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Productivity and Trade Spillovers: Horizontal Crowding-Out Versus Vertical Synergies in Europe as a Response to Foreign Direct Investment

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Productivity and Trade Spillovers: Horizontal Crowding-Out Versus Vertical Synergies in Europe as a Response to Foreign Direct Investment

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Abstract

We analyze the impact of multinational enterprises (MNEs), via their foreign direct investment (FDI), 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, UN Comtrade and BACI data sources. 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, in terms of both changing the market structure and improving productivity. The impact is not always positive, as domestic firms are often crowded-out. However, those firms that withstand such double competition receive additional benefits stemming from trade (export) spillovers. In our complex model, we did not find significant (positive) interactions of domestic firms with horizontal MNEs which would suggest desirable productivity spillovers.

Keywords: multinational enterprise (MNE), foreign direct investment (FDI), European firms, spillovers, international trade
JEL Classification: C33, F15, F21, F23, O24

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1. Introduction

Governments often try to attract foreign direct investments (FDI) with costly economic incentives (Meyer, 2004).[1] Such behavior is driven by a strong belief that multinational enterprises (MNEs) bring, via their FDI, substantial external benefits to a host country. Some of these benefits materialize through various spillovers that impact domestic firms (Blomström et al., 2000; Görg and Strobl, 2001; Görg and Greenaway, 2004). The key issue is that policy makers need accurate estimates of the impact of entry of MNEs in order to assess their costs both (i) for governments, which decide whether or not to promote FDI, and (ii) for MNEs, which need to know their bargaining power in negotiations over the conditions of the investment (Dunning and Lundan, 2008; Jones, 2014). The interactions between domestic firms and MNEs are complex, and the existing literature fails to take into account important domestic and international trade links. Thus, in this study we consider address industrial and trade channels which have not previously been controlled for. In so doing, we provide a comprehensive analysis of the impact of MNEs and their FDI on domestic firms in Europe and uncover the existence of horizontal, vertical, and export spillovers.

The literature on the effects of FDIs on firms in a host economy is vast, but fragmented.[2] There are three distinct perspectives from which existing studies analyze the impact of MNEs and FDIs on domestic firms. First, researchers primarily analyze interactions between MNEs and domestic firms from a production perspective, along with resulting productivity and technology spillovers (Bodman and Le, 2013; Görg and Strobl, 2001). This is done 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 intermediary goods for other firms in a host economy (forward linkage). Alternatively, as a downstream industry entity, an MNE uses intermediary goods provided by domestic firms (backward linkage). Second, researchers accentuate the changes in market conditions that are caused by the MNEs. In this respect, MNEs may also substantially change domestic market conditions in terms of increasing competition, which prompts crowding-out of those domestic firms who are unable to withstand the new environment. On the other hand, changes in domestic market

[1] Foreign direct investments (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.

[2] We review the appropriate literature in Section 2.

conditions might lead to increasing demand for intermediary goods, thus providing more room for competent domestic firms. Third, researchers stress the international dimension of the FDI presence: (i) goods produced by the MNEs can be sold on the domestic market or exported, and (ii) goods used by the MNEs as inputs can be purchased domestically or imported. Thus, the MNEs' export activity is often substantial and significantly affects domestic firms via the trade/export spillover effect. 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 costs of trade and helps to increase the export activities of domestic firms. Despite their importance, export spillovers are much less researched than traditional productivity spillovers. Potential reasons for this may lie in obstacles imposed by the availability of data.

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 for the less than accurate results frequently presented in the related empirical literature. We aim to overcome part of the above issues by assembling the data that allow for much less fragmented assessment. Our unique database, which covers the production-trade linkages in 30 European countries from 2001 to 2013 is constructed using the Amadeus, Eurostat, UN Comtrade and BACI databases. We provide separate findings for Western and Eastern European countries, before and after the global financial crisis (GFC). This approach allows for assessment of potential differences between both groups, as well as between periods of relative calm and distress. More importantly, such a large geographical coverage allows us to incorporate the effect of international industrial linkages; analyzing the sourcing and supply patterns of MNEs in Europe, as well as their interaction with domestic competitors. In so doing, we stress the upstream-downstream relations, i.e. links between producers of intermediary (upstream) and consumer (downstream) goods.

Based on the above rich data we are able to analyze the effects of the MNEs and FDIs on domestic firms while controlling for variation in (i) industry production, horizontal and vertical spillovers, and (ii) in international trade flows. We also include controls for backward and forward linkages.[3] Our empirical analysis is grounded in the adaptation of the theoretical model of Markusen and Venables (1999), which we modify to capture international industrial

[3] A rich set of interactions in our model generates a variety of questions that motivate our analysis. How does the FDI shape inter-industry allocations on a national and international level? Do MNEs purchase intermediary goods from domestic suppliers, or do they prefer to import them? Alternatively, do MNEs purchase these goods from other multinationals in the domestic downstream sector? Additionally, once we control for the changing sourcing patterns, do we observe any productivity spillovers from MNEs towards their domestic suppliers? Finally, do we observe any export spillovers from the FDI towards domestic firms?

linkages. Our identification strategy allows us to investigate the impact of FDI on the host economy, both along the vertical axis (between industries) and the horizontal axis (within industry), in greater detail than any of the existing empirical analyses to date. In terms of the spillovers arising from the FDIs, we are able to determine whether, (and to what extent), the demand for intermediary goods rises, and whether any such increase is met by domestic firms or covered by imports. Thus, our empirical analysis yields more detailed estimates of how the FDIs impact domestic suppliers, in that it accurately disentangles various channels through which the impact is propagated. The granular view thus produces specific policy implications.

Our results do not show a pure spillover effect when other channels are controlled for. Based on a multifaceted model we find that the presence of MNEs affects domestic firms both in terms of changing the market structure and potential improvements in productivity resulting in positive export spillovers. Further, we find evidence of a change in sourcing patterns, which often results in the crowding out of domestic firms. However, we do not find significant (positive) interactions of domestic firms with horizontal MNEs, suggesting desirable productivity spillovers. Rather, the model suggests that MNEs are likely bundled in producer-supplier chains and hence the potential benefit for local firms from horizontal interactions is rather limited. We also document the existence of trade (export) spillovers for both upstream and downstream levels. Taken together, while the direct impact of the MNEs and their FDI is not always beneficial for the domestic firms, due to their being crowded-out of the market, our evidence for positive production and trade spillovers is strong, and indirectly underlines the importance of international production networks in Europe.

The rest of the paper is structured as follows. In Section 2, we review the literature. In Section 3, we describe the theoretical model, potential channels of the FDI effects and 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

This section focuses on the literature that is directly related to our analysis, and also provides relevant references, primarily to surveys and meta-analyses.

The related literature studies two key dimensions of the impact of FDIs. The first 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). The second link is the intra-industry (or horizontal) level, which

concerns the interaction between an MNE and its local competitors within the same industry. On the vertical and horizontal level, there are two main channels of interactions between the MNE and other firms in the economy: market structure and 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 off-set 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 MNE in the market (Meyer and Sinani, 2009). Researchers assume that technologically more advanced MNEs represent a positive example which domestic firms can follow by, for example, copying new technologies, and/or by hiring workers or managers who have experience in the 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).

In their theoretical model, Markusen and Venables (1999) describe both the market structure change and the productivity spillovers arising from the entry of a highly efficient MNE in the domestic market along the vertical axis. They compare three different scenarios: (i) the goods in the domestic market are produced by domestic firms, (ii) they are produced by MNEs operating in the domestic market and (iii) they are imported from abroad. The authors conclude that, whereas the second and the third scenario increase competition within the industry, and may thus threaten domestic firms, the second scenario also boosts the demand for intermediary goods across industries and may bring profits to domestic suppliers. In addition, the second, (but not the third), scenario 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).

The Markusen and Venables (1999) model has one drawback - it does not allow for imports of intermediary goods, and so foreign subsidiaries have to source all their imports locally.[4] This assumption is not realistic: FDIs are closely related to inter-sectoral trade and the vertical integration of production chains as has been shown theoretically (e.g. Helpman, 1984) and documented empirically (see Lanz, 2011). In reality, the potential increase in

[4] Markusen and Venables (1999) model is one of the two theoretical models that study the impact of MNEs on the local suppliers of intermediary 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 good because there are not enough suppliers of sophisticated intermediary goods in the country and domestic firms cannot import them. We do not think such assumptions are realistic in EU countries.

demand for intermediary goods due to the inflow of FDI and related enhanced industrial activity (as predicted by Markusen and Venables, 1999) is not always covered by domestic firms. MNEs may prefer to purchase the intermediary goods from abroad, and thus the overall impact on domestic suppliers may, ultimately, even be negative.

Whether foreign subsidiaries use domestic suppliers more or less than domestic firms is not usually 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 intermediary goods is the main reason why MNEs source from abroad. In contrast, Jindra (2009) explains that the choice of local or foreign supplier depends also, to a great extent, on the type of foreign subsidiary. In any case, whether links between MNEs' subsidiaries and local suppliers are established or not is a question of crucial importance, because only then can potential productivity spillovers materialize. These spillovers may further improve the efficiency of domestic firms and amplify the positive effect of increasing demand. Thus, they 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 (Havránek and Iršová, 2012).

Unfortunately, the empirical literature fails to reflect the complexity of the issue of spillovers related to sourcing patterns of MNEs. First, empirical analyses are usually focused solely on productivity spillovers (Görg and Strobl, 2001) and omit the issue of changing market structure and increasing demand (Peretto, 2002). 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. An even more detailed survey of these papers can be found 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 depends usually 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, 2004), which certainly provides an interesting insight, but from which is hard to generalize further.

A second important drawback of the existing empirical literature is the fact that it usually ignores, or at least underestimates, the role of international trade and its interaction with FDI activities. The importation of intermediary goods by MNEs suggests that FDI and trade flows might be closely linked. 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, and yet, these approaches, even if they confirm that the 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.

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)					✓	
					x	
Aitken & Harrison (1999)	✓					
		x				
Blalock & Gertler (2008)			✓			
			x			
Damijan et al. (2003)	✓					
	x	x				
Djankov & Hoekman (2000)	✓					
		x				
Dries & Swinnen (2004)			✓			
			x			
Gorodnichenko et al. (2015)	✓					
	x					
Greenaway et al. (2004)					✓	
					x	
Javorcik (2004)	✓		✓			
		x	x			
Javorcik & Spatareanu (2009)			✓			
			x			
Jordaan (2011)			✓			
			x			
Jurajda & Stančík (2012)	✓					
	x					
Koenig et al. (2010)					✓	
					x	
Kokko et al. (2001)	✓				✓	
	x	x			x	x
Konings (2001)	✓					
		x				
Lesher & Miroudot (2008)			✓		✓	
			x		x	
Stančík (2010)	✓		✓			
		x	x	x		

Note: The three columns indicate whether the particular study examines horizontal, vertical, or export spillover and the appropriate rows indicate whether the relationship is positive or negative.

For ease of exposition, in Figure 1 we summarize the key approaches from the existing empirical literature[5]. In three columns we indicate whether a particular study examines

[5] 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).

horizontal, vertical, or export spillovers, and in the relevant rows we indicate whether the empirically found relationship is positive or negative. Based on the information provided in Figure 1, it becomes clear that while numerous studies examine two spillover effects, there is no study which controls for all three spillovers. In our paper we pursue exactly this goal.

3. Methodology

3.1. Model and theoretical predictions

We build on the theoretical model of Markusen and Venables (1999) and modify it to capture international industrial linkages. In the model, the authors show that under certain circumstances, the increased activity of multinational firms in the downstream sector should increase the demand for intermediary goods. They assume that the MNEs are more efficient than domestic firms, which increases production in the consumer goods sector, and moreover, that they use intermediary goods more intensively, which drives the demand for these goods up.

To represent this idea formally, we need to introduce the notation that will be used throughout our paper. In Markusen and Venables' (1999) model, two sectors are defined: intermediary goods and consumer goods. In reality, all sectors of the economy could be considered as producing both intermediary and consumer goods, and therefore such a distinction would not be practical here. Hence, we will denote *downstream* and *upstream* sectors, with the former using intermediary goods provided by the latter. Obviously, all industries can play a downstream and upstream role: as upstream industries, they provide intermediary goods for other sectors, as downstream industries, they use intermediary goods provided by other sectors.

Formally, Markusen and Venables (1999) assume the sales by upstream sector ($Sales^{Up}$) to be a function of FDI in the downstream sector (FDI^{Down}): $Sales^{Up} = f(FDI^{Down})$, with $\frac{dSales^{Up}}{dFDI^{Down}} > 0$. To answer our research question, this prediction of the theoretical model will be modified in two ways. First, it should not be forgotten that the model is derived under the assumption that the total demand for the goods produced in the downstream sector is fixed, and that there is no trade in intermediary goods. Neither of this has to be true. The demand for consumer goods produced by the downstream sector varies over time, which would also affect the demand for intermediary goods produced by the upstream sector. Also, a portion of the intermediary goods can be imported or exported. It is therefore more realistic to see the sales

of intermediary goods produced by the upstream sector ($Sales^{Up}$) as a function of FDI in the downstream sector (FDI^{Down}), sales of consumer goods by the downstream sector ($Sales^{Down}$), imports of intermediary goods ($Imports^{Up}$) and exports of intermediary goods ($Exports^{Up}$):

$$Sales^{Up} = f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up}).$$

Moreover, according to the models described in Section 2, it has to be expected that the production of consumer goods, as well as imports and exports of intermediary goods are also a function of FDI in the downstream sector. The above facts lead to the formulation of the following stylized model:

$$Sales^{Up} = f\left(FDI^{Down}, Sales^{Down}(FDI^{Down}), Imports^{Up}(FDI^{Down}), Exports^{Up}(FDI^{Down})\right).$$

Second, in Markusen and Venables (1999) model, intermediary goods are produced only by domestic firms, whereas in reality, MNEs can also enter the upstream sector. We want to estimate the impact of downstream FDI on sales of domestically produced intermediate goods, which is only a part of total sales. When we denote the domestically produced intermediate goods $DSales^{Up}$ and those produced by MNEs operating in the intermediate goods sector $FSales^{Up}$, we can write

$$Sales^{Up} = DSales^{Up} \cdot \left(\frac{Sales^{Up}}{DSales^{Up}}\right) = f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})$$

$$DSales^{Up} = \frac{DSales^{Up}}{Sales^{Up}} \cdot f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up}).$$

This implies that

$$\frac{dDSales^{Up}}{dFDI^{Down}} = \frac{d\,Dsales^{Up}/Sales^{Up}}{dFDI^{Down}} \cdot f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up}) + \frac{DSales^{Up}}{Sales^{Up}} \cdot \frac{df(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{dFDI^{Down}},$$

where

$$\frac{df(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{dFDI^{Down}}$$
$$= \frac{\partial f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{\partial FDI^{Down}}$$
$$+ \frac{\partial f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{\partial Sales^{Down}} \cdot \frac{dSales^{Down}}{dFDI^{Down}}$$
$$+ \frac{\partial f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{\partial Imports^{Up}} \cdot \frac{dImports^{Up}}{dFDI^{Down}}$$
$$+ \frac{\partial f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up})}{\partial Exports^{Up}} \cdot \frac{dExports^{Up}}{dFDI^{Down}} .$$

After substituting back $f(FDI^{Down}, Sales^{Down}, Imports^{Up}, Exports^{Up}) = Sales^{Up}$, we obtain:

$$\frac{dDSales^{Up}}{dFDI^{Down}} = \frac{d\,DSales^{Up}/Sales^{Up}}{dFDI^{Down}} \cdot Sales^{Up} + \frac{DSales^{Up}}{Sales^{Up}}$$
$$\cdot \left(\frac{\partial Sales^{Up}}{\partial FDI^{Down}} + \frac{\partial Sales^{Up}}{\partial Sales^{Down}} \cdot \frac{dSales^{Down}}{dFDI^{Down}} + \frac{\partial Sales^{Up}}{\partial Imports^{Up}} \cdot \frac{dImports^{Up}}{dFDI^{Down}} \right.$$
$$\left. + \frac{\partial Sales^{Up}}{\partial Exports^{Up}} \cdot \frac{dExports^{Up}}{dFDI^{Down}} \right) .$$

Such an expression is rather complex, but it can be schematized in the following way:

$$\frac{dDSales^{Up}}{dFDI^{Down}} = \Delta_1 + \Delta_2 + \Delta_3 + \Delta_4 + \Delta_5 , \qquad (1)$$

where Δ's stand for five different channels through which downstream FDI can influence sales of intermediate goods by domestic firms in the upstream sector. Their economic interpretation is as follows:

- $\Delta_1 = \frac{dDSales^{Up}/Sales^{Up}}{dFDI^{Down}} \cdot Sales^{Up}$ captures the impact of downstream FDI through the changing proportion of intermediary goods supplied by domestic producers, as compared to multinational firms operating in the country within the upstream sector. We may expect this impact to be negative for at least two reasons. First, according to Javorcik and Spatareanu (2005), domestic suppliers, especially in less developed countries, often do not meet the standard required by MNEs in the downstream sector, which then prefer to source from foreign suppliers. Further, according to Cohen (2007), it is very likely that these foreign suppliers will really be present in the country through

FDI in the upstream sector, as the presence of MNEs in one sector often attracts further FDI in related sectors.

- $\Delta_2 = \frac{DSales^{Up}}{Sales^{Up}} \cdot \frac{\partial Sales^{Up}}{\partial FDI^{Down}}$ captures the direct impact of downstream FDI on sales of intermediary goods, which can be interpreted as the pure spillover effect. Based on empirical studies such as Gorodnichenko et al (2015) or Stančík (2010), we can expect this impact to be positive: MNEs are motivated to help their local suppliers to improve.
- $\Delta_3 = \frac{DSales^{Up}}{Sales^{Up}} \cdot \frac{\partial Sales^{Up}}{\partial Sales^{Down}} \cdot \frac{dSales^{Down}}{dFDI^{Down}}$ captures the impact of downstream FDI through sales of intermediary goods, that is given by 1) change in sales by downstream industry driven by FDI (the term $\frac{dSales^{Down}}{dFDI^{Down}}$) and 2) change in the sales of intermediary goods given by change in sales by downstream industry (the term $\frac{\partial Sales^{Up}}{\partial Sales^{Down}}$). The first component of this impact is supposed to be positive, since many studies, such as e.g. Jurajda and Stančík (2012), predict that FDI inflow is correlated with productivity in the given sector. The second component of the impact is naturally supposed to also be positive - increasing production in the downstream sector should go in hand with increasing production of intermediary goods that serve as inputs. It has to be noted that, quantitatively, this relation may depend on the level of FDI in the downstream sector: for example, Markusen and Venables (1999) suppose that MNEs may use intermediary goods more intensively than domestic firms. Studies that deal with horizontal spillovers (see e.g. Hanousek et al. 2010) give rise to opposing ideas i.e. that compared to domestic firms, more efficient MNEs may be able to produce more output with less input. Hence, even if the production in the downstream sector increases due to FDI, the positive effect on demand for intermediary goods may be offset by the capacity of MNEs to save on inputs. For this reason, the effect Δ_3 captures both the potential increase of production in the downstream sector and the consecutive increase of demand for intermediary goods, but also the correction of such an increase given by the intensity with which MNEs source the inputs.
- $\Delta_4 = \frac{DSales^{Up}}{Sales^{Up}} \cdot \frac{\partial Sales^{Up}}{\partial Imports^{Up}} \cdot \frac{dImports^{Up}}{dFDI^{Down}}$ captures the impact of downstream FDI on sales of intermediary goods that is given by 1) change in imports driven by downstream FDI (the term $\frac{dImports^{Up}}{dFDI^{Down}}$) and 2) change in sales of intermediate goods given by the change in imports (the term $\frac{\partial Sales^{Up}}{\partial Imports^{Up}}$). Based on a survey described in Javorcik and

Spatareanu (2005), the first component of this impact is presumed to be positive, because MNEs are more likely to import their inputs from abroad than domestic firms. The second component of the impact is clearly negative if we assume that domestic and imported intermediate goods are substitutes and their suppliers compete. For this reason, the overall effect Δ_4 is presumed to be negative.

- $\Delta_5 = \frac{DSales^{Up}}{Sales^{Up}} \cdot \frac{\partial Sales^{Up}}{\partial Exports^{Up}} \cdot \frac{dExports^{Up}}{dFDI^{Down}}$ captures the impact of downstream FDI on sales of intermediary goods that is prompted by 1) change in exports driven by downstream FDI (the term $\frac{dExports^{Up}}{dFDI^{Down}}$) and 2) change in sales of intermediary goods prompted by the change in exports (the term $\frac{\partial Sales^{Up}}{\partial Exports^{Up}}$). Thus, this term captures the so-called export spillovers but exhibits some difficulties in its interpretation. Both components can be positive or negative based on circumstances. All depends on whether local producers of intermediary goods (domestic or with foreign owners) benefit from the presence of MNEs in the downstream sector and become more efficient and thus also more likely to export. Further, it also depends on whether the firms exploit this hypothetical potential to export and whether their exports are proportional or not to domestic sales. Finally, exports may even be reduced if goods that were previously exported are now supplied to incoming MNEs. Hence, the overall impact given by Δ_5 is hard to predict. However, this part of the model enables the detection of export spillovers in a more direct way than in earlier literature.

3.2. Econometric specification for the upstream sector

The main purpose of our analysis is to describe how FDI in the downstream sector influences the sales of domestic suppliers in the upstream sector. In order to assess whether the above impact is in line with the theoretical predictions presented in Section 3.1., we propose a semi-logarithmic specification (2) that contains all variables of interest; we are also able to interpret most of the coefficients as elasticities. We keep in mind that there are five main channels of the downstream FDI impact that we need to capture in our specification: the pure spillover effect, impact through changing upstream FDI, impact through changing imports, impact through changing exports and impact through changing sales in the upstream industry,

We observe industries over time, and hence a panel is the natural structure of our data. This structure is also in line with Görg and Strobl (2001) and Aitken and Harrison (1999) who argue that panel data analysis is more appropriate method to assess productivity spillovers.

Our basic specification is as follows:

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

where all variables are denoted in the same way as in Section 3.1. Index *t* denotes time, index *i* denotes a specific industry in a specific country and ϑ_{it} is the structured error term that in our panel specification takes the following form: $\vartheta_{it} = \alpha_i + \eta_t + \varepsilon_{it}$, where α_i is the country-industry specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term.

The main variable of interest is the presence of multinational firms in the downstream industry (FDI^{Down}), and its interaction terms. The control variables are chosen in line with the theoretical reasoning presented above. The industry, country and country-industry specific fixed effects allow us to control for time-invariant industry and country characteristics, and time specific fixed effects control for aggregate shocks to the economy due to business cycles.

The parameter β_1 represents the pure spillover effect, since all other channels through which downstream FDI influences the upstream sector of intermediary goods (according to theoretical predictions) are controlled for.

The parameter β_2 captures the effect on sales of intermediary goods driven by the potential preference of the foreign firms coming into the downstream sector to source their supplies from other multinational firms, rather than from domestic suppliers. Its interpretation is based on the interaction between the levels of FDI in the upstream and downstream sectors. Our prior is that if β_2 is negative, it means that foreign firms in the downstream sector prefer to source their inputs from multinational suppliers, which decreases the sales of domestic producers of intermediary goods.

The parameter β_4 describes the effect on sales of intermediary goods driven by the fact that foreign firms coming into the downstream sector may prefer to import their supplies, rather than purchase them from domestic suppliers.

The parameter β_6 represents the influence that downstream FDI has on upstream sales by affecting exports from the upstream industry.

The parameters β_3 and β_8 capture the influence of imports and foreign sales,

respectively. These are so-called pull factors and represent a direct competition within the industry. The parameters β_5 and β_7, on the other hand, capture the influence of exports and sales of the downstream industry goods, respectively. These are so-called push factors and represent potential changes in demand.

The parameter β_9 corresponds to a dummy $noFDI^{Up}$, which is 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 $FSales^{Up}$=0). The coefficient on this dummy variable is the mean effect of missing foreign firms in the industry – such a situation could have different reasons, ranging from local regulations/restrictions to low attractiveness of the underlying sector.

The parameters β_{10} and β_{11} allow us to control for the effect of exports and imports in the downstream sector and thus capture changes in demand for consumer goods, as well as changes in competition within the sector of these goods, which may have additional impact on the upstream sector.

3.3. Econometric specification for the downstream sector

The treatment of the linkages from the perspective of the upstream sector 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 in the previous sections of this paper. 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:

$$
\begin{aligned}
ln(DSales_{it}^{Down}) = {} & \beta_0 + \beta_1 FDI_{it}^{Up} + \beta_2 FDI_{it}^{Down} FDI_{it}^{Up} \\
& + \beta_3 ln(Imports_{it}^{Down}) + \beta_4 ln(Imports_{it}^{Down}) \cdot FDI_{it}^{Up} + \\
& + \beta_5 ln(Exports_{it}^{Down}) + \beta_6 ln(Exports_{it}^{Down}) \cdot FDI_{it}^{Up} + \\
& + \beta_7 ln\left(Sales_{it}^{Up}\right) + \beta_8 ln(FSales_{it}^{Down}) + \beta_9 noFDI_{it}^{Down} + \\
& + \beta_{10} ln\left(Exports_{it}^{Up}\right) + \beta_{11} ln\left(Imports_{it}^{Up}\right) + \vartheta_{it}.
\end{aligned} \tag{3}
$$

All variables in specification (3) are denoted in the same way as in the model presented in Section 3.1. Further, in a similar fashion as in specification (2), index *t* denotes time, index *i* denotes a specific industry in a specific country and ϑ_{it} is the combined error term that in our panel specification takes the following form: $\vartheta_{it} = \alpha_i + \eta_t + \varepsilon_{it}$, where α_i is the country-industry specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term.

The main variable of interest in (3) is FDI^{Up}, the presence of multinational firms in the upstream industry, and its interaction terms. With the help of these variables we are able to ask how upstream FDI affects the sales of domestic firms in the downstream industry through different channels.

In specification (3), the parameter β_1 represents the pure spillover effect stemming from multinational firms in the industries supplying intermediary goods. The parameter β_2 relativizes this spillover effect – it allows for a different intensity (and even sign) of the spillover on domestic producers of consumer goods in industries with a higher share or MNEs, in which the effect of upstream FDI could be different if MNEs tend to cooperate between sectors.

The parameters β_3 and β_8 capture the influence of imports and foreign sales, thus representing direct competition within the industry. The parameter β_4 relativizes the competition given by imports in industries that use multinational suppliers more intensively. The parameters β_5 and β_7 capture the influence of exports and sales of the upstream goods, thus representing potential changes in demand. In the case of exports, this influence is relativized by the parameter β_6 for industries that use multinational suppliers more intensively.

The parameter β_9 corresponds to a dummy $noFDI^{Down}$, which is equal to 1 when there is no FDI in the downstream sector and 0 otherwise. Similarly to the upstream model, when using this dummy we will increase the number of observations. Hence, the coefficient on the dummy $noFDI^{Down}$ contains the mean effect on missing foreign presence in the industrial

sector.

The parameters β_{10} and β_{11} allow us to control for the effect of exports and imports in the upstream sector and thus capture changes in demand for intermediate goods, as well as changes in competition within the sector of these goods, which may have additional impact on the downstream sector.

4. Data description

4.1. Geographic and time coverage

Our analysis covers 30 European countries and spans from 2001 - 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 (in alphabetical order): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and 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 European Union in 2004, 2010 and 2015. Hence, the Eastern 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 see the differences between fully developed countries and those who underwent the transition period and/or EU-accession-screening.[6] The comparison of these two groups allows us to draw further conclusions 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. We link this database with information from the UN COMTRADE, respectively from the BACI database.[7]

[6] Estrin and Uvalić (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).

[7] The BACI dataset is developed by the CEPII (Gauilier and Zignago, 2010); it is constructed using

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.[8] Specifically, we use aggregated I-O tables for EU27 or EA17 countries[9] , since they are available from EUROSTAT for the whole period under research. These tables allow us to construct a matrix with coefficients representing the share of output supplied to different downstream industries, which will be used for definition of variables used in our analysis in a way that we describe later.

The I-O tables are available in two different NACE revisions – revision 1.1 for 2001-2007 and revision 2 for 2008-2013.[10] 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.[11] 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.

The only technical problem is that the BACI database is coded under the SITC

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.

[8] These are *naio_agg__60* and *naio_agg_60_r2* files accessible from http://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_P21JlHPgZkWW&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=3

[9] The EU27 covers the whole European Union and is used for Eastern countries. The EA17 table covers the Euro area countries and is used for Western countries.

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

[11] These correspondence tables display *n*-to-*n* relations, and hence we collapse several industries together, following the structure of Eurostat I-O tables.

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. 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.[12] 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. However the final assembly and verification of all corresponding links (in a table of some 4000 rows) was done manually; 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. In the main specification we use logarithmic transformation and ratios, and hence the interpretation of our empirical models is independent of currencies and units used.

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 intermediary goods (upstream sector), and 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 intermediary 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 intermediary goods and we link them to their corresponding downstream sectors to which they supply.

One of the most important tools for this construction is the input-output matrix $\boldsymbol{A}_t$,

[12] http: //unstats.un.org/unsd/cr/registry/regot.asp?Lg=1

[13] Let us note that correspondence provided in the Appendix depicts the main associations, since we were linking SITC goods at five or four digits level. In the table presented in the Appendix, 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.

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). The matrix $\boldsymbol{A}_t$ is used for the construction of variables in the downstream analysis (Section 4.2), while in 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 the Appendix Tables A1 and A2, respectively. Both tables also contain precise information on the sources and units used.

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 all variables are provided in Table 1.

Table 1. Descriptive statistics
Descriptive statistics of the variable FDI in the upstream and downstream sectors.

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

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 (2). Recall that the structure of the error term in specification (2) is $\vartheta_{it} = \alpha_i + \eta_t + \varepsilon_{it}$, where α_i captures interacting country-industry specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term. In this case, the interacting country-industry specific fixed effect denotes specific industry sector *i* in an individual country from within Western or Eastern countries. Thus, in this setting, the countries are assumed to represent separate markets within the specific industry.[14]

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, individual country and time specific fixed effects. In this case, the structure of the error term (ϑ_{it}) in specification (2) is slightly modified as $\vartheta_{it} = \theta_i + \delta_j + \eta_t + \varepsilon_{it}$, where θ_i is the industry specific fixed effect, δ_j is an individual country specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term. In this modification, individual countries from within Western or Eastern countries are assumed to behave as common markets for specific industries. We present the results for this specification in Appendix Tables A3 and A4 for Western and Eastern European countries, respectively.[15] There is, of course, a question as to which of the two specifications (separate markets or a common market) reflects reality in a better way. Within the EU, there are no

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

[15] 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.

legally-based trade barriers between countries. However, countries are still more or less geographically distant and consumers may still have specific local preferences. This is why we believe that the reality lies in fact somewhere in between our two specifications and therefore we estimate and present both of 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^{Up} .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)
$ln(Imports^{Up})$	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)
$ln(Imports^{Up})$. 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)
$ln(Exports^{Up})$	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)
$ln(Exports^{Up})^c$ 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)
$ln(FSales^{Up})$	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)
$noFDI^{Up}$	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)		5,903	5,903	3,780	3,780	2,123	2,123

Note: 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. Dependent variable is $ln(DSales^{Up})$, logarithm of sales of the domestic companies in 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)
$FDI^{Up\ c}\ FDI^{Down}$	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)
$ln(Imports^{Up})$	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)
$ln(Imports^{Up})^c\ FDI^{Down}$	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)
$ln(Exports^{Up})$	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)
$ln(Exports^{Up})^c\ FDI^{Down}$	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)
$ln(FSales^{Up})$	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)
$noFDI^{Up}$	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

Note: 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. Dependent variable is $ln(DSales^{Up})$, logarithm of sales of the domestic companies in 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 (2) is quite rich, and we report results separately for two groups of countries based on two sets of estimates, we facilitate presentation and interpretation of our results in the following text by including coefficients' symbols and table numbers. Our results below are discussed using the five main channels through which FDI affects sales in the

downstream industry (see Section 3.1).

First, we do not find evidence for a pure spillover effect (β_1) due to the lack of statistical significance for both Western and Eastern countries (Tables 2 and 3). In our modified estimation, no evidence is available for the Western countries (Table A3) and the effect is even negative for the Eastern countries during the pre-crisis period (Table A4). 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.

The second channel through which downstream FDI affects the position of domestic suppliers of intermediary goods is the change in sourcing patterns, where these domestic firms are potentially replaced by MNEs entering the upstream industry. The interaction between downstream and upstream FDI (β_2) should be negative – in such a case the FDI in downstream industries attracts FDI to upstream industries, which then crowds-out domestic firms. This effect is clearly visible in our results and is consistent for both Western and Eastern countries, before and after the crisis, as well as for both types of estimation. The effect is particularly strong in the pre-crisis period.

The third channel through which downstream FDI affects the position of domestic suppliers of intermediary goods is a change in sourcing patterns resulting in a situation where domestic suppliers may be replaced by imports of upstream goods. This effect is captured by the interaction term between downstream FDI and upstream imports (β_4), whose coefficient is indeed consistently negative for both types of estimation and is strongest in the pre-crisis period. Unfortunately, the effect is statistically significant only for Western countries in the modified estimation (Table A3). However, we believe that the loss of significance for the Eastern countries is purely due to inflated standard errors, since the magnitude of the coefficient is very similar for both groups. [16] We can thus conclude that downstream FDI indeed attracts more imports of intermediary goods. However, the evidence of this mechanism being harmful for domestic producers is weaker than in the case of FDI attracted upstream.

[16] Note also that we observe relatively often an effect that is insignificant in our main estimation (separate markets) and becomes significant in our auxiliary estimation (common market), while being of a comparable magnitude. This signals that in our main specification, standard errors tend to be relatively larger, which is not surprising, since, by its construction, the main specification contains many more fixed effect dummies, taking a larger portion of the overall variation.

The fourth channel through which downstream FDI affects the position of domestic suppliers of intermediary goods is enhanced exports of these goods; the effect is captured by the interaction between downstream FDI and upstream exports (β_6). The enhanced exports may be 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 to target new foreign markets when a domestic market shrinks after domestic producers are crowded-out by MNEs and by importers. Our main estimation yields statistically insignificant coefficients (Tables 2 and 3). However, we do find statistically significant evidence of this effect for Western countries in our modified estimation (Table A3). Further, for Eastern countries we see a positive effect of similar magnitude, whose significance is undermined by inflated standard errors (Table A4).

The fifth and last channel through which downstream FDI affects the position of domestic suppliers of intermediary goods is that it boosts production in the corresponding sector, and more intermediary goods are demanded. Such a scenario is based on two priors. First, the presence of MNEs in a sector boosts the production in this 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 (Tables 2, 3, A3, and A4). 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). This indicates that MNEs enter sectors in which there is potential for larger sales. An important implication is that even if MNEs crowd out domestic producers, 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 (Tables 3 and A4). A higher presence of FDI in the new-EU than in the old-EU, and the and corresponding ownership effects on firms' performance documented in Hanousek et al. (2015) are likely factors behind the above results.

Our results also shed light on the issue of export, or rather trade-related, spillovers. We show that increasing exports of upstream goods (β_5) are linked to increased production of domestic suppliers of these goods when we consider the modified estimation (Tables A3 and A4), but not when we consider our main panel estimation (Tables 2 and 3). The difference hints that increased production of domestic suppliers of upstream goods is responsive to production-trade developments in a specific industry across countries (Tables A3 and A4)

rather than to direct production-trade links within each country (Tables 2 and 3).

Finally, across both country groups and types of estimation, we see a negative coefficient on upstream sales by foreign firms (β_8) but a positive coefficient on imports of these goods (β_3). This indicates that domestic producers are, in general, competing with MNEs in their industry. However, imported goods seem to be rather complements – they may indicate an increased demand for the overall production of the sector that is covered both by domestic producers and by importers. The result may also explain why imports induced by downstream FDI are much less harmful than those attracted by the MNEs in the upstream sector.

5.2. Results for downstream analysis

In this section, we present the results of our complementary specification (3) 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 to Section 5.1, we report results separately for Western and Eastern European countries, based on two sets of estimates.

Table 4. 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} c FDI^{Down}	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)
$ln(Imports^{Down})$	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)
$ln(Imports^{Down})^c$ 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)
$ln(Exports^{Down})$	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)
$ln(Exports^{Down})^c$ 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)
$ln(FSales^{Down})$	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)
$noFDI^{Down}$	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)
$ln(Imports^{Upn})$	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)		5,891	5,891	3,791	3,791	2,100	2,100

Note: The estimation is based on the specification (3), 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. Dependent variable is $ln(DSales^{Down})$, logarithm of sales of the domestic companies in 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 5. 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} [c] FDI^{Down}	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)
$ln(Imports^{Down})$	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)
$ln(Imports^{Down})^c$ 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)
$ln(Exports^{Down})$	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)
$ln(Exports^{Down})^c$ 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)
$ln(FSales^{Down})$	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)
$noFDI^{Down}$	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)
$ln(Imports^{Upn})$	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)		4,003	4,003	2,572	2,572	1,431	1,431

Note: The estimation is based on the specification (3), 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. Dependent variable is $ln(DSales^{Down})$, logarithm of sales of the domestic companies in 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 (3) and are reported in Tables 4 and 5. Recall that the structure of the error term in specification (3) is $\vartheta_{it} = \alpha_i + \eta_t + \varepsilon_{it}$, where α_i captures the interacting country-industry specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term. In this case, the

interacting country-industry specific fixed effect denotes the specific industry sector *i* in an individual country from within Western or Eastern countries. Thus, in this setting, the countries are assumed to represent separate markets within the specific industry.[17] In addition to our key results, we also report results based on a modified estimation that serves as an extension and robustness check: in this case the individual countries from within Western or Eastern countries are assumed to behave as a common market for a specific industry (Appendix Tables A5 and A6). Recall that this is enabled by modification to specification (3) where the structure of the error term (ϑ_{it}) is slightly modified as $\vartheta_{it} = \theta_i + \delta_j + \eta_t + \varepsilon_{it}$, where θ_i is the industry specific fixed effect, δ_j is an individual country specific fixed effect, η_t is the time specific fixed effect and ε_{it} is the idiosyncratic error term. Each table has three column sections (the whole period from 2001-2013, and the pre- and post-crisis periods). The coefficient's symbols and table numbers are included in the text whenever they ease access to interpretation of our results.

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 4 and 5).

We find a weak positive pure spillover effect (β_1) in the post-crisis period in Eastern countries (Table 5). The result indicates that within a given country and industry, domestic firms may benefit in difficult times from multinational suppliers by increasing their own efficiency. However, given the negative sign of the coefficient on interaction between upstream and downstream FDI (β_2), the positive pure spillover effect (β_1) becomes relativized if the domestic downstream firms operate in sectors that are also characterized by increased FDI levels. This can be due to the fact that vertical interactions happen primarily between MNEs themselves. Interestingly, we see a very different pattern in Western countries, where, in the pre-crisis period, the coefficient on interaction between upstream and downstream FDI is significantly positive (β_2; Table 4). This finding indicates that in developed markets, and at least during economic stability, domestic firms manage to benefit from vertical interactions

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

between MNEs.

Another interesting result is the impact of imports (β_3), which should represent a competition factor, though for Eastern countries, we do not observe such a competition effect (Table 5). On the contrary, at least in pre-crisis times, imports seem to be rather complementary to domestic production of downstream goods and this statement is not affected by the activity of MNEs (β_4). For Western countries, the competition effect is more pronounced in a complementary estimation where industries are considered across countries and, in the pre-crisis period, the effect is even stronger for downstream industries with higher FDI presence (β_4; Table A5). When we consider the industry-country specific units, then the complementarity of imports also appears, even in Western countries (Table 4).

The competition effect of foreign sales within the industry (β_8) is clearly negative across time periods, groups of countries, and types of estimation. On the other hand, the effect of upstream sales (β_7) is inconclusive and mostly insignificant. The exception is the outcome of the country-industry specific estimation for Eastern countries, where we observe a very weak negative relation between upstream sales and sales of downstream domestic producers (Table 5).

The coefficient on downstream exports (β_5) is positive overall; it is mostly statistically insignificant in the main estimation (Tables 5 and 6) but statistically significant in an alternative one (Tables A5 and A6). A positive coefficient is something we could expect, since it captures at least partially the effect of growing demand for consumer goods. For Western countries, this positive effect gets more pronounced in the pre-crisis period (Tables 4 and A5) and weakens in the post-crisis period (Tables 5 and A6) 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. In Eastern countries, where such competition is likely to be even fiercer for domestic producers, we see that upstream FDI (β_6) reduces the positive effect of total exports on sales by domestic producers across both time periods, even though in most specifications, we fail to find this effect to be significant (Tables 5 and A6).

Finally, we should add that the coefficient of the dummy indicating no-FDI-presence in the downstream sector (β_9) is always negative. Interpretation is similar to that in the upstream

analysis (Section 5.1): the production of domestic firms is higher only in sectors where MNEs operate. Hence, MNEs enter the sectors in which there is potential for larger sales, and even if they crowd out domestic producers, the overall sales of the sector increase. This result is not surprising because all sectors can be downstream or upstream. This means that all variables that characterize within-industry linkages should have the same influence in both the upstream and downstream analyses.

6. Conclusion

In this paper we provide a comprehensive analysis of the impact of MNEs and FDIs on domestic firms. Our framework covers both upstream and downstream directions through which the impacts materialize. We modify the theoretical model of Markusen and Venables (1999) to also capture international industrial-trade linkages. Based on the model, we identify five basic channels how the FDIs potentially affect domestic suppliers. We then empirically analyze the impact of MNEs and FDIs in a unique database that covers 30 European countries from 2001 to 2013. The database is constructed from the Amadeus, Eurostat, UN Comtrade and BACI data sources and provides a rich source of production-trade linkages within our framework.

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. Therefore, on a more detailed level we show that a MNE's presence, via its FDI, has a significant effect on domestic firms in the upstream sectors, both in terms of changing market structure and productivity improvements.

Further, 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 intermediary 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 intermediary goods, which are preferred by MNE's customers and substitute the domestic production. In Eastern European countries, this

substitution effect is further intensified by increased competition with importers. On the other hand however, those domestic firms that are able to withstand this double competition receive additional benefits stemming from their interaction with downstream MNEs in the form of productivity spillovers.

We also document the existence of trade (export) spillovers for both upstream and downstream levels. We show that increasing exports of upstream goods are also linked to increased production of 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 intermediary 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. However, the existence of positive production and trade spillovers is overwhelming. Those spillovers are also indirectly in line with the related offshoring activities within Europe as documented in Frensch et al. (2016).

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Appendix

Table A1. Definition of variables for upstream analysis

Variable	*Definition*	*Formula*	*Units*	*Source*
$Sales^{Up}$	Sales in the upstream industry analyzed, i.e., sales of intermediary goods. Computed as sum of sales of all firms operating in the industry.	$Sales_{it}^{Up} = \sum_{j=1}^{N_{it}} Sales_{ijt}$	Millions of EUR	Amadeus
$FSales^{Up}$	Share of $Sales^{Up}$ due to foreign firms only.	$FSales_{it}^{Up} = \sum_{j=1}^{N_{it}} F_{ijt} Sales_{ijt}$,	Millions of EUR	Amadeus
$DSales^{Up}$	Share of $Sales^{Up}$ due to domestic firms only.	$DSales_{it}^{Up} = Sales_{it}^{Up} - FSales_{it}^{Up}$	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 $\boldsymbol{Sales}^{Down}$ representing All downstream industries) $\boldsymbol{Sales}_t^{Down} = \boldsymbol{A_t} \times \boldsymbol{Sales}_t^{Up}$	Millions of EUR	Amadeus Eurostat (I-O tables)
FDI^{Up}	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	$FDI_{it}^{Up} = \frac{FSales_{it}^{Up}}{Sales_{it}^{Up}}$	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 $\boldsymbol{FDI}^{Down}$ representing All downstream industries) $\boldsymbol{FDI}_t^{Down} = \boldsymbol{A_t} \times \boldsymbol{FDI}_t^{Up}$	Ratio (0 to 1)	Amadeus Eurostat (I-O tables)

Table A1. Definition of variables for upstream analysis (continued)

Variable	*Definition*	*Formula*	*Units*	*Source*
$Exports^{Up}$	Exports from the upstream industry studied summed over All trade partners.	$Exports_{it}^{Up} = \sum_{k=1}^{K_{it}} Exports_{ikt}$	Thousands of USD	BACI
$Exports^{Down}$	Exports form 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 $\boldsymbol{Exports}^{Down}$ representing All downstream industries) $\boldsymbol{Exports}_t^{Down} = \boldsymbol{A_t} \times \boldsymbol{Exports}_t^{Up}$	Thousands of USD	BACI
$Imports^{Up}$	Imports to the upstream industry studied, summed over All trade partners.	$Imports_{it}^{Up} = \sum_{l=1}^{L_{it}} Imports_{ilt}$	Thousands of USD	BACI
$Imports^{Down}$	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 $\boldsymbol{Imports}^{Down}$ representing All downstream industries) $\boldsymbol{Imports}_t^{Down} = \boldsymbol{A_t} \times \boldsymbol{Imports}_t^{Up}$	Thousands of USD	BACI

Notes

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

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

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

Table A2. Definition of variables for downstream analysis

Variable	*Definition*	*Formula*	*Units*	*Source*
$Sales^{Down}$	Sales in the downstream industry analyzed, i.e., sales of final goods. Computed as sum of sales of All firms operating in the industry.	$Sales_{it}^{Down} = \sum_{j=1}^{N_{it}} Sales_{ijt}$	Millions of EUR	Amadeus
$FSales^{Down}$	Share of $Sales^{Down}$ due to foreign firms only.	$FSales_{it}^{Down} = \sum_{j=1}^{N_{it}} F_{ijt} Sales_{ijt}$,	Millions of EUR	Amadeus
$DSales^{Down}$	Share of $Sales^{Down}$ due to domestic firms only.	$DSales_{it}^{Down} = Sales_{it}^{Down} - FSales_{it}^{Down}$	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 $\boldsymbol{Sales}^{Up}$ representing All downstream industries) $\boldsymbol{Sales}_t^{Up} = \boldsymbol{A}_t^{\boldsymbol{T}} \times \boldsymbol{Sales}_t^{Down}$	Millions of EUR	Amadeus Eurostat (I-O tables)
FDI^{Down}	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	$FDI_{it}^{Down} = \frac{FSales_{it}^{Down}}{Sales_{it}^{Down}}$	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 $\boldsymbol{FDI}^{Up}$ representing All downstream industries) $\boldsymbol{FDI}_t^{Up} = \boldsymbol{A}_t^{\boldsymbol{T}} \times \boldsymbol{FDI}_t^{Down}$	Ratio (0 to 1)	Amadeus Eurostat (I-O tables)

Table A2. Definition of variables for downstream analysis (continued)

Variable	*Definition*	*Formula*	*Units*	*Source*
$Exports^{Down}$	Exports from the upstream industry studied, summed over All trade partners.	$Exports_{it}^{Down} = \sum_{k=1}^{K_{it}} Exports_{ikt}$	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 $\boldsymbol{Exports}^{Down}$ representing All downstream industries) $\boldsymbol{Exports}_t^{Up} = \boldsymbol{A}_t^{\boldsymbol{T}} \times \boldsymbol{Exports}_t^{Down}$	Thousands of USD	BACI
$Imports^{Down}$	Imports to the upstream industry studied, summed over All trade partners.	$Imports_{it}^{Down} = \sum_{l=1}^{L_{it}} Imports_{ilt}$	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 $\boldsymbol{Imports}^{Up}$ representing All downstream industries) $\boldsymbol{Imports}_t^{Up} = \boldsymbol{A}_t \times \boldsymbol{Imports}_t^{Down}$	Thousands of USD	BACI

Notes

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

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

$Sales_{ijt}$ ... sales of firm *j* in sector *i*, year *t*
$Exports_{ilt}$ ... exports from industry *i* to country *k* in year *t*
$Imports_{ilt}$ ... imports in industry *i* 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^{Up} . 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)
$ln(Imports^{Up})$	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)
$ln(Imports^{Up}).FDI^{Down}$	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)
$ln(Exports^{Up})$	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)
$ln(Exports^{Up}). FDI^{Down}$	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)
$ln(FSales^{Up})$	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)
$noFDI^{Up}$	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		5,903	5,903	3,780	3,780	2,123	2,123

Note: 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. Dependent variable is $ln(DSales^{Up})$, logarithm of sales of the domestic companies in 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^{Up} . 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)
$ln(Imports^{Up})$	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)
$ln(Imports^{Up}).FDI^{Down}$	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)
$ln(Exports^{Up})$	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)
$ln(Exports^{Up}). FDI^{Down}$	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)
$ln(FSales^{Up})$	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)
$noFDI^{Up}$	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

Note: The estimation is based on the specification (2), 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. Dependent variable is $ln(DSales^{Up})$, logarithm of sales of the domestic companies in 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^{Down}	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)
$ln(Imports^{Down})$	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)
$ln(Imports^{Down}).FDI^{Up}$	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)
$ln(Exports^{Down})$	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)
$ln(Exports^{Down})$. 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)
$ln(FSales^{Down})$	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)
$noFDI^{Down}$	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)
$ln(Imports^{Upn})$	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

Note: The estimation is based on the specification (3) 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. Dependent variable is $ln(DSales^{Down})$, logarithm of sales of the domestic companies in 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.

		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} c FDI^{Down}	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)
$ln(Imports^{Down})$	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)
$ln(Imports^{Down}).\ FDI^{Up}$	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)
$ln(Exports^{Down})$	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)
$ln(Exports^{Down}).FDI^{Up}$	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)
$ln(FSales^{Down})$	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)
$noFDI^{Down}$	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)
$ln(Imports^{Upn})$	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

Note: The estimation is based on the specification (3) 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. Dependent variable is $ln(DSales^{Down})$, logarithm of sales of the domestic companies in downstream sector. [a], [b] and [c] denote significance at the 1%, 5%, and 10% levels, respectively. Heteroscedasticity consistent standard errors are presented in parentheses.

Abstrakt

Analyzujeme dopad nadnárodních podniků (prostřednictvím přímých zahraničních investic do domácích firem) ve 30 evropských hostitelských ekonomikách v letech 2001 až 2013. Do standardního teoretického rámce zahrnujeme mezinárodní průmyslové a obchodní vazby a testujeme je empiricky na jedinečném datovém souboru sestaveném z datových zdrojů Amadeus, Eurostat, UN Comtrade a BACI. Při kontrole horizontálních, vertikálních a exportních kanálů v dodavatelských a odběratelských sektorech ukazujeme, že přítomnost nadnárodních společností významně ovlivňuje domácí firmy, a to jak z hlediska změny struktury trhu, tak z hlediska zvýšení produktivity. Dopad není vždy pozitivní, neboť domácí firmy jsou často vytlačované z trhu zahraničními firmami. Ty firmy, které odolávají takové dvojí konkurenci, však dostávají další výhody vyplývající z obchodních (exportních) efektů. V našem komplexním modelu jsme nenalezli významné (pozitivní) interakce domácích firem s horizontálními MNE, což by naznačovalo žádoucí zvýšení produktivity.

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