(0.340)
Constant	β_0	21.218[a]	21.111[a]	21.542[a]	21.267[a]	21.341[a]	20.151[a]
		(1.078)	(1.226)	(1.297)	(1.852)	(2.064)	(5.242)
Country*Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Within R^2		0.030	0.030	0.033	0.033	0.033	0.034
Between R^2		0.202	0.206	0.165	0.192	0.212	0.292
Overall R^2		0.176	0.180	0.145	0.167	0.196	0.267
N (observations)		5891	5891	3791	3791	2100	2100

Notes: The estimation is based on the specification (2), where we treated each country (within the group of Western countries) as a "separated", not fully integrated market. This approach means that we consider interaction between country and industry fixed effects. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the downstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table 6 Sourcing Effects of FDI Activity: Downstream Sector, Eastern Countries

Interacting country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Up}	β_1	0.680[a]	0.674[a]	12.248	12.181	0.709[a]	0.688[a]
		(0.218)	(0.217)	(9.333)	(9.397)	(0.266)	(0.263)
FDI^{Up}. FDI	β_2	-0.217[a]	-0.215[a]	-1.295	-0.750	-0.264[a]	-0.259[a]
		(0.059)	(0.059)	(8.675)	(8.939)	(0.082)	(0.082)
ln(Imports)	β_3	0.172[b]	0.172[b]	0.226[b]	0.226[b]	0.067	0.065
		(0.082)	(0.081)	(0.091)	(0.091)	(0.120)	(0.120)
ln(Imports).FDI^{Up}	β_4	0.012	0.011	1.493	1.519	0.054	0.052
		(0.055)	(0.055)	(1.212)	(1.231)	(0.074)	(0.076)
ln(Exports)	β_5	0.134[c]	0.135[c]	0.125	0.124	0.191	0.191
		(0.077)	(0.077)	(0.078)	(0.078)	(0.122)	(0.122)
ln(Exports). FDI^{Up}	β_6	-0.052	-0.050	-2.529	-2.569[c]	-0.089	-0.086
		(0.055)	(0.055)	(1.534)	(1.541)	(0.072)	(0.074)
ln($Sales^{Up}$)	β_7	-0.113[c]	-0.117[c]	-0.101[c]	-0.101	-0.137	-0.157
		(0.061)	(0.063)	(0.061)	(0.062)	(0.166)	(0.180)
ln(FSales)	β_8	-0.063[a]	-0.063[a]	-0.073[a]	-0.073[a]	-0.045	-0.043
		(0.012)	(0.012)	(0.013)	(0.013)	(0.029)	(0.030)
noFDI	β_9	-1.084[a]	-1.092[a]	-1.237[a]	-1.242[a]	-0.819	-0.793
		(0.217)	(0.218)	(0.231)	(0.231)	(0.511)	(0.519)
ln($Exports^{Up}$)	β_{10}		0.084		-0.088		-0.314
			(0.105)		(0.155)		(0.371)
ln($Imports^{Up}$)	β_{11}		-0.025		0.060		0.317
			(0.111)		(0.157)		(0.498)
Constant	β_0	19.418[a]	18.677[a]	18.763[a]	19.155[a]	20.532[a]	20.812[a]
		(1.908)	(1.917)	(1.984)	(2.397)	(4.416)	(4.559)
Country*Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
Within R^2		0.039	0.040	0.045	0.045	0.033	0.034
Between R^2		0.122	0.141	0.143	0.133	0.063	0.057
Overall R^2		0.129	0.142	0.152	0.146	0.081	0.076
N (observations)		4003	4003	2572	2572	1431	1431

Notes: The estimation is based on the specification (2), where we treated each country (within the group of Eastern countries) as a "separated", not fully integrated market. This approach means that we consider interaction between country and industry fixed effects. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the downstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Our key results for the downstream analysis are based on specification (2), where the error term contains interacting country-industry specific fixed effects representing countries as separate markets (see section 3.4). The panel regression estimates are presented in Tables 5 and 6 for Western and Eastern European countries, respectively. As an extension and robustness check, we also present results of the estimation that allows for separate industry and individual country fixed effects, where individual countries are assumed to behave as common markets for

specific industries (see section 3.4). We present the results for this specification in *Appendix* Tables A5 and A6 for Western and Eastern European countries, respectively.

The important observation related to the results of the downstream analysis is that they are more heterogeneous than those from the upstream analysis, with respect to the chosen time-period and estimation specification. This shows that the link between domestic firms and their multinational suppliers in the downstream sectors is more sensitive to the overall economic situation. Further, in the downstream-to-upstream direction, the markets seem to be more divided by national borders: vertical linkages differ more when we consider the industry to be aggregated over several countries (Tables A5 and A6) as opposed to specific country-industry units (Tables 5 and 6). Similarly, as in Section 5.1, we decided to present our results in a summary table. However, because of the heterogeneity of the results, we do so for both the main and for the alternative specifications in Tables 7 and 8, respectively. Further, because of this heterogeneity, we cannot rely on attributing the loss of significance to inflated standard errors only and therefore we present only statistically significant results.

Table 7 Simplified Presentation of Quantitative Results – Main Specification (2)

Dependent variable: (log of) downstream sales of domestic firms

Channels of FDI impact	Western countries		Eastern countries	
	Before crisis	***After crisis***	***Before crisis***	***After crisis***
Pure forward spillover effect	none		none	0.690%
Crowding-out by MNEs	none	-0.073 %	none	-0.037%
Crowding-out by imports	none		none	
Forward export spillover	none		-0.002%	none

Notes: The table presents percentage change of downstream sales by domestic producers associated with the increase of the corresponding explanatory variable by a percentage point in case of spillover effect and crowding-out by MNEs (where the corresponding variables are upstream FDI and downstream FDI respectively) and by one percent in case of crowding-out by imports and enhanced exports (where the corresponding variables are downstream imports and downstream exports, respectively). In the specification (2), we assume that the FDI effects are primarily interacting and affecting domestic firms of the target country FDI. (We use country-industry specific fixed effects representing each country as separate market).

Table 8 Simplified Presentation of Quantitative Results – Alternative Specification

Channels of FDI impact	Western countries		Eastern countries	
	Before crisis	*After crisis*	*Before crisis*	*After crisis*
Pure forward spillover effect	none		none	
Crowding-out by MNEs	0.014%	-0.099%	none	
Crowding-out by imports	-0.006%	0.021%	none	
Forward export spillover	0.006%	-0.018%	none	

Notes: The table presents percentage change of upstream sales by domestic producers associated with the increase of the corresponding explanatory variable by a percentage point in case of spillover effect and crowding-out by MNEs (where the corresponding variables are upstream FDI and downstream FDI respectively) and by one percent in case of crowding-out by imports and enhanced exports (where the corresponding variables are downstream imports and downstream exports, respectively). Here, using the specification (2), we assume that the FDI flows affect horizontally and vertically integrated industries in a similar manner across all countries. (We use separately country and industry specific fixed effects, assuming all countries behave as a single market).

We find a weakly statistically significant positive pure spillover effect in the post-crisis period in Eastern countries (Table 7). The result indicates that within a given country and industry, domestic firms may benefit from multinational suppliers in the period following an economic crisis by increasing their own efficiency. Given the crowding-out effect of the MNEs, mostly confirmed in our analysis only for the post-crisis period, the positive pure spillover effect becomes relativized if the domestic downstream firms operate in sectors that are also characterized by increased FDI levels. The outcome could be driven by the fact that vertical interactions happen primarily between MNEs themselves, at least in time of economic distress.

Especially for Eastern countries, imports do not represent a clear competition effect and this statement is not affected by the activity of MNEs - the competition appears to be associated with the foreign sales within the industry. Also, we do not find clear evidence of export spillovers – even though the overall effect of exporting is positive, which is natural since it captures at least partially the effect of growing demand for consumer goods. For Western countries, this positive effect becomes more pronounced in the pre-crisis period and weakens in the post-crisis period if there are more MNEs in the upstream sector (β_6). This finding indicates interesting vertical linkages: if firms have more interactions with MNEs in the supplying sector, exports contribute to increased sales of domestic firms during an economic upturn and to decreased sales during recession. This may be due to the fact that upstream FDI is often accompanied by downstream FDI (as we have already shown in Section 5.1). In addition, MNEs in the downstream sector may be more competitive in exporting than domestic producers, especially when the overall economic situation is not favorable.

6. Conclusion

In this paper, we provide a comprehensive analysis of the impact of MNEs and FDI on domestic firms. Our framework covers both upstream and downstream directions through which the impacts materialize. We build on the theoretical model of Markusen and Venables (1999) to capture international industrial-trade linkages. We identify five basic channels through which the FDI potentially affects domestic suppliers. We then empirically analyze the impact of MNEs and FDI in a unique

database that covers 30 European countries from 2001 to 2013. Our unique dataset is constructed from the Amadeus, Eurostat, UN Comtrade and BACI databases and provides a rich source of production-trade linkages.

We do not find evidence of a pure spillover effect (at the upstream level) when other channels are controlled for. This result is not surprising given the extent of our dataset; we are able to properly disentangle different channels of the FDI's impact and identify specific spillovers that would otherwise stay hidden under a general effect. On this more detailed level, we show that an MNE's presence, via its FDI, has a significant effect on domestic firms in the upstream sectors in terms of changing degree of competition and trade spillovers.

We find evidence of a change in sourcing patterns, because when MNEs enter the upstream industry they either replace domestic firms, or domestic suppliers may be replaced by imports of the upstream goods. Specifically, we show that due to higher productivity in sectors which host entering MNEs, the demand for intermediate goods rises, which is positive for suppliers of these goods. Unfortunately, the extent to which domestic suppliers benefit from this increased demand is limited by the increased competition with other MNEs operating in the sector of intermediate goods, which are preferred by the MNE's customers and substitute the domestic production. This substitution effect is further intensified by increased competition with importers.

We also document the existence of trade (export) spillovers: we show that increasing exports of upstream goods are also linked to increased production by domestic suppliers of these goods. The effect might materialize either because of the newly opened trade channels or because of the aim to target new foreign markets. In both cases the MNEs' presence is behind the finding.

Our main results are complemented by the analysis at the downstream level, for which we find rather limited evidence of positive pure spillover effects. We show that production of domestic firms is sensitive to the MNEs' presence as it increases in sectors where MNEs operate. We also document that downstream FDI boosts production in the corresponding sector, and as a result more intermediate goods are demanded. Despite the fact that MNEs purposefully enter sectors in which there is potential for larger sales, the overall sales of the sector increase even if they crowd out domestic producers.

We conclude that the presence of the MNEs and their FDI in Europe substantially impacts domestic firms. The impact is not always beneficial at first sight because the presence of MNEs often crowds-out domestic suppliers by intensifying competition on both horizontal and vertical level. On the other hand, increasing demand for intermediate goods and potential export spillovers due to MNE is beneficial for domestic firms that are able to withstand the competition.

The main contribution of our paper lies in a comprehensive assessment of how the spillover effects materialize and via what channels they propagate. The detailed assessment is possible thanks to a rich dataset that combines information about firms' performance, trade flows and interactions between sectors. This allows us to control for different channels through which FDI may affect domestic producers and leads to a better assessment of these heterogeneous effects. We clearly show that the ex-ante expected crowding-out effect where supply of domestic firms is replaced by imports or MNEs production is not really offset by technological

spillovers. Rather, it is offset by increasing domestic demand and a greater possibility (or maybe necessity) to access foreign markets. Overall, the estimated size of these effects is rather small, likely due to the complexity of our model, in which positive and negative effects immediately offset each other. Our complex specification, therefore, identifies much smaller effects of each channel compared to their size when the channels are estimated separately. We believe that some of the effects could be stronger when (time-changing) country-specific conditions of both macro and microeconomics are considered. For a detailed analysis of country-specific effects 1) one should analyse estimated country and industry fixed effects, and/or 2) combine sectoral data and effects with the firm-level data and analyse those effects on local firms. These extensions would allow us to draw better (and country-specific) policy implications, but it is clearly beyond the scope of the existing paper and thus we suggest it for future research.

APPENDIX

Table A1 Definition of Variables for Upstream Analysis

Variable	*Definition*	*Formula*	*Units*	*Source*
Sales	Sales in the upstream industry analyzed, i.e., sales of intermediate goods. Computed as sum of sales of all firms operating in the industry.	$Sales_{ict} = \sum_{j=1}^{N_{ict}} Sales_{ictj}$	Millions of EUR	Amadeus
FSales	Share of *Sales* due to foreign firms only.	$FSales_{ict} = \sum_{j=1}^{N_{ict}} F_{ictj} Sales_{ictj}$	Millions of EUR	Amadeus
DSales	Share of *Sales* due to domestic firms only.	$DSales_{ict} = Sales_{ict} - FSales_{ict}$	Millions of EUR	Amadeus
Sales^{Down}	Sales in all downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *Sales*^{Down} representing all downstream industries) $Sales_{ct}^{Down} = A_t \times Sales_{ct}$	Millions of EUR	Amadeus Eurostat (I-O tables)
FDI	FDI presence in the upstream industry analyzed, defined as the ratio of the sales of foreign owned firms in a given industry over the sales of all firms operating in that industry	$FDI_{ict} = \frac{FSales_{ict}}{Sales_{ict}}$	Ratio (0 to 1)	Amadeus
FDI^{Down}	FDI presence in downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *FDI*^{Down} representing all downstream industries) $FDI_{ct}^{Down} = A_t \times FDI_{ct}$	Ratio (0 to 1)	Amadeus Eurostat (I-O tables)

Table A1 Definition of Variables for Upstream Analysis (Continued)

Variable	*Definition*	*Formula*	*Units*	*Source*
Exports	Exports from the upstream industry studied summed over all trade partners.	$Exports_{ict} = \sum_{k=1}^{K_{ict}} \text{Exports}_{ictk}$	Thousands of USD	BACI
$\text{Exports}^{\text{Down}}$	Exports from downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector $\text{Exports}^{\text{Down}}$ representing all downstream industries) $\text{Exports}_{ct}^{\text{Down}} = \text{A}_t \times Exports_{ct}$	Thousands of USD	BACI
Imports	Imports to the upstream industry studied, summed over all trade partners.	$Imports_{ict} = \sum_{l=1}^{L_{ict}} \text{Imports}_{ictl}$	Thousands of USD	BACI
$\text{Imports}^{\text{Down}}$	Imports to downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector $\text{Imports}^{\text{Down}}$ representing all downstream industries) $\text{Imports}_{ct}^{\text{Down}} = \text{A}_t \times Imports_{ct}$	Thousands of USD	BACI

Notes

c ... country index
i ... industry index
j ... firm index
k ... trade partner country index for exports
l ... trade partner country index for imports
t ... time index

F_{ictj} ... dummy defining the firm j in sector i, country c and year t as foreign controlled firm
N_{ict} ... number of firms in sector i, country c in year t
K_{ict} ... number of countries to which industry i in country c exports in year t
L_{ict} ... number of countries from which industry i in country c imports in year t
$\mathbf{A_t}$ ... I-O matrix; row elements represent shares in which the upstream industry supplies in the downstream industries; diagonal is 0 by definition

$Sales_{ictj}$ ... sales of firm j in sector i, country c, year t
$Exports_{ictl}$ ... exports from industry i in country c to country k in year t
$Imports_{ictl}$ ... imports in industry i in country c from country l in year t

Table A2 Definition of Variables for Downstream Analysis

Variable	*Definition*	*Formula*	*Units*	*Source*
Sales	Sales in the downstream industry analyzed, i.e., sales of final goods. Computed as sum of sales of all firms operating in the industry.	$Sales_{ict} = \sum_{j=1}^{N_{ict}} Sales_{ictj}$	Millions of EUR	Amadeus
FSales	Share of *Sales* due to foreign firms only.	$FSales_{ict} = \sum_{j=1}^{N_{ict}} F_{ictj} Sales_{ictj}$	Millions of EUR	Amadeus
DSales	Share of *Sales* due to domestic firms only.	$DSales_{ict} = DSales_{ict} - FSales_{ict}$	Millions of EUR	Amadeus
Sales^{Up}	Sales in all upstream industries, i.e., industries that are considered to be supplying to the downstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *Sales*^{Up} representing all upstream industries) $Sales_{ct}^{Up} = A_t^T \times Sales_{ct}$	Millions of EUR	Amadeus Eurostat (I-O tables)
FDI	FDI presence in the downstream industry analyzed, defined as the ratio of the sales of foreign owned firms in a given industry over the sales of all firms operating in that industry	$FDI_{ict} = \frac{FSales_{ict}}{Sales_{ict}}$	Ratio (0 to 1)	Amadeus
FDI^{Up}	FDI presence in upstream industries, i.e., industries that are considered to be supplying to the downstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *FDI*^{Up} representing all upstream industries) $FDI_{ct}^{Up} = A_t^T \times FDI_{ct}$	Ratio (0 to 1)	Amadeus Eurostat (I-O tables)

Table A2 Definition of Variables for Downstream Analysis (Continued)

Variable	*Definition*	*Formula*	*Units*	*Source*
Exports	Exports from the upstream industry studied, summed over all trade partners.	$Exports_{ict} = \sum_{k=1}^{K_{ict}} Exports_{ictk}$	Thousands of USD	BACI
Exports^{Up}	Exports from downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *Exports*^{Up} representing all upstream industries) $Exports_{ct}^{Up} = A_t^T \times Exports_{ct}^{Down}$	Thousands of USD	BACI
Imports	Imports to the upstream industry studied, summed over all trade partners.	$Imports_{ict} = \sum_{l=1}^{L_{ict}} Imports_{ictl}$	Thousands of USD	BACI
Imports^{Up}	Imports to downstream industries, i.e., industries that are considered to be sourcing from the upstream industry analyzed. For definition of upstream-downstream relations, Eurostat I-O tables are used.	In vector notation (vector *Imports*^{Up} representing all upstream industries) $Imports_{ct}^{Up} = A_t \times Imports_{ct}^{Down}$	Thousands of USD	BACI

Notes

c ... country index
i ... industry index
j ... firm index
k ... trade partner country index for exports
l ... trade partner country index for imports
t ... time index

F_{ictj} ... dummy defining the firm *j* in sector *i*, country *c* and year *t* as foreign controlled firm
N_{ict} ... number of firms in sector *i*, country *c* in year t
K_{ict} ... number of countries to which industry *i* in country *c* exports in year *t*
L_{ict} ... number of countries from which industry *i* in country *c* imports in year *t*
A_t^T ... transposed I-O matrix; row elements represent shares in which the downstream industry sources from the upstream industries; diagonal is 0 by definition

$Sales_{ictj}$ ... sales of firm *j* in sector *i*, country *c*, year *t*
$Exports_{ictl}$ ... exports from industry *i* in country *c* to country *k* in year *t*
$Imports_{ictl}$ ... imports in industry *i* in country *c* from country *l* in year *t*

Table A3 Sourcing Effects of FDI Activity: Upstream Sector, Western Countries

Separate country and industry fixed effects.

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Down}	β_1	-1.290	-1.248	-1.983	-1.963	-1.432	-1.322
		(1.100)	(1.096)	(5.063)	(5.000)	(1.192)	(1.172)
FDI .FDI^{Down}	β_2	-1.722[a]	-1.704[a]	-12.491	-8.021	-1.845[a]	-1.912[a]
		(0.356)	(0.353)	(22.348)	(23.140)	(0.410)	(0.401)
ln(Imports)	β_3	-0.052[c]	-0.047[c]	-0.050	-0.045	-0.045	-0.025
		(0.029)	(0.028)	(0.037)	(0.036)	(0.046)	(0.045)
ln(Imports). FDI^{Down}	β_4	-0.068	-0.050	-1.851[a]	-1.801[a]	-0.020	0.018
		(0.203)	(0.200)	(0.638)	(0.629)	(0.194)	(0.188)
ln(Exports)	β_5	0.325[a]	0.319[a]	0.327[a]	0.321[a]	0.310[a]	0.290[a]
		(0.022)	(0.021)	(0.027)	(0.027)	(0.035)	(0.034)
ln(Exports). FDI^{Down}	β_6	0.160	0.143	2.262[b]	2.244[b]	0.115	0.071
		(0.197)	(0.195)	(0.942)	(0.940)	(0.197)	(0.192)
ln($Sales^{Down}$)	β_7	-0.034	-0.053[b]	-0.071[b]	-0.086[b]	-0.045	-0.094
		(0.026)	(0.026)	(0.034)	(0.034)	(0.073)	(0.071)
ln(FSales)	β_8	-0.050[a]	-0.049[a]	-0.055[a]	-0.054[a]	-0.044[b]	-0.044[b]
		(0.012)	(0.012)	(0.016)	(0.016)	(0.021)	(0.021)
noFDI	β_9	-1.227[a]	-1.217[a]	-1.323[a]	-1.295[a]	-1.111[a]	-1.147[a]
		(0.245)	(0.245)	(0.316)	(0.315)	(0.405)	(0.407)
ln($Exports^{Down}$)	β_{10}		0.169[a]		0.154[b]		0.377[a]
			(0.046)		(0.069)		(0.076)
ln($Imports^{Down}$)	β_{11}		-0.020		0.011		0.727[a]
			(0.064)		(0.117)		(0.175)
Constant	β_0	19.441[a]	17.343[a]	20.327[a]	17.824[a]	19.997[a]	1.232
		(0.785)	(1.265)	(0.985)	(1.975)	(2.062)	(4.128)
Country FE		YES	YES	YES	YES	YES	YES
Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
R^2		0.816	0.817	0.814	0.815	0.822	0.826
N		5903	5903	3780	3780	2123	2123

Notes: The estimation is based on the specification (1) where we treat the whole group of Western countries as an integrated market. This approach means that we consider separate fixed effects for country and industry. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the upstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table A4 Sourcing Effects of FDI Activity: Upstream Sector, Eastern Countries

Separate country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Down}	β_1	-0.462	-0.462	-23.455[b]	-23.195[c]	-0.570	-0.520
		(0.561)	(0.559)	(11.933)	(12.036)	(0.622)	(0.620)
FDI .FDI^{Down}	β_2	-0.105[a]	-0.109[a]	-4.848[a]	-4.704[a]	-0.139[a]	-0.149[a]
		(0.033)	(0.033)	(0.992)	(1.027)	(0.035)	(0.035)
ln(Imports)	β_3	0.176[a]	0.171[a]	0.253[a]	0.249[a]	0.036	0.023
		(0.042)	(0.043)	(0.052)	(0.053)	(0.075)	(0.075)
ln(Imports). FDI^{Down}	β_4	-0.006	-0.004	-4.001	-4.067	0.052	0.053
		(0.103)	(0.103)	(3.555)	(3.562)	(0.112)	(0.112)
ln(Exports)	β_5	0.185[a]	0.187[a]	0.135[a]	0.137[a]	0.288[a]	0.295[a]
		(0.030)	(0.030)	(0.038)	(0.039)	(0.052)	(0.052)
ln(Exports). FDI^{Down}	β_6	0.054	0.051	6.408	6.510	0.012	0.007
		(0.086)	(0.086)	(3.960)	(3.977)	(0.093)	(0.093)
ln($Sales^{Down}$)	β_7	0.106[c]	0.102[c]	0.173[b]	0.171[b]	0.154	0.118
		(0.054)	(0.056)	(0.070)	(0.072)	(0.166)	(0.189)
ln(FSales)	β_8	-0.064[a]	-0.066[a]	-0.076[a]	-0.078[a]	-0.049[b]	-0.051[b]
		(0.011)	(0.011)	(0.013)	(0.013)	(0.020)	(0.020)
noFDI	β_9	-1.107[a]	-1.136[a]	-1.220[a]	-1.255[a]	-1.001[a]	-1.045[a]
		(0.194)	(0.196)	(0.233)	(0.235)	(0.359)	(0.365)
ln($Exports^{Down}$)	β_{10}		0.193[c]		0.212		0.383
			(0.110)		(0.142)		(0.248)
ln($Imports^{Down}$)	β_{11}		-0.147		-0.162		-0.269
			(0.115)		(0.182)		(0.199)
Constant	β_0	12.126[a]	11.854[a]	10.549[a]	10.224[a]	12.035[a]	14.227[a]
		(1.217)	(1.587)	(1.535)	(2.259)	(3.862)	(5.252)
Country FE		YES	YES	YES	YES	YES	YES
Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
R^2		0.712	0.713	0.718	0.719	0.712	0.713
N		0.712	0.713	0.718	0.719	0.712	0.713

Notes: The estimation is based on the specification (1), where we treated the whole group of Eastern countries as an integrated market. This approach means that we consider separate fixed effects for country and industry. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the upstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table A5 Sourcing Effects of FDI Activity: Downstream Sector, Western Countries

Separate country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Up}	β_1	-1.152	-1.061	11.512	11.512	-1.340	-1.184
		(0.947)	(0.845)	(8.134)	(8.234)	(1.025)	(1.024)
FDI^{Up}. FDI	β_2	-1.783[a]	-1.781[b]	13.552[a]	13.811[a]	-1.953[a]	-1.849[a]
		(0.431)	(0.745)	(4.618)	(4.714)	(0.336)	(0.316)
ln(Imports)	β_3	-0.055[c]	-0.056[a]	-0.039	-0.039	-0.080	-0.080
		(0.031)	(0.020)	(0.036)	(0.036)	(0.056)	(0.055)
ln(Imports).FDI^{Up}	β_4	0.285	0.300[c]	-5.654[a]	-5.793[a]	0.396[b]	0.400[b]
		(0.193)	(0.169)	(1.715)	(1.732)	(0.194)	(0.191)
ln(Exports)	β_5	0.346[a]	0.339[a]	0.323[a]	0.314[a]	0.378[a]	0.367[a]
		(0.023)	(0.015)	(0.026)	(0.026)	(0.044)	(0.043)
ln(Exports). FDI^{Up}	β_6	-0.217	-0.235	5.169[a]	5.478[a]	-0.326[c]	-0.336[c]
		(0.191)	(0.159)	(1.809)	(1.861)	(0.194)	(0.190)
ln($Sales^{Up}$)	β_7	0.015	-0.015	0.005	-0.027	0.045	-0.017
		(0.025)	(0.024)	(0.033)	(0.033)	(0.060)	(0.061)
ln(FSales)	β_8	-0.056[a]	-0.055[a]	-0.072[a]	-0.072[a]	-0.027[c]	-0.027[c]
		(0.011)	(0.012)	(0.015)	(0.015)	(0.016)	(0.016)
noFDI	β_9	-1.282[a]	-1.268[a]	-1.577[a]	-1.576[a]	-0.720[b]	-0.699[b]
		(0.225)	(0.225)	(0.299)	(0.292)	(0.319)	(0.317)
ln($Exports^{Up}$)	β_{10}		0.141[a]		0.153[c]		0.182
			(0.051)		(0.092)		(0.115)
ln($Imports^{Up}$)	β_{11}		0.047		0.125		0.551[a]
			(0.074)		(0.145)		(0.208)
Constant	β_0	17.865[a]	15.446[a]	18.420[a]	14.531[a]	16.482[a]	4.767
		(0.787)	(1.108)	(0.997)	(2.026)	(1.795)	(3.365)
Country FE		YES	YES	YES	YES	YES	YES
Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
R^2		0.824	0.824	0.827	0.827	0.824	0.826
N		5891	5891	3791	3791	2100	2100

Notes: The estimation is based on the specification (2) where we treat the whole group of Western countries as an integrated market. This approach means that we consider separate fixed effects for country and industry. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the downstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table A6 Sourcing Effects of FDI Activity: Downstream Sector, Eastern Countries

Separate country and industry fixed effects

	Coefficient	*All years*		*2001-2008*		*2009-2013*	
FDI^{Up}	β_1	0.264	0.178	-0.731	-3.020	0.061	-0.018
		(0.350)	(0.342)	(15.28)	(15.34)	(0.370)	(0.348)
FDI^{Up}. FDI	β_2	-0.173	-0.184	20.100	18.175	-0.230	-0.243
		(0.171)	(0.185)	(27.43)	(27.67)	(0.181)	(0.179)
ln(Imports)	β_3	0.081[b]	0.085[b]	0.141[a]	0.145[a]	-0.042	-0.027
		(0.040)	(0.040)	(0.049)	(0.050)	(0.066)	(0.066)
ln(Imports).FDI^{Up}	β_4	0.034	0.038	-0.760	-0.700	0.072	0.066
		(0.086)	(0.085)	(3.294)	(3.224)	(0.088)	(0.086)
ln(Exports)	β_5	0.263[a]	0.253[a]	0.254[a]	0.238[a]	0.285[a]	0.280[a]
		(0.029)	(0.028)	(0.035)	(0.035)	(0.052)	(0.051)
ln(Exports). FDI^{Up}	β_6	-0.041	-0.039	0.788	0.894	-0.057	-0.046
		(0.083)	(0.082)	(3.106)	(3.068)	(0.087)	(0.084)
ln($Sales^{Up}$)	β_7	-0.036	-0.071	-0.026	-0.068	0.318[b]	0.261
		(0.054)	(0.056)	(0.070)	(0.072)	(0.159)	(0.159)
ln(FSales)	β_8	-0.060[a]	-0.059[a]	-0.059[a]	-0.060[a]	-0.066[b]	-0.060[b]
		(0.014)	(0.014)	(0.016)	(0.015)	(0.027)	(0.029)
noFDI	β_9	-1.120[a]	-1.118[a]	-1.062[a]	-1.078[a]	-1.341[a]	-1.227[b]
		(0.243)	(0.245)	(0.279)	(0.276)	(0.483)	(0.522)
ln($Exports^{Up}$)	β_{10}		-0.066		-0.024		-0.570[a]
			(0.095)		(0.123)		(0.205)
ln($Imports^{Up}$)	β_{11}		0.415[a]		0.452[b]		0.930[a]
			(0.120)		(0.183)		(0.264)
Constant	β_0	15.472[a]	11.615[a]	18.554[a]	12.535[a]	11.875[a]	6.277
		(1.198)	(1.434)	(1.900)	(2.567)	(4.592)	(5.354)
Country FE		YES	YES	YES	YES	YES	YES
Industry FE		YES	YES	YES	YES	YES	YES
Year FE		YES	YES	YES	YES	YES	YES
R^2		0.719	0.721	0.724	0.726	0.721	0.723
N		4003	4003	2572	2572	1431	1431

Notes: The estimation is based on the specification (2) where we treat the whole group of Eastern countries as an integrated market. This approach means that we consider separate fixed effects for country and industry. The dependent variable is ln(DSales), logarithm of sales of domestic companies in the downstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Table A7 Correspondence Between NACE Rev. 1.1 and SITC Rev. 4 Codes

NACE/SITC	00	01	02	03	04	05	06	07	08	09	11	12	21	22	23	24	25	26	27	28	29	32	33	34	35	41	42	43	51	52	53	54	55	56	57	58	59	61	62	63	64	65	66	67	68	69	71	72	73	74	75	76	77	78	79	81	82	83	84	85	87	88	89	96	97
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Notes: For the sake of limited space, we present only an excerpt of the correspondence table for manufacturing industries. The x symbol denotes the row NACE sector in which a given column SITC good is produced. The representation is only schematical in the sense that in fact we were linking SITC goods at five- or four-digits level. It may seem that several SITC goods fall into more than one NACE categories, but this is dues only to the fact that goods with the same SITC two-digits representation fall into different NACE industries when considered at a more disaggregated level. Detailed correspondence table is available upon a request.

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