Climbing the Rungs of the Quality Ladder: FDI and Domestic Exporters in Romania

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Abstract

This paper argues that inflows of foreign direct investment can facilitate export upgrading in host countries. Using customs data merged with firm-level information for 2005-2011, it shows a positive relationship between the quality of products exported by Romanian firms and the presence of multinational enterprises (MNEs) in the downstream (input-sourcing) and upstream (input-supplying) sectors. These conclusions hold when the product quality is proxied with unit values and when it is estimated following the approach of Khandelwal et al. (2013). At the same time, MNE presence does not appear to have any positive impact on the export product portfolio, the number of destinations or their average income level.

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1 Introduction

Economic growth is positively correlated with the sophistication and the quality of the export structure at the country level (Hausmann et al., 2007; Hidalgo and Hausmann, 2009). From an individual firm's perspective, reaching a certain quality threshold is a precondition for successful exporting (Brooks, 2006; Verhoogen, 2008; Hallak and Sivadasan, 2013; Sutton, 2012; Iacovone and Javorcik, 2012), which, in turn, may open doors to learning from exporting (De Loecker, 2007; Van Biesebroeck, 2005; Atkin et al., 2017). Given the positive link between export quality and economic prosperity, it is not surprising that upgrading of the industrial structure in general, and of the export structure in particular, is a major objective of industrial policies in countries around the world. This is particularly true in countries trying to escape the "middle income trap".[1]

This paper argues that export upgrading can be facilitated by inflows of foreign direct investment (FDI). More specifically, we document a positive relationship between the quality of products exported by local firms and the presence of multinational enterprises (MNEs) in the downstream (input-sourcing) and upstream (input-supplying) sectors, where the quality is captured using unit values and the approach used by Khandelwal et al. (2013). Our evidence comes from Romania, a middle-income country in Eastern Europe.

MNEs play a central role in the global value chains. Their know-how, technology and marketing prowess represent a powerful source of knowledge for indigenous firms in countries where MNEs establish their affiliates. Thus MNE presence can facilitate performance improvements in indigenous firms. This could happen through a number of channels. First, in their quest for cheaper and higher quality inputs, MNEs may provide their local suppliers with expertise, training and incentives for quality improvements, and possibly even cooperate on development of new and higher quality products. Many MNEs subject their potential suppliers to technical audits and require improvements in performance or product quality as a pre-condition for receiving a contract. The resulting product upgrading and improved performance may then be reflected not only in the domestic firms' sales to the MNEs but also in the local firms' exports.[2]

[1] For instance, the South African National Industrial Policy Framework states: "Given the competitiveness squeeze that South African industry finds itself in, industrial upgrading is a logical progression in order to avoid cut-throat price competition as certain parts of manufacturing are becoming increasingly commoditised, particularly due to a combination of global trade liberalisation and pressure from Chinese and Indian firms in particular." The Comprehensive National Industrial Strategy of the Philippines mentions: "Upgrading and transforming industries would enable the movement of workers from the informal to the formal sector, as well as from low-value added activities to high-value added activities where wages and compensation are much higher" (Republic of the Philippines, 2016).

[2] There is substantial anecdotal evidence suggesting that these effects take place. A survey among Czech man-

Second, the presence of foreign firms in the upstream industries may provide indigenous producers with more diverse and higher quality intermediates and capital goods and in this way allow them to increase their productivity, upgrade the quality of their products and broaden or upgrade their product range. For instance, Javorcik et al. (2008) report that small Mexican producers meet with their input suppliers (usually foreign affiliates) every six months to learn about the possibilities of upgrading their products. Suppliers provide the necessary inputs and often prepare a new formula for the product based on these inputs.[3]

Finally, domestic firms may learn from MNEs operating in the same industry. Either by observing the foreign firms or through hiring former MNE employees, they may learn about procedures which improve the quality and standardization of their products, their marketing skills and reliability of their shipments.[4] Domestic firms may also learn about the profitability of various export opportunities by observing their foreign peers' exports, and this knowledge may persuade them to make investments into quality upgrading, developing new products or even moving to different broad product categories.[5]

Our analysis focuses on Romania — a manufacturing-intensive economy in Eastern Europe — at the time of massive inflows of FDI linked to its accession to the European Union. We draw on an annual panel of Romanian firms matched with detailed customs data recording Romanian exports at the level of the firm, 8-digit HS (Harmonized System) product classification, destination country

ufacturing firms analysed by Javorcik (2008) shows that 40% of domestic suppliers receive some kind of assistance from their MNE customers, including personnel training (19%), provision of inputs (10%), help with quality assurance (10%) and help with finding export opportunities (7%). Even more remarkably, 50% of domestic firms selling to MNEs report they have had to improve product quality in order to become suppliers. Furthermore, Javorcik et al. (forthcoming) show that presence of MNEs stimulates domestic firms in the supplying sectors to introduce more complex products where complexity is measured using an indicator due to Hidalgo and Hausmann (2009).

[3] Amiti and Konings (2007), Bas and Strauss-Kahn (2015) and Goldberg et al. (2010a) provide evidence on the importance of access to diverse and high quality inputs for productivity, export quality and product scope, respectively.

[4] Though, this may be the weakest of the three channels discussed, given the mixed evidence on the link between FDI inflows and productivity of domestic firms in the same industry (see Haskel et al. (2007) and Keller and Yeaple (2009) who find positive effects and Aitken and Harrison (1999), Javorcik (2004), Javorcik and Spatareanu (2008, 2011) who fail to do so). A new generation of studies uses matched employer-employee data to provide evidence consistent with knowledge spillovers through labour mobility (see Poole (2013) and Balsvik (2011)).

[5] Aitken et al. (1997) demonstrate that the presence of exporting MNEs in the same region reduces the costs of exporting for Mexican firms. Using detailed Chinese trade statistics, Chen and Swenson (2007) find that the MNE presence is associated with more and higher unit value trade transactions by Chinese firms in the same sector, while Swenson (2008) shows that it stimulate new export connections by Chinese exporters. Using cross-country data, Harding and Javorcik (2012) find that sectors targeted by national investment promotion efforts tend to subsequently increase the unit values of exports.

and year. We focus on the period 2005-2011, which is determined by the data availability.

We measure 'product upgrading' — within-product improvements in export quality — in two ways: (i) we apply the approach of Khandelwal et al. (2013) which builds on the work of Khandelwal (2010); and (ii) we focus on unit values of exports.[6]

Our empirical strategy follows the literature on FDI spillovers (Javorcik, 2004) and relies on the assumption that domestic firms are more likely to supply MNEs when foreign firms account for a larger share of output in their downstream industries, i.e., the industries to which they sell inputs. Similarly, we assume that domestic firms are more likely to buy inputs from MNEs if MNEs account for a larger share of the domestically sold output in the upstream industries, i.e., the industries from which the domestic firms source inputs, according to the Romanian input-output tables. Finally, we expect the effect of foreign presence on domestic firms in the same sector to increase with the MNE share in the sectoral output. In our preferred specification, we relate increases in export product quality (expressed as first or longer differences) to the lagged proxies for FDI spillovers. This allows us to difference out time-invariant unobservables specific to a particular firm exporting a particular product to a particular destination. We control for region-year unobservables and industry-region-specific trends. Thus our results are identified based on industry-specific variation observed over time that cannot be captured by linear trends and is not driven by broad regional factors.[7]

Our results show a positive relationship between the within-product quality upgrading in goods exported by Romanian firms and the increased presence of MNEs in downstream (input-sourcing) and upstream (input-supplying) manufacturing industries. This result holds for both measures of quality and is robust across a number of specifications. Moreover, it does not seem to be driven by reverse causality, by multicollinearity among the measures of MNE presence or by third factors such as international demand for particular products, demand in downstream sectors or exporter entry and exit. The estimated coefficients are not only statistically significant, but also economically meaningful. They suggest that the average increase in the foreign presence in downstream industries observed over the period studied translates into a 13-15% increase in the quality of domestic firms' exports. The foreign presence in the upstream sector is associated with a smaller effect of about

[6]Despite their shortcomings, export unit values have been extensively used as a proxy for quality, see, for example, Schott (2004); Hallak (2006); Bas and Strauss-Kahn (2015).

[7] While we are unable to pin down the exact source of this variation, it is likely to be driven by idiosyncratic location decisions by MNEs made against the background of broad trends such as Romania's EU entry, the economic crisis and the government policy in Romania and in countries with which Romania competes for FDI.

4%. The impact of MNEs in the input-sourcing sectors is higher if MNEs are located in the same region as the domestic firms, suggesting that geographic proximity facilitates interactions. The geographic dimension does not matter in the case of MNEs in the input-supplying sectors, which suggests that the knowledge passed to Romanian buyers is embodied in products and thus the need for interactions is not as large.

Additionally, we explore the impact of foreign presence on unit values of imports, based on the idea that higher quality exports require higher quality imports (Manova and Zhang, 2012; Bas and Strauss-Kahn, 2015). As expected, we find that presence of MNEs in downstream and upstream sectors is positively correlated with the demand for higher quality imports. Further, we ask if firms likely to interact with MNEs change their product mix and move towards products that are more skill-, R&D- and advertising-intensive. We also examine the link between MNE presence and the extensive margin of exports. We find no indication of FDI inflows leading to upgrading in the portfolio of exported products. There is no statistically significant relationship between FDI inflows and the number of products exported or their R&D and advertising intensity. Skill intensity of the export product portfolio is negatively correlated with the presence of MNE is downstream sectors, which is suggestive of foreign affiliates primarily sourcing (and thus boosting production and exports of) unskilled-labor intensive products in Romania. There is no statistically significant link between the number of destinations or their average income level and the MNE presence.

In sum, our results suggest that interactions with MNEs in downstream and upstream industries do not affect *what* local firms do but *how* they do it. Our findings are in line with the view that MNEs pass onto their local suppliers and customers knowledge and know-how about standards and procedures needed for producing products of consistently high quality, but they do not fundamentally change the production structure itself. In that sense, MNEs do not act as vehicles for structural change. Our results also reconcile the common finding that access to diverse and high-quality inputs is important for firm performance (e.g., Amiti and Konings (2007); Goldberg et al. (2010a) and Manova and Zhang (2012)) with the quantitatively limited effect of upstream FDI on productivity typically found in the spillovers literature (see survey by Havranek and Irsova (2011)). They indicate that while the effect of upstream FDI on productivity may be small, it has a sizeable effect on the quality of exported products.

This paper is structured as follows. The next section introduces the context of the study, giving a brief overview of trends in FDI and exports in Romania in the period considered. The data and the empirical strategy are described in Section 3. Section 4 discusses the results. Finally, Section 5 concludes.

2 FDI and exports in Romania

Romania is an interesting country for studying the effect of FDI on manufacturing firms for at least three reasons. First, manufacturing plays a comparatively large role in the Romanian economy. In fact, the share of manufacturing value added in Romanian GDP in 2004 (the last year available in the World Development Indicators) was at 30% the largest in the EU, 5 percentage points ahead of the second largest figure found in the Czech Republic.

Second, Romania entered the European Union in 2007, and its entry was accompanied by the highest inflows of FDI in the country's modern history. Appendix Table B.1 shows the evolution of FDI inflows for ten post-communist members of the EU for years 2003-2012. Between 2004 and 2008 the average annual FDI inflows amounted to over 7% of Romanian GDP. Our data cover most of the high-inflow period as well as the crisis years 2009 and 2010, when the FDI inflows fell below 3% of GDP. The only two countries in the region with higher proportional FDI inflows in the studied period are Estonia and another EU entrant from 2007, Bulgaria.

A substantial part of FDI inflows entered the manufacturing sector. This is reflected in Columns 2 and 3 of Table 1, which summarizes the share of output due to foreign-owned firms in 58 manufacturing industries during our sample period. In line with the aggregate data, the average share of output due to foreign firms increased from 55% in 2005 to 63% in 2010. Seventeen of 58 manufacturing industries in our sample saw an increase of foreign output share of more than 10 percentage points. As illustrated in Figure B.1 in the appendix, the increase was largest for computers and office machinery (79 percentage points), other chemicals (52), agricultural machinery (39), foundry (34) and basic chemicals (32). Large industries with a significant increase in foreign presence included electric machinery (18), textiles (15) and metal structures and products (14). The only industry with a large decrease in foreign presence was stone processing, representing less than 0.1% of the aggregate manufacturing output. For the evolution of foreign presence in individual sectors, see Figure B.2 in the appendix.

The third reason for Romania being an interesting case to study is that with the GDP per capita (adjusted for the purchasing power parity) at only 36% of the EU average in 2005, it had a large potential for improvement of its manufacturing performance. Figure 1 displays unit values of Romanian exports relative to unit values of exports by the 15 old members of the EU (EU15). The relative unit values are shown separately for exports by foreign-owned and domestic Romanian producers. The figure shows that in 2006 domestic exporters in a median Romanian industry exported at less than 75% of unit values seen in EU15 countries. The gap was substantial also for

Table 1: Share of output due to foreign-owned firms (%)

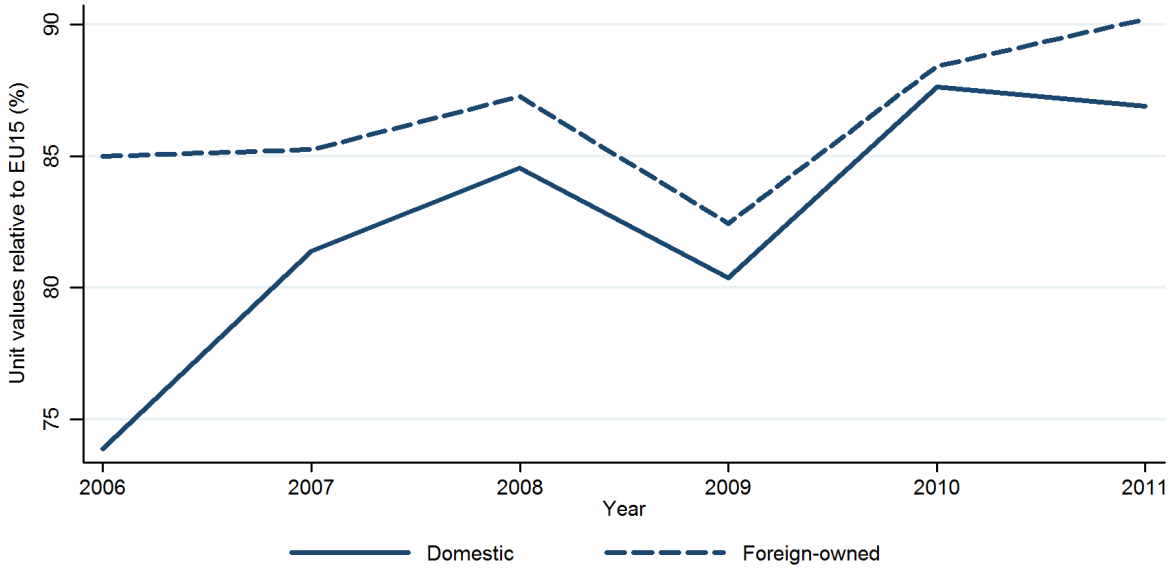
		Own FDI		Downstream FDI		Upstream FDI	
Year	Industries	Mean	SD	Mean	SD	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2005	58	55.2	27.0	56.1	15.0	54.4	13.2
2006	58	54.7	26.3	56.0	15.7	53.3	13.4
2007	58	57.4	24.9	57.3	14.7	55.9	12.3
2008	58	58.8	24.3	59.1	14.4	57.6	12.8
2009	58	61.1	24.3	61.6	13.9	59.0	12.7
2010	58	62.5	24.1	62.3	13.7	60.9	12.3

Downstream and upstream FDI output shares are defined based on equations (1) and (2) in Section 3. SD stands for standard deviation.

foreign-owned exporters, with unit values at 85% of the EU15 level. But Romania was catching up. Between 2006 and 2011, the relative unit values increased for both domestic and foreign-owned Romanian exporters. In particular, with a 13-percentage point increase in relative unit values, domestic exporters almost caught up with the foreign-owned ones and erased half of the gap with respect to EU15. Figure B.3 in the appendix shows the 5-year change in the median relative unit values of exports by domestic firms for industries where the change exceeded 10 percentage points in either direction. Important export industries with significant increases in the relative unit values included radio, TV and ICT equipment; wood products; apparel; footwear; and basic chemicals.

To summarize, Romania is an emerging economy with a strong manufacturing focus. In the period under study, it received large FDI inflows, which coincided with a significant increase in the export unit values relative to the EU15. The latter development was particularly pronounced in the case of exports by domestic firms. In the following sections, we examine the connection between the two phenomena.

Figure 1: Unit values relative to EU15



Lines represent medians of relative unit values across 58 manufacturing industries. For each industry, the relative unit values are calculated as the ratio of unit values of exports by domestically owned or foreign-owned Romanian firms to unit values of exports by EU15 countries. Information on Romanian exports comes from Romanian customs data described in Section 3; information on EU15 exports comes from Eurostat. Each product is assigned to the industry with highest number of exporter-destination pairs for that product. Only CN 8-digit products exported by both Romania and EU15 in all years are included.

3 Data and empirical strategy

3.1 Data

Our analysis is based on the rich firm-level data for Romania compiled from two sources. The first source, the Structural Business Statistics (SBS), is available for 2005-2010. It is an annual survey conducted by the Romanian National Statistical Institute among all Romanian firms with at least 20 employees and a subsample of smaller firms. Each firm is sent a questionnaire which it is obliged to fill in. The questionnaire covers the standard variables pertaining to firm's operations, profits and losses. All monetary variables are reported in current Lei. The ownership information collected in the survey allows us to distinguish between purely domestic firms, wholly foreign-owned firms, and firms with mixed ownership. We do not observe the exact ownership shares among the mixed firms. Fortunately, national tax identifiers assigned to individual firms allow us to match our data to the commercial database Amadeus compiled by the Bureau van Dijk. It is possible to match the data for about three quarters of the firms. We follow the standard practice by defining a firm as foreign if the share of foreign ownership exceeds 10%. A vast majority of firms appearing as mixed in the SBS data have foreign ownership above this threshold. Therefore, the mixed ownership cases for which it is not possible to find information in the Amadeus are treated as foreign.

The SBS data are matched with the Romanian customs data for years 2005-2011 using the firm tax identifiers. The customs data contain information on annual exports at the firm-product-destination level. The data cover all exports to countries outside the EU and over 95% of exports to EU member countries. Starting from 2007, when Romania joined the EU, intra-EU exports are not processed at the customs but instead have to be reported to the Intrastat. Firms with annual exports below 900,000 Lei (approx. $250,000) are exempt from the reporting obligation and therefore do not appear in the customs data. Products are defined in terms of the 8-digit EU Combined Nomenclature (CN8), which is based on the 6-digit Harmonized System classification and is further disaggregated with two additional digits. Export values are recorded in current Lei. Besides export values, there are two variables measuring the physical quantity of exports. One measures it in kilograms and the other in supplementary units. Supplementary units may represent pieces, litres, square metres or other units. Where both measures of physical quantity are available, we use supplementary units.[8]

We construct some of our variables with the help of the Romanian input-output tables for 2002 prepared by the National Statistical Institute. They use Lei at current prices as units, and they

[8] See subsection A.1 in the appendix for more details on the construction of unit values.

are defined in terms of the Romanian industrial classification where each manufacturing industry corresponds to one or several 3-digit NACE (rev. 1.1) industries. The SBS data state the 4-digit NACE codes, which allows us to match the firm-level data with the input-output tables. We use words 'industry' and 'sector' as synonyms in our analysis, and we use them to refer to the 58 manufacturing industries as defined in the Romanian industrial classification.[9]

To compare Romanian export unit values to those of EU15 and to control for fluctuations in international prices of individual products, we use EU trade data from Eurostat. They include country-level export flows for each CN8 product in each year.

3.2 Empirical strategy

Our goal is to examine the link between upgrading by Romanian firms and the presence of MNEs in the same, downstream and upstream sectors. Following the literature on FDI spillovers, we measure the presence of foreign firms in an industry (Own FDI) with their share in the total industry output. Let J_{st} denote the set of all manufacturing firms operating in Romania in sector s in year t, f_{jt} a dummy for whether firm j is foreign-owned in year t and Y_{jt} the total output of the firm. Then we define own-sector FDI as

$$OwnFDI_{st} = \frac{\sum_{j \in J_{st}} f_{jt} Y_{jt}}{\sum_{j \in J_{st}} Y_{jt}}.$$

In order to identify vertical spillovers from multinationals in downstream sectors, we rely on the assumption that a domestic firm is more likely to supply multinationals and benefit from vertical spillovers if foreign firms account for a larger share of output in the downstream industries, i.e., industries supplied by the industry of the domestic firm. Define α_{sd} as the share of intermediate inputs supplied by industry s which is sold to downstream industry d, according to the input-output matrix. Define further S as the set of all manufacturing sectors. Then the proxy for downstream FDI is defined as

$$DownstreamFDI_{st} = \sum_{d \in S} \alpha_{sd} OwnFDI_{dt}. \tag{1}$$

Similarly, we proxy for access to inputs produced by MNEs by assuming that a domestic firm is more likely to buy inputs from an MNE if foreign firms account for a larger share of output in the upstream industries, i.e., industries from which the industry of the domestic firm sources inputs. Define α_{us} as the share of the intermediate inputs purchased by industry s from the upstream

[9] See subsection A.2 in the appendix for more details on how we determine the industry affiliation of each firm.

industry u. Define $OwnFDI^*_{st}$ in the same way as $OwnFDI_{st}$ but only counting domestically sold output. Then the upstream FDI is defined as

$$UpstreamFDI_{st} = \sum_{d \in S} \alpha_{us} OwnFDI^*_{ut}. \tag{2}$$

Our analysis relates the presence of foreign firms to product quality of domestic exporters. We measure within-product quality improvements using two complementary approaches. The first approach is to analyse export unit values of narrowly defined products. This is the most common approach used in the literature (see, for example, Schott (2004); Hallak (2006); Bas and Strauss-Kahn (2015)), but it is exposed to the risk that high unit values reflect high markups rather than superior quality. Our second approach uses the methodology of Khandelwal et al. (2013) which builds on the work of Khandelwal (2010).[10] Khandelwal et al. (2013) identify the relationship between quantity and price by assuming specific elasticities of substitution. We use the estimates of Broda and Weinstein (2006) and allow the elasticity of substitution to differ across HS 2-digit product classes.[11] We can then infer quality as the OLS residual $\hat{e}_{ipct}$ from estimating

$$\log q_{ipct} + \sigma_s \log p_{ipct} = \alpha_p + \alpha_{ct} + \sigma_s \alpha_{ct} + e_{ipct} \tag{3}$$

where q_{ipct} and p_{ipct} are the quality and the price, respectively, of exports of product p by firm i to destination country c in year t, σ_s represents elasticity of substitution in industry s, α_p captures time-invariant product characteristics, α_{ct} represents destination-year effects to capture aggregate incomes and price indices in destination countries.[12]

Our baseline empirical specification takes the following form:

$$\begin{aligned} Quality_{ipct} = {} & \beta_1 OwnFDI_{s,t-1} + \beta_2 UpstreamFDI_{s,t-1} + \beta_3 DownstreamFDI_{s,t-1} \\ & + \gamma_{ipc} + \gamma_{rt} + \epsilon_{ipct} \end{aligned} \tag{4}$$

where Quality is proxied using the two measures described above, which vary at the level of the firm, product, export destination and year. The explanatory variables include the lagged proxies for

[10] Khandelwal (2010) combines information on prices and physical quantities to infer quality, based on the insight that ability of an exporter to sell a higher quantity at a given price should imply higher quality.

[11] Fan et al. (2015) also rely on estimates by Broda and Weinstein (2006) aggregated to the HS 2-digit, and, as an alternative approach, they infer quality directly from their data using an instrumental variable approach. They find that both approaches lead to highly similar results.

[12] For more details, see Khandelwal et al. (2013). One difference is that, as they focus only on clothing and textile exports, they assume a homogenous σ. Allowing σ_s to vary across industries necessitates adding the interaction term $\sigma_s \alpha_{ct}$ in equation (3) to capture the fact that the destination price index will have different effects on sales across industries with different elasticities of substitution.

FDI presence in the same, downstream and upstream sectors. The specification controls for firm-product-destination fixed effects, which capture the fact that a kilogram of caviar has a different value than a kilogram of flour. These fixed effects also take into account any time-invariant characteristics specific to firm, product and destination combinations. In addition, the model controls for any effects that are common to all firms in a given region in a particular year.[13]

Although we report the estimates of equation (4) in levels, in most of the subsequent analysis we estimate specifications in differences, as in equation (5). Estimation in differences not only controls for the same time-invariant firm-product-destination characteristics as the specification in levels, but it also allows each combination of an industry and a region to have an idiosyncratic trend (captured by industry-region fixed effects (π_{sr})). The effect of FDI identified based on deviations from these trends. The specification also includes region-year fixed effects (π_{rt}) which capture region-specific shocks occurring in particular years. We employ first to fourth differences, where n-th difference for variable X in time t is defined as $\Delta X_t = X_t - X_{t-n}$.

$$\begin{aligned}\Delta Quality_{ipct} = \delta_1 \Delta OwnFDI_{s,t-1} + \delta_2 \Delta UpstreamFDI_{s,t-1} + \delta_3 \Delta DownstreamFDI_{s,t-1} \\ + \pi_{rt} + \pi_{sr} + \eta_{ipct}\end{aligned} \tag{5}$$

We estimate the equation on a sample of domestically owned manufacturing firms. In all specifications, we lag the FDI indices by one year. This allows for some time gap between the increase of foreign presence and its effect taking place. It also somewhat mitigates the concern, discussed in the next section, that reverse causality is driving our results. The FDI indices vary only with industry and year, but our outcome variables also vary across products, destinations or both. We, thus, cluster standard errors to allow for correlation between error terms within the same industry and year.

4 Results

4.1 FDI and quality of exports

The estimation results are presented in Table 2, where Panel A displays the results for export unit values and Panel B the results for the quality estimates based on the Khandelwal et al. (2013) approach. In each panel, Column 1 shows the results of a specification in levels, while the following columns show the results from estimation in first to fourth differences.

[13] Regions are defined at the NUTS2 level, which includes eight regions.

The strongest and the most robust finding emerging from our analysis is that the quality of domestic firms' exports is positively correlated with the foreign presence in downstream (input-sourcing) industries. The estimated coefficients on $Downstream\ FDI_{st}$ are positive and statistically significant for both measures of quality in all specifications. The magnitude of the estimated coefficient tends to increase with longer differencing. It is also economically meaningful. Over the studied period, foreign presence in downstream industries grew on average by 6.2 percentage points. This corresponds to a 13 and 15% increase in the quality of exports proxied by unit values and the alternative measure, respectively (based on estimates from Column 5).

FDI in upstream (input-supplying) industries is also positively correlated with export upgrading in domestic firms. These results are, however, less robust and smaller in magnitude. In the case of unit values, the effect is statistically significant in the specifications in levels, first and third differences. When the alternative measure of quality is used, the effect is statistically significant in all specifications. When we consider the estimates in Column 4, our results are consistent with the 6.5-percentage-point increase in upstream FDI observed over the studied period translating into about a 4% increase in the quality of domestic exporters for both quality proxies. It is quite remarkable that both measures of quality lead to such similar conclusions.

In line with some earlier studies on horizontal productivity spillovers, we find that the effect of foreign presence on domestic firms in the same industry is, if anything, negative. We are not able to exactly pinpoint the reasons for this negative effect. However, in interviews conducted by World Bank consultants, representatives of MNE subsidiaries and local experts repeatedly mentioned and emphasized competition for a limited pool of skilled labour as the key constraint on firm performance and growth in export sectors (Agency for Regional Development - Region West, 2013). Therefore, we interpret the negative sign on the own-sector FDI as consistent with possibility that foreign firms tend to pull skilled workers away from the domestic firms. This is a plausible scenario, given the well-known fact that foreign affiliates pay higher wages than domestic firms do in emerging markets (see, for instance, Aitken et al. (1996)).[14]

To the extent that firms use intermediate inputs from their own sectors, our measures of downstream and upstream FDI also reflect own-sector FDI and the three FDI variables are likely to be positively correlated. To check if our results might be affected by multicollinearity issues, we

[14]Our interpretation is consistent with the study by Hale and Long (2011) who find that presence of foreign firms in the same industry and region in China leads to higher wages of skilled workers and lower observed quality of engineers in both state-owned and private domestic enterprises. Alfaro and Chen (2012) also document inflows of FDI as having a substantial impact on domestic firms through an increase in factor prices.

repeat the specification in first differences but include one FDI variable at a time. We report the results in Table B.2. The coefficients on downstream and upstream FDI are large and statistically significant. They are somewhat smaller for downstream FDI and larger for upstream FDI when compared to the situation when all FDI variables included together. When included by itself, own-industry FDI bears a small coefficient which is not statistically significant.

The results for estimated quality presented in Table 2 are based on elasticity of substitution that is allowed to vary across 2-digit product groups. As another robustness check, Table B.3 presents results for estimated quality based on the assumption of σ that is homogenous across products. They are similar to those with heterogeneous σ_i except that the coefficient for upstream FDI in second differences is no longer statistically significant.

In an additional exercise, we split all products into two groups: (i) intermediate and capital inputs, and (ii) final products.[15] If the strong positive results for downstream FDI are due to exporters supplying inputs to MNEs located in Romania, we should see the effect of MNE presence in input-sourcing sectors only for the non-final products (i.e., intermediate inputs and capital goods). Table B.4 in the appendix shows that this is indeed the case. The effect of downstream FDI is large and significant for non-final products, whereas for final products it is not significantly different from zero. Obtaining the expected result on this more nuanced prediction gives us confidence that the link between the quality of exports and the presence of FDI in downstream sectors captures the effects of interactions between Romanian firms and their MNE suppliers. In contrast, we would expect that upstream FDI matters for both groups of goods. And indeed the upstream coefficient is positive and statistically significant for both types of products in one of the two specifications.

4.2 Addressing alternative explanations

Although our results are consistent with Romanian firms benefitting from knowledge spillovers due to supplying MNEs and from accessing better inputs produced by MNEs, there exist possible alternative explanations. First, one could potentially argue that there is reverse causality, since FDI may be more likely to flow to industries with access to high quality domestic inputs and demand for high quality foreign inputs. Insofar as these location factors are time-invariant, they are captured by firm-product-market fixed effects in the specification in levels and they get differenced out in the other specifications. Furthermore, if MNEs perceive them as evolving over time in a linear fashion, they would be captured by industry-region-specific trends in the differenced specifications.

[15] We rely on a stage-of-processing classification prepared by the WTO Trade Policies Review Division.

Table 2: Exported product quality and FDI: Levels and first to fourth differences

	(1)	(2)	(3)	(4)	(5)
	Levels	First diff.	Second diff.	Third diff.	Fourth diff.
			A. Unit values		
(Δ) Downstream FDI (s,t-1)	0.637***	0.797***	1.061***	0.856*	2.276***
	(0.196)	(0.269)	(0.331)	(0.435)	(0.396)
(Δ) Upstream FDI (s,t-1)	0.332***	0.272**	0.245	0.689***	0.283
	(0.092)	(0.123)	(0.167)	(0.234)	(0.187)
(Δ) Own FDI (s,t-1)	-0.243***	-0.178	-0.409***	-0.051	-0.364*
	(0.093)	(0.114)	(0.151)	(0.288)	(0.200)
N	146760	51573	30151	17872	10040
R-squared	0.059	0.010	0.011	0.007	0.007
			B. Khandelwal et al. (2013)		
(Δ) Downstream FDI (s,t-1)	0.630**	0.704**	1.387***	1.100*	2.057***
	(0.256)	(0.346)	(0.483)	(0.626)	(0.622)
(Δ) Upstream FDI (s,t-1)	0.338***	0.511***	0.425**	0.605**	0.657***
	(0.119)	(0.144)	(0.192)	(0.282)	(0.239)
(Δ) Own FDI (s,t-1)	-0.215*	-0.229	-0.280	-0.083	-0.533*
	(0.129)	(0.175)	(0.280)	(0.505)	(0.272)
N	146760	49598	28558	16766	9281
R-squared	0.008	0.003	0.005	0.004	0.002

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In panel A, the dependent variable is the logarithm of export unit values. In panel B, the dependent variable is the quality estimated as in Khandelwal et al. (2013) assuming 2-digit-HS-specific σ_i based on estimates of Broda and Weinstein (2006) (see Section 3 for more detail). The dependent variables are employed in levels or first to fourth differences as stated in the column headers. The n-th difference for variable X in time t is defined as $X_t - X_{t-n}$. Observations are defined at the firm-product-destination-year level. The specification in column 1 includes region-year and firm-product-destination fixed effects; the specifications in columns 2-5 include region-year and industry-region fixed effects.

The potential problem is also mitigated by lagging the explanatory variables. However, reverse causality could still be a problem if MNEs enter Romania in industries where high quality domestic suppliers are increasingly becoming available or where there is a growing demand from domestic firms for high quality inputs, and if these dynamics are not captured by the linear trends. To shed light on this possibility we perform the strict exogeneity test suggested by Wooldridge (2010). It entails estimating a specification where, in addition to the lagged FDI variables, we include their contemporaneous and lead values. If foreign firms' entry into Romania is a consequence of quality upgrading in upstream and downstream industries, the coefficients on the lead values should be statistically significant.

Table 3 shows the results of the test. The positive coefficient on downstream FDI seems to be driven by the contemporaneous variable, while the effect of upstream FDI seems to come from the lagged variable. Most importantly, the leads for all three FDI measures bear small and insignificant coefficients, suggesting that reverse causality is not driving our results.

Another potential alternative explanation is that a shock in the international market is driving both FDI inflows to Romania and unit values of Romanian exports. Imagine there is a global positive shock in demand for automobiles. As a result foreign car manufacturers decide to expand their production and invest in Romania. At the same time, demand for inputs to car production increases, leading to higher international prices including the ones faced by Romanian exporters. It would then be incorrect to interpret the resulting correlation between unit values of Romanian exporters and the downstream foreign investments as evidence of spillovers. Fortunately, we can easily test for this case by including the international price of each product as a control. Column 2 of Table 4 shows the results of an estimation, where we control for unit values of exports by the other EU members. Doing so has virtually no effect on the estimated coefficients for FDI variables. So an international shock driving both foreign investment to Romania and unit values of Romanian firms does not seem to explain our results.

Yet another potential alternative explanation of our results is related to domestic, rather than international, demand. Foreign investment in downstream industries could lead to an increase in their demand for inputs. If supply of these inputs is relatively inelastic, at least in the short term, upstream domestic firms might react to the increased demand by increasing prices of both their domestic sales and their exports. In such case, the correlation between foreign presence in downstream industries and export prices of upstream firms would reflect a price increase in reaction to an increased demand rather than a quality improvement. To test for this possibility, we follow Javorcik (2004) and define an index capturing input demand by downstream industries. Column 3

Table 3: Exported product quality and FDI: Strict exogeneity test

	(1)	(2)
	Unit values	Khandelwal et al. (2013)
Δ Downstream FDI (s,t-1)	0.369	0.596
	(0.377)	(0.407)
Δ Downstream FDI (s,t)	0.577	1.186**
	(0.489)	(0.552)
Δ Downstream FDI (s,t+1)	-0.241	0.001
	(0.322)	(0.369)
Δ Upstream FDI (s,t-1)	0.281**	0.594***
	(0.118)	(0.139)
Δ Upstream FDI (s,t)	-0.310*	-0.064
	(0.166)	(0.181)
Δ Upstream FDI (s,t+1)	0.014	-0.202
	(0.197)	(0.219)
Δ Own FDI (s,t-1)	-0.217	-0.546**
	(0.179)	(0.222)
Δ Own FDI (s,t)	-0.278	-0.485*
	(0.225)	(0.261)
Δ Own FDI (s,t+1)	0.087	-0.018
	(0.190)	(0.226)
R-squared	0.013	0.002
N	31108	29551

**** 1%, ** 5%, * 10%.* The table reports strict exogeneity test described by Wooldridge (2010). Standard errors, reported in parentheses, have been clustered on industry-year combinations. In column 1, the dependent variable is the logarithm of export unit values. In column 2, the dependent variable is the quality estimated as in Khandelwal et al. (2013) assuming 2-digit-HS-specific σ_i based on estimates of Broda and Weinstein (2006) (see Section 3 for more detail). The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. The specification includes region-year and industry-region fixed effects.

of Table 4 shows that when we include this index in the estimation, it indeed has a strong positive effect on export unit values. However, its inclusion actually makes the coefficients on downstream FDI slightly larger and more precisely estimated, suggesting that downstream demand is not driving our results.

It is also possible that as foreign-owned firms enter downstream industries, those upstream domestic firms that are unable to improve their product quality are forced to exit the market. In such a case, the observed correlation between downstream FDI and upstream export quality would be driven by differential entry and exit rather than by spillovers. We explore this possibility by restricting the estimation sample to firms continuously exporting throughout the sample period (see column 3 of Table 4). Doing so *increases* the magnitude of estimated coefficients on downstream FDI. Thus differential entry/exit patterns are unlikely to represent mechanisms behind the positive effect of downstream FDI on export unit values.

Finally, we consider the possibility that the estimated positive association between export quality and upstream FDI is driven by a concurrent increase in availability of imported intermediate inputs. Therefore, in the last column of Table 4, we control for the value of industry-level imports. Imports appear to be positively correlated with export unit values, though not with the alternative measure of export quality. The coefficient on upstream FDI ceases to be statistically significant in Panel A of the table, but it continues to be large and statistically significant at the 1% level in Panel B.

4.3 Are the effects regional or national?

The results so far suggest a positive relationship between MNE presence in downstream and upstream sectors and the quality of domestic firms' exports. The next question we examine is whether these spillovers are regionally concentrated, i.e., whether they are stronger for domestic firms located closer to the MNEs. This could be the case, for example, if MNEs look for suppliers located in the same region or if proximity facilitates interactions and knowledge transfer. Knowing the answer to this question is important for FDI promotion policies.

Our data include information on location, turnover and employment of all plants belonging to each firm, and this allows us to construct an alternative version of our FDI variables that varies over regions as well as industries. It captures the MNE share in the total output of a domestic firm's industry in the region where the domestic firm operates. As the matched customs data refer to firms rather than plants, we conduct estimation at firm level, as before. For domestic firms

Table 4: Exported product quality and FDI: Alternative explanations

	(1)	(2)	(3)	(4)	(5)
	Baseline	Price control	Demand control	Cont. firms	Import control
			A. Unit values		
Δ Downstream FDI (s,t-1)	0.797***	0.800***	0.865***	1.006***	0.859***
	(0.269)	(0.268)	(0.229)	(0.224)	(0.281)
Δ Upstream FDI (s,t-1)	0.272**	0.272**	0.192*	0.286**	0.186
	(0.123)	(0.123)	(0.112)	(0.125)	(0.124)
Δ Own FDI (s,t-1)	-0.178	-0.179	-0.162	-0.351***	-0.177
	(0.114)	(0.115)	(0.104)	(0.115)	(0.118)
Δ Log UV of EU exports (p,t)		-0.001			
		(0.003)			
Δ Log downstr. demand (s,t-1)			0.207***		
			(0.059)		
Δ Log industry imports (st)					0.072***
					(0.024)
R-squared	0.010	0.010	0.010	0.010	0.010
N	51573	51572	51573	34780	51573
			B. Khandelwal et al. (2013)		
Δ Downstream FDI (s,t-1)	0.704**	0.713**	0.771**	0.761**	0.737**
	(0.346)	(0.346)	(0.320)	(0.299)	(0.352)
Δ Upstream FDI (s,t-1)	0.511***	0.510***	0.444***	0.590***	0.461***
	(0.144)	(0.143)	(0.141)	(0.154)	(0.155)
Δ Own FDI (s,t-1)	-0.229	-0.232	-0.218	-0.419**	-0.228
	(0.175)	(0.176)	(0.166)	(0.190)	(0.180)
Δ Log UV of EU exports (p,t)		-0.002			
		(0.003)			
Δ Log downstr. demand (s,t-1)			0.168*		
			(0.087)		
Δ Log industry imports (st)					0.043
					(0.031)
R-squared	0.003	0.003	0.003	0.003	0.003
N	49598	49597	49598	34780	49598

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In panel A, the dependent variable is the logarithm of export unit values. In panel B, the dependent variable is the quality estimated as in Khandelwal et al. (2013) assuming 2-digit-HS-specific σ_i based on estimates of Broda and Weinstein (2006) (see Section 3 for more detail). The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. All specifications include region-year and industry-region fixed effects. International unit values are based on exports of 26 EU countries (excl. Romania) as reported by Eurostat. For each product and year, they are calculated by summing export value and quantity over all countries and then dividing value by quantity. Downstream demand is defined as a weighted mean of output across downstream industries. The output is deflated by industry-specific deflators. The weights are given by the intermediate inputs from the upstream industry corresponding to one unit of output in each downstream industry. Column 4 includes only firms exporting throughout the sample period.

with plants in multiple regions, we compute the local FDI variables as a weighted average over regions, with weights given by the share of each firm's employment located in each region. We define 'regions' as either level 2 or level 3 units in the Eurostat Nomenclature of Territorial Units for Statistics (NUTS). Romania consists of 8 NUTS-2 regions, which can be further disaggregated into 42 NUTS-3 counties.[16]

To investigate whether there are additional effects of FDI presence in the same region, beyond those of FDI presence in Romania, we estimate a model which includes both regional and national FDI proxies. The results, presented in Table 5, suggest that this is indeed the case for downstream FDI. There is a statistically significant link between downstream FDI and quality upgrading in Romanian firms for both national and regional measures of FDI. The regional effect, however, amounts to only about a third of the national effect. This means that while the spillovers from downstream MNEs are stronger for firms in the same region, they are by no means restricted to them. The results for regional effects defined at NUTS-2 and NUTS-3 aggregation level are very similar.

In contrast, there is no evidence that spillovers from upstream MNEs are any stronger if the MNEs are located in the same region or county. It appears that access to high-quality inputs and capital goods within national boundaries is what matters, and additional geographic proximity does not play a role. FDI in own sector does not appear to matter, thus reinforcing our earlier findings.

4.4 Import unit values

Khandelwal et al. (2013) derive the equation for estimating quality from a utility function with a constant utility of substitution, not allowing for differences in mark-ups across firms. Although column 3 of Table 4 suggests that our results are not driven by increased mark-ups due to strong domestic demand, our analysis so far does not allow us to reject the possibility that they are driven by mark-up increases due to other reasons. To shed light on this issue, we follow several recent studies which make the observation that high-quality outputs require high-quality inputs, and which interpret input prices as proxies for the input quality.[17]

[16] More precisely, there are 41 counties and the capital Bucharest, which has a special status.

[17] Kugler and Verhoogen (2012) find that larger Colombian firms not only charge higher prices for their output, but they also pay higher prices for their inputs. The authors interpret these patterns as evidence of quality differences between firms of different size. Goldberg et al. (2010b) study Indian trade and firm data, and they also emphasize the importance of inputs for production improvements, although they focus on the number of imported and produced varieties rather than specifically on quality. Manova and Zhang (2012) identify a number of stylized facts about export and import prices of Chinese exporters. They argue that their findings are in line with the high-productivity

Table 5: Exported product quality and FDI: National vs. local FDI

	Unit values		Khandelwal et al. (2013)	
	(1)	(2)	(3)	(4)
	NUTS 2	NUTS 3	NUTS 2	NUTS 3
Δ Downstream FDI (national) (s,t-1)	0.551**	0.573**	0.481*	0.511*
	(0.224)	(0.229)	(0.274)	(0.278)
Δ Downstream FDI (local) (s,r,t-1)	0.187**	0.136*	0.195*	0.156*
	(0.095)	(0.078)	(0.112)	(0.094)
Δ Upstream FDI (national) (s,t-1)	0.318**	0.276**	0.548***	0.550***
	(0.125)	(0.136)	(0.151)	(0.165)
Δ Upstream FDI (local) (s,r,t-1)	-0.072	0.001	-0.065	-0.016
	(0.061)	(0.051)	(0.072)	(0.065)
Δ Own FDI (national) (s,t-1)	-0.144	-0.064	-0.210	-0.104
	(0.161)	(0.164)	(0.175)	(0.174)
Δ Own FDI (local) (s,r,t-1)	-0.024	-0.035	-0.007	-0.030
	(0.057)	(0.041)	(0.065)	(0.050)
R-squared	0.010	0.013	0.003	0.006
N	51573	51573	49598	49598

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-region-year combinations. In columns 1 and 2, the dependent variable is the logarithm of export unit values. In columns 3 and 4, the dependent variable is quality estimated as in Khandelwal et al. (2013) assuming HS 2-digit-specific σ_i based on estimates of Broda and Weinstein (2006) (see Section 3 for more detail). The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. The specification in columns 1 and 3 includes region-year and industry-region fixed effects, the specification in columns 2 and 4 includes county-year and industry-county fixed effects. Local FDI variables are defined in the same way as the national FDI variables described in Section 3 but only taking into account MNE presence in the same region. Columns 1 and 3 are based on 8 NUTS-2 regions, and columns 2 and 4 are based on 42 NUTS-3 counties.

Therefore, in the next exercise, we examine the link between MNE presence and the quality of products imported by domestic firms. If domestic firms upgrade the quality of their production as a result of supplying inputs to foreign subsidiaries in downstream industries, this may require importing higher-quality inputs. Presence of foreign firms in upstream industries could also lead to an increase in the quality of imported inputs, if the imported inputs are complements to the higher quality inputs available from the upstream foreign affiliates. Finally, if the presence of foreign-owned firms in the same industry puts competitive pressure on the domestic firms in output and input markets, the domestic firms, in order to cut costs, may start importing cheaper inputs. Importantly, to the extent that the increases in export unit values observed in relation to an increased presence of foreign-owned firms in the downstream and the upstream industries are due to increased mark-ups rather than quality upgrading, input prices should not vary with the FDI variables.

In order to obtain higher-quality inputs, firms are likely to switch countries from which they source their inputs.[18] Thus we collapse the import data across origin countries, so that each observation is defined by a firm, an imported product and a year. This allows the increases in the prices that firms pay for imported inputs to capture both buying higher-quality inputs from the same country and switching to source countries that offer higher quality. More specifically, we estimate the following equation

$$\Delta Quality_{ipt} = \delta_1 \Delta OwnFDI_{s,t-1} + \delta_2 \Delta UpstreamFDI_{s,t-1} + \delta_3 \Delta DownstreamFDI_{s,t-1} + \pi_{rt} + \pi_{sr} + \eta_{ipt}$$

The results, presented in Table 6, show a positive and statistically significant relationship between MNE presence in downstream and upstream sectors and the unit values of products imported by Romanian firms. The coefficients for downstream and upstream FDI are similar in magnitude, but more precisely estimated for upstream FDI. The presence of foreign-owned firms in the same industry appears to be related to a fall in import unit values. This may be capturing local producers being squeezed by competition from MNEs in the same sector and thus being forced to find cheaper inputs. The described patterns are true for the subsample of exporters (Column 1) as well

exporters using higher quality inputs to produce higher quality output. Bas and Strauss-Kahn (2015) establish a causal link from input-tariff reductions in China to increases in both import and export prices of Chinese exporters. They, too, interpret their results as evidence of quality-upgrading by Chinese firms.

[18] Bas and Strauss-Kahn (2015) show that when Chinese firms became able to afford higher quality inputs, they increased the share of their imported inputs that were sourced from developed countries. Goldberg et al. (2009) document that as a trade liberalisation increased Indian firms' access to new imported inputs, three quarters of the resulting growth in the product extensive margin of Indian imports were due to imports from advanced economies.

Table 6: Import unit values and FDI

	(1)	(2)	(3)
	Exporters	All firms	Imports & exports
Δ Downstream FDI (s,t-1)	0.354*	0.313*	0.294*
	(0.189)	(0.171)	(0.172)
Δ Upstream FDI (s,t-1)	0.317***	0.323***	0.256***
	(0.083)	(0.076)	(0.092)
Δ Own FDI (s,t-1)	-0.253**	-0.236**	-0.174*
	(0.122)	(0.111)	(0.091)
R-squared	0.004	0.004	0.002
N	125444	139565	5045

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In columns 1 and 2, the dependent variable is the logarithm of import unit values in first differences, respectively for exporters and for all manufacturing firms. In column 3, the dependent variable is a product of the shares of exported and imported products that saw larger annual changes in unit values than median exported and imported firm-products in the same year (see text for more detail). In columns 1 and 2, observations are defined at the firm-product-year level. In column 3, they are defined at the firm-year level. All specifications include region-year and industry-region fixed effects.

as for all manufacturing firms that import inputs (Column 2). As was the case with export unit values and estimated quality, import unit values seem to be positively related to the presence of foreign-owned firms in the downstream and upstream industries.

To shed light on whether the observed increases in export and import unit values in response to greater foreign presence in upstream and downstream sectors are indeed related, next we test whether the same firms experience an increase in both their export and import prices. For each firm in each year, we first calculate the share of the firm's exported products that saw a larger year-to-year change in unit values than a median firm-product observation in that year. We also calculate an analogous share for imported products. We then define the dependent variable as the product of the two shares. The dependent variable then represents an index, between zero and one that is larger for firms which simultaneously experience an increase in unit values of both their exported and imported products. As shown in Column 3, this dependent variable is positively correlated with MNE presence in both downstream and upstream industries, suggesting the increases in export and import unit values are indeed driven by the same firms.

Overall, the results for import unit values strongly point towards interpreting the previous findings as quality upgrading rather than as increased mark-ups.

4.5 Upgrading product and destination portfolio

The results so far suggest that MNE presence in downstream and upstream industries is an important driver of within-product quality upgrading. Now we turn to the question whether it also facilitates other types of export upgrading. Specifically, we ask if it is related to the changes in the product and destination portfolio of domestic exporters. We do so using product-specific measures of skill-, R&D- and advertising-intensity provided by Ma et al. (2014).[19] For each Romanian exporter-destination pair, we calculate the weighted average of these measures across all exported products, with weights given by export values.

The results, presented in Table 7, provide little support for our hypothesis. If anything, the results suggest that downstream FDI is *negatively* related to the skill-intensity of domestic firms' export baskets. This could happen if MNEs source in Romania mainly low-skill-intensive products and their domestic suppliers shift their export portfolios in the same direction as their domestic sales. We also find a negative correlation between presence of FDI in the same industry and R&D intensity of the product portfolio. A potential explanation is that domestic firms are unable to compete with MNEs in R&D-intensive products, and they shift to other products in both their domestic and export sales. The remaining coefficients for the relationship between MNE presence and the characteristics of exported products are close to zero and not statistically significant.

Even if the presence of MNEs does not make domestic exporters specialise in more sophisticated products, it might allow them to broaden the range of exported products. MNEs may help their suppliers develop new products, and the suppliers may then sell these new products abroad. Furthermore, access to imported inputs helps firms introduce new products (Goldberg et al., 2010b), and the same could be true for inputs available from MNEs in the same country. Finally, firms may learn about new products they could profitably introduce by observing MNEs in the same industry. We examine this hypothesis in the last column of Table 7, but we find no support for it in the data. None of the coefficients of interest appears to be statistically significant.

Supplying MNEs could also help domestic firms reach more export markets and start serving more sophisticated export markets. Domestic firms could benefit from the increased quality of their products or capitalise on reputation gained from being MNE suppliers. They could start supplying affiliates of the same MNE located in other countries. MNE customers and suppliers could introduce Romanian business partners to new potential customers, possibly to help Romanian firms

[19] These measures were constructed as the weighted averages of the respective intensities across firms exporting each product from China.

Table 7: Export product portfolios and FDI

	(1) Skill	(2) R&D	(3) Advertising	(4) # products
Δ Downstream manuf. FDI (s,t-1)	-0.088***	0.000	-0.001	-0.014
	(0.027)	(0.002)	(0.001)	(0.195)
Δ Upstream manuf. FDI (s,t-1)	-0.014	0.000	0.001	0.249
	(0.018)	(0.001)	(0.001)	(0.180)
Δ Own FDI (s,t-1)	0.017	-0.003***	0.000	-0.194
	(0.020)	(0.001)	(0.001)	(0.141)
R-squared	0.002	0.000	0.001	0.010
N	22791	22791	22791	22791

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In columns 1-3, the dependent variables are the weighted average factor intensities of exported products, where weights are given by export values and the 6-digit-HS product intensities come from Ma et al. (2014). In column 4, the dependent variable is the number of exported products. The dependent variables are employed in first differences. Observations are defined at the firm-destination-year level. All specifications include region-year and industry-region fixed effects.

to reach a larger scale and boost their productivity and demand for inputs. We test this hypothesis by considering three additional outcome variables defined at the firm-product-year level: (i) the average GDP per capita of countries where firm i supplies product p at time t (with export values as used as weights); (ii) the share of the product's exports going to developed markets;[20] and (iii) the number of export destinations to which a firm exports a given product. However, as evident from Table 8, the hypothesis finds no support in the data.

5 Conclusion

Economic development is inseparably related to structural change and in particular to upgrading of industrial production and exports. Many countries employ industrial and trade policies aiming at such upgrading, but our knowledge of factors which can contribute to this goal is limited.

Our study suggests that foreign direct investment can stimulate quality upgrading of exports by domestic firms. Using a panel of all Romanian firms with more than 20 employees, matched with detailed customs data and observed over the period 2005-2011, we find evidence consistent

[20] We take GDP per capita comes from the World Bank's World Development Indicators. We consider countries to be rich if they are members of OECD other than the Czech Republic, Hungary, Poland, Slovakia, Slovenia, Chile, Mexico or Turkey.

Table 8: Export destination portfolios and FDI

	(1)	(2)	(3)
	Mean log GDP p.c.	Share of rich	# destinations
Δ Downstream manuf. FDI (s,t-1)	-0.171	-0.087	-0.123
	(0.266)	(0.121)	(0.156)
Δ Upstream manuf. FDI (s,t-1)	0.007	-0.010	0.062
	(0.157)	(0.068)	(0.107)
Δ Own FDI (s,t-1)	0.181	0.024	0.058
	(0.153)	(0.059)	(0.105)
R-squared	0.003	0.002	0.004
N	32035	32783	32783

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In column 1, the dependent variable is the weighted average of the logarithm of destination gross domestic product per capita (World Development Indicators), with weights given by export values. In column 2, the dependent variable is the share of exports sold to OECD countries other than the Czech Republic, Hungary, Poland, Slovakia, Slovenia, Chile, Mexico or Turkey. In column 3, the dependent variable is the number of export destinations. The dependent variables are employed in first differences. Observations are defined at the firm-product-year level. All specifications include region-year and industry-region fixed effects.

with the view that supplying MNEs or purchasing inputs from MNEs, as proxied by their presence in downstream and upstream industries, respectively, helps domestic exporters increase the quality of their exports. This is true when we proxy for quality with unit values or estimate quality following Khandelwal et al. (2013). The estimated effects are not only statistically significant, but also economically meaningful. They suggest that the increases in foreign presence in downstream and upstream manufacturing sectors over period studied correspond to a 13-15% and around a 4% increase in export quality, respectively. Although we do not claim that FDI is the only, or the most important, contributor to export upgrading in Romanian manufacturing, the combined effect of these increases is of a similar order of magnitude as the total catching up of Romanian domestic firms' export unit values with those of the developed European countries over the same period.

Overall, our findings indicate that when policy makers are looking for effective and actionable policies aimed at quality upgrading among domestic exporters, they should consider FDI promotion, and, in particular, efforts to bring foreign investors into industries which are likely to buy inputs from domestic firms or industries that are likely to provide inputs for domestic firms. FDI promotion efforts could be complemented by policies facilitating establishment of supplier-buyer relationships between domestic firms and MNEs.

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A Construction of variables

A.1 Unit values

We calculate unit value as the monetary value of an export flow divided by its physical quantity. The key question is which measure of physical quantity to use. We proceed as follows. First, we drop observations with export values equal to zero or with both measures of physical quantity equal to zero. Second, we use supplementary units as measure of physical quantity for all products which have supplementary units available for over 90% of the observations, and we use kilograms as measure of physical quantity for the remaining observations. Finally, we drop observations where the measure of physical quantity chosen for the given product is equal to zero. Using this procedure, we measure physical quantity in supplementary units for 34% observations and in kilograms for 66% observations, and we drop unit values for 0.2% observations.

Some values of unit values and their fluctuations within firm and product over time are too extreme to be likely to be true. We deal with the suspected outliers in three steps. First, to eliminate extreme levels of unit values, we demean each log unit value by the corresponding product-year-specific mean and then drop the 1% smallest and 1% largest observations. Second, to eliminate extreme unit value fluctuations over time within firm-product-destination combinations, we drop the 1% firm-product-destination combinations with highest variation of unit values over time. Finally, to eliminate extreme unit value year-to-year-changes, we drop the 1% largest year-to-year changes within a firm-product-destination combination.

A.2 Industry classification

The SBS data define the main activity of each firm in terms of 4-digit NACE industries. Data for years 2005-2007 use NACE (rev. 1.1) and data for years 2008-2010 NACE (rev. 2). In order to make the SBS data compatible with our input-output table, we first convert all observations to NACE rev. 1.1. There is no unambiguous concordance between rev. 1.1 and rev. 2, so we derive our own concordance from the data so as to maximize the continuity in NACE within firms across time. For each observation from 2008 or later, we define pre-revision NACE as the NACE of the same firm in 2007 (or earlier if we do not observe the firm in 2007). We create a concordance where each 4-digit NACE rev. 2 code corresponds to the most common pre-revision NACE among observations with the same 4-digit NACE rev. 2 code. Then, we convert NACE for years 2008 and later to NACE rev. 1.1 using this concordance. Validity of this method is supported by the fact that on the 2-digit level where our subsequent analysis takes place, the number of firms which

Table B.1: FDI inflows into central and eastern European countries (percent of GDP)

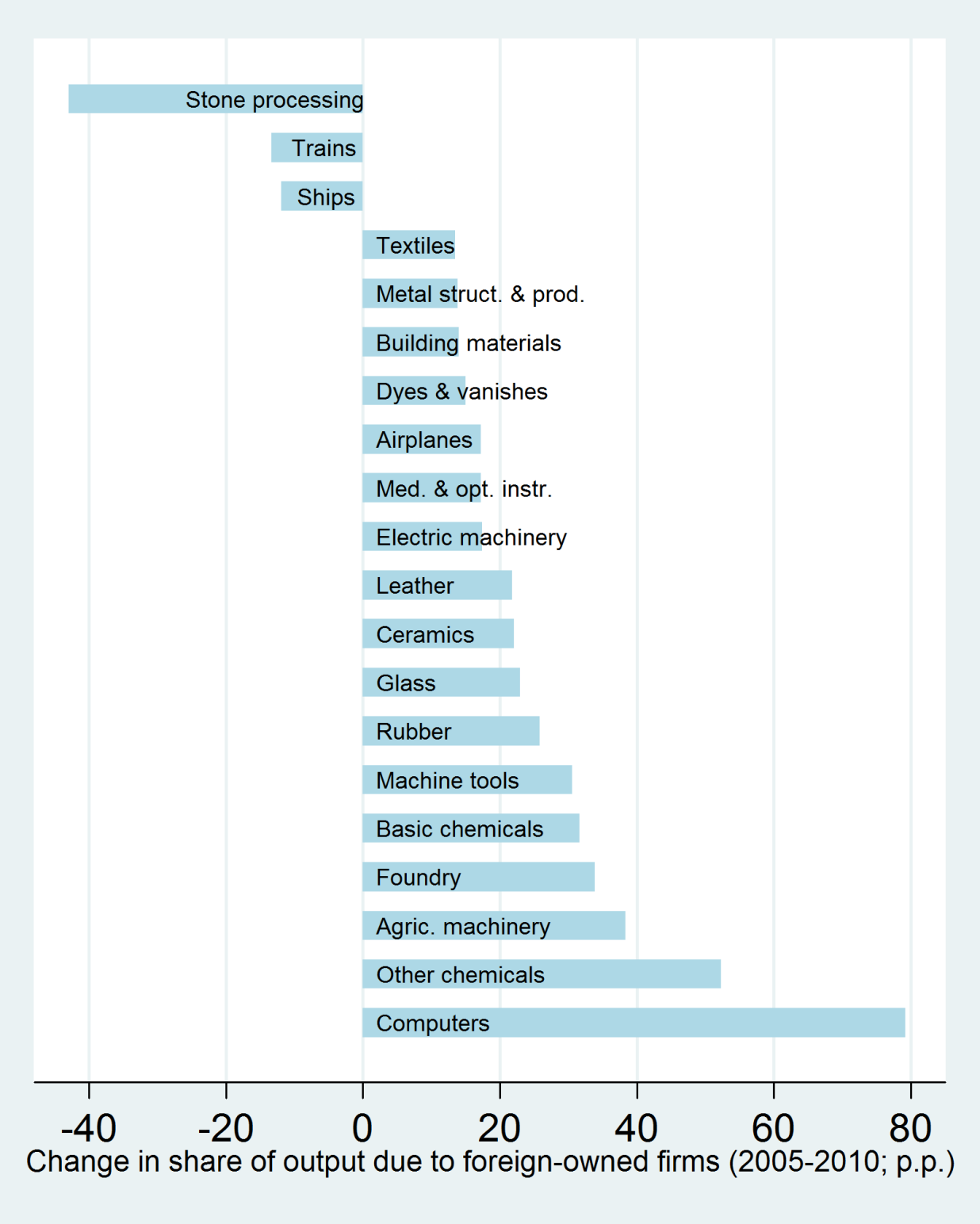
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Bulgaria	10.1	13.4	13.6	23.5	29.4	19.0	7.0	3.2	3.4	3.7	15.9
Czech Republic	2.2	4.4	9.0	3.7	5.8	2.9	1.5	3.1	1.1	5.4	4.3
Estonia	9.4	8.0	20.6	10.7	12.4	7.3	9.6	8.4	1.2	6.7	11.5
Hungary	2.6	4.2	7.0	6.1	2.9	4.1	1.6	1.7	4.2	10.6	3.9
Latvia	2.7	4.6	4.4	8.4	8.1	3.8	0.4	1.6	5.1	3.5	4.4
Lithuania	1.0	3.4	3.9	6.0	5.1	4.1	-0.0	2.2	3.4	2.0	3.6
Poland	2.1	5.1	3.4	5.7	5.5	2.8	3.0	3.0	3.7	0.7	3.9
Romania	3.7	8.5	6.5	9.3	5.8	6.8	2.9	1.8	1.3	1.3	5.5
Slovakia	8.9	9.6	6.5	10.4	5.4	5.2	-0.0	2.0	2.2	3.1	4.9
Slovenia	1.0	2.4	1.6	1.7	3.2	3.6	-1.3	0.8	2.0	0.3	1.6

UNCTAD. Underlined years appear in our data. Column Average represents the average over that period 2005-2010.

change NACE between 2007 and 2008 is very similar to the corresponding numbers for other years. Once we know the 4-digit NACE (rev 1.1) for each firm in each year, we use a concordance table to convert the NACE industries into the Romanian industrial classification in which the input-output table is defined. Finally, to ensure that variation over time in FDI presence in different industries is not driven by firms changing their reported industrial affiliation, we make the affiliation time-invariant by setting it to the mode value for each firm. This procedure modifies NACE for less than 4% of firm-year observations.

B Additional tables and figures

Figure B.1: Industries with the largest changes in foreign presence (2005-2010)

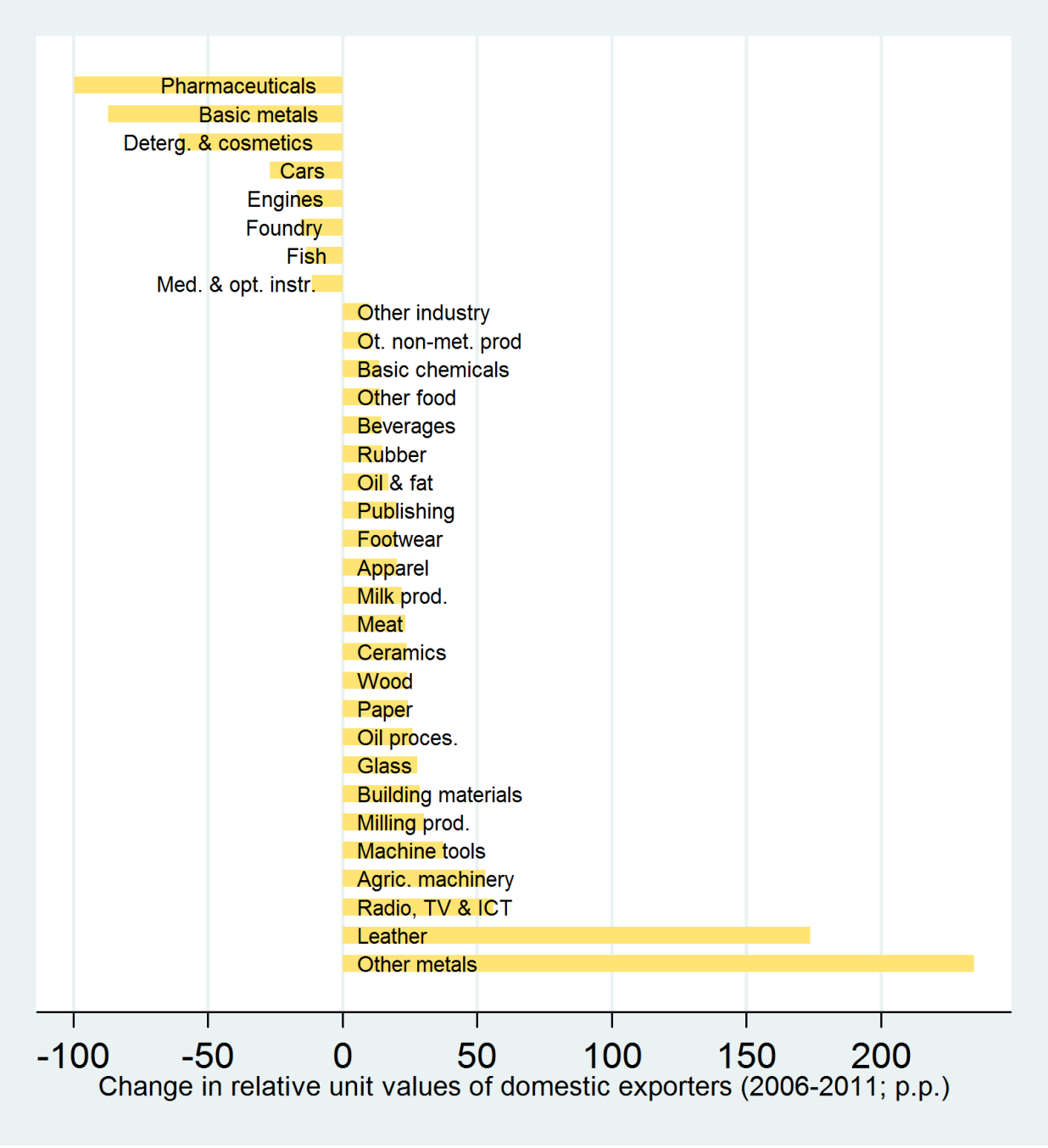


Only industries with an increase or a decrease of more than 10 percentage points are included.

Figure B.2: Evolution of foreign presence in individual industries (2005-2010)

The x-axis represents time and the y-axis represents the share of output due to foreign firms.

Figure B.3: Industries with largest changes in unit values relative to EU15 (2006-2011)



Bars represent medians (across products exported by each industry) of the ratio of unit values of exports by domestically owned Romanian firms to unit values of exports by EU15 countries. Information on Romanian exports comes from Romanian customs data described in Section 3; information on EU15 exports comes from Eurostat. Each product is assigned to the industry with highest number of exporter-destination pairs for that product. Only 8-digit-CN products exported by both Romania and EU15 in all years and only industries with increase or decrease of more than 10 percentage points are included.

Table B.2: Exported product quality and FDI: FDI variables one by one

	Unit values			Khandelwal et al. (2013)		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ Downstream FDI (s,t-1)	0.698***			0.662**		
	(0.212)			(0.314)		
Δ Upstream FDI (s,t-1)		0.427***			0.596***	
		(0.137)			(0.150)	
Δ Own FDI (s,t-1)			0.188			0.125
			(0.125)			(0.170)
R-squared	0.010	0.009	0.009	0.002	0.003	0.002
N	51573	51573	51640	49598	49598	49665

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In columns 1-3, the dependent variable is the logarithm of export unit values. In columns 4-6, the dependent variable is quality estimated as in Khandelwal et al. (2013) assuming 2-digit-HS-specific σ_i based on estimates of Broda and Weinstein (2006); see Section 3 for more detail. The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. The specification includes region-year and industry-region fixed effects.

Table B.3: Exported product quality and FDI: Homogenous elasticity of substitution

	Khandelwal et al. (2013)				
	(1)	(2)	(3)	(4)	(5)
	Levels	First diff.	Second diff.	Third diff.	Fourth diff.
(Δ) Downstream FDI (s,t-1)	0.614***	0.784**	0.965**	1.049**	1.949***
	(0.231)	(0.377)	(0.411)	(0.478)	(0.639)
(Δ) Upstream FDI (s,t-1)	0.270**	0.374**	0.320	0.732***	0.862***
	(0.112)	(0.152)	(0.194)	(0.266)	(0.232)
(Δ) Own FDI (s,t-1)	-0.227**	-0.250*	-0.329*	-0.144	-0.365
	(0.107)	(0.145)	(0.178)	(0.247)	(0.245)
R-squared	0.008	0.002	0.003	0.004	0.003
N	146760	49598	28558	16766	9281

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. The dependent variable is quality estimated as in Khandelwal et al. (2013) assuming homogenous σ calculated as median across HS 2-digit-specific σ_i based on estimates of Broda and Weinstein (2006); see Section 3 for more detail. The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. The specification includes region-year and industry-region fixed effects.

Table B.4: Exported product quality and FDI by stage of production

	Unit values		Khandelwal et al. (2013)	
	(1)	(2)	(3)	(4)
	Non-final	Final	Non-final	Final
Δ Downstream FDI (s,t-1)	1.452***	-0.148	0.987*	0.104
	(0.359)	(0.241)	(0.509)	(0.484)
Δ Upstream FDI (s,t-1)	0.463**	0.197	0.534**	0.614***
	(0.222)	(0.121)	(0.250)	(0.166)
Δ Own FDI (s,t-1)	-0.694***	0.293**	-0.489	0.049
	(0.243)	(0.126)	(0.297)	(0.169)
R-squared	0.009	0.016	0.004	0.003
N	20830	29381	19805	28479

**** 1%, ** 5%, * 10%.* Standard errors, reported in parentheses, have been clustered on industry-year combinations. In columns 1 and 2, the dependent variable is the logarithm of export unit values. In columns 3 and 4, the dependent variable is quality estimated as in Khandelwal et al. (2013) assuming HS 2-digit-specific σ_i based on estimates of Broda and Weinstein (2006); see Section 3 for more detail. The dependent variables are employed in first differences. Observations are defined at the firm-product-destination-year level. The specification includes region-year and industry-region fixed effects. The stage of production classification comes from the WTO Trade Policies Review Division. We consider products non-final if they are classified as intermediary inputs or capital goods.