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GDAŃSK UNIVERSITY OF TECHNOLOGY
FACULTY OF MANAGEMENT AND ECONOMICS

JOINT FOREIGN OWNERSHIP AND GLOBAL VALUE CHAINS EFFECTS ON PRODUCTIVITY: A COMPARISON OF FIRMS FROM POLAND AND GERMANY

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Joint foreign ownership and global value chains effects on productivity: A comparison of firms from Poland and Germany

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Abstract

The study confronts the joint effects of foreign ownership and its involvement in global value chains (GVC) on the productivity performance of firms from a catching-up country (Poland) and a leader economy (Germany). Domestic owned firms are less productive than foreign ones, which is particularly true at low GVC participation levels. However, as GVC involvement increases, the foreign ownership productivity premium decreases, leading to productivity catching up between foreign and domestic owned firms. This mechanism is similar in Poland and Germany. However, in the leader country (Germany), domestically-owned firms' productivity performance is more stable along the GVC distribution.

Keywords: GVC, FDI, productivity, firms, Amadeus database
JEL: F23, F21, F61, D24, D22

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1. Introduction

Among the several factors determining a firms' productivity (Syverson, 2011), the dynamic international context of business activity, namely trade and investment patterns, plays a fundamental role. Global foreign direct investment (FDI) has been rising sharply since the 1970s, reaching the peak of over $2 trillion in 2016 (Figure 1), with noticeable effects of the economic downturns and, recently, the COVID-19 pandemic[1]. There has been hope for positive FDI spillovers via technology and knowledge transfer (e.g., Blomström and Sjöholm, 1999; Arnold and Javorcik, 2005; Chuang and Lin, 1999; Haddad and Harrison, 1993; Newman et al., 2015; Javorcik, 2004). However, quantifying the productivity benefits of foreign investment is not trivial, primarily due to the challenge of identifying a causal relationship (Fons-Rosen et al., 2021). In recent decades, we have also witnessed the proliferation of global value chains (GVC); see Antras and Chor, 2021 for a thorough review. GVC account for half the global trade (World Bank, 2020). Interestingly, in Europe, the foreign value added (FVA) share in gross exports almost doubled between 1995 and 2018 (Figure 2). This tendency reinforced linkages between foreign companies and host economies, creating a complex trade-GVC-investment nexus (Cadestin et al., 2018; Okah et al., 2021; Adarov and Stehrer, 2021; Qiang et al., 2021). FDI is the primary form of global expansion for multinational companies (MNCs) that fuels trade and GVC (World Bank, 2020; Antràs and Yeaple, 2014).

This study's contribution is twofold. First, we focus on the within-firm productivity effects of the joint FDI-GVC connection. The key research question is: does the link between productivity and the degree of involvement in global production structures depends on the firms' ownership? To answer this question, we combine insights from two literature streams on the global organization of production. The first is on productivity effects of international production fragmentation and GVC (Criscuolo and Timmis, 2017; Del Prete et al., 2017; Kordalska et al., 2016; Amador and Cabral, 2015). The second stream, which is much more abundant, is on foreign ownership premium and FDI-driven productivity spillovers (among multiple others, Fons-Rosen et al., 2021; Demena, 2015; Görg and Strobl, 2001; Mebratie and van Bergeijk, 2013; Meyer and Sinani, 2009; Wooster and Diebel, 2010; Bruno and Cipollina, 2010). Instead of treating these mechanisms separately, we integrate them within one framework, assessing the

[1] Due to the COVID-19 pandemic, global FDI flows fell by 35 per cent in 2020, reaching $1 trillion (the lowest level since 2005, almost 20 per cent lower than the 2009 trough after the global financial crisis). Source of the data: UNCTAD FDI database (2022).

linkages between firms' productivity, ownership type (domestic vs foreign-owned), and GVC participation. We thus build our approach upon Dunning's eclectic paradigm of international production, stating that "foreign direct investment is just one of a number of possible channels of international economic involvement" (Dunning, 1987; 2015: 50).

Our second contribution is from a comparative approach: we verify whether the mechanisms at play are the same or different in a catching-up economy and in a well-developed, leader country. The related literature is rich (see Section 2) but, to the best of our knowledge, none of the existing Europe-focused firm-level studies links the FDI-productivity nexus with GVC trends using this approach. Most of the evidence is country-specific: for instance, out of 52 firm-level studies on the effects of FDI on the performance of domestic firms in Europe surveyed by Bruno and Cipollina (2018), only 9 use the data on firms from more than one country. While only four focused on productivity, others analyzed output growth or revenue efficiency. Among the recent multi-country studies on foreign investment and productivity, Fons-Rosen et al. (2021) analyzed eight European countries. Still, they confined their interest to the advanced economies, while Gorodnichenko et al. (2014) and Hagemejer (2016) focused on the European (and post-Soviet) transition economies. Extra-European evidence on FDI productivity spillovers is abound. However, this research is mainly on selected (typically developing) countries (e.g., Blomström and Sjöholm, 1999 or Arnold and Javorcik, 2005 on Indonesia; Chuang and Lin, 1999 on Taiwan; Haddad and Harrison, 1993 on Morocco; Newman et al., 2015 on Vietnam; Wand and Wang, 2015 on China). Overall, we lack a direct comparison for firms from countries located at distinct ends of the productivity distribution spectrum.

Therefore, we use micro-level data on firms from two distinct European countries: Poland and Germany, to address this research gap. Despite being geographically close, they differ substantially in productivity. Germany is a frontrunner, with output per hour exceeding the EU average by approximately 20%, which has remained largely unchanged over the past decade, starting in 2009. Poland is a catching-up economy with labor productivity of only 64% of the EU average, which used to be even lower at 53% in 2009[2]. Both countries are largely involved in global production structures, exceeding the level of GVC participation typical for the whole of Europe. However, Poland is more dependent on FVA than Germany (Figure 2). The two

[2] Labor productivity per hour worked (EU27_2020=100). Source of data: Eurostat (online data code: TESEM160) [date of access: 11.03.2022].

countries play different roles in the global investment context (Table 1). Germany was among the largest FDI suppliers globally in 2020, accounting for approximately 5% of global outward FDI stock (Poland: 0.06%). Up to now, Poland has received 0.6% of global FDI (Germany: 2.5%), but the FDI inward stock accounts for as much as 42% of Polish gross domestic product (GDP) compared to Germany's 28%. In hindsight, it is clear that at the outset of the political and economic transformation in Central and Eastern Europe in the early 1990s, Polish FDI was practically null and sharply increased after the system transformation.

[Figure 1 about here]

[Figure 2 about here]

[Table 1 about here]

Consequently, we believe the comparison of foreign ownership-GVC-productivity links in these two countries can be insightful. The rest of the study is structured as follows. Section 2 presents key insights from the literature on FDI/foreign-ownership productivity premium, linking it to the evidence on productivity effects of GVC. Section 3 describes our firm-level data and the methodological approach, while Section 4 presents the key results, and the last section concludes the study.

2. Literature review

In line with the theory of MNCs (Dunning, 1988; Markusen, 2002), foreign-owned firms are often expected to be more productive than purely domestic ones. When FDI flow is directed to developing countries, foreign ownership premium can be connected with the transfer of knowledge and technology, generating productivity spillovers (Wooster and Diebel, 2010; Newman et al., 2015). The mechanisms at play are complex. FDI spillovers can be horizontal and vertical, the former affecting firms in the same industry, the latter acting through backward and forward linkages between foreign firms and their suppliers or customers (e.g., as in Smarzynska Javorcik, 2004; Nicolini and Resmini, 2010; Newman et al., 2015). However, a meta-analysis by Demena and van Bergeijk (2017)[3] reports positive and statistically significant productivity spillovers of FDI in developing countries in approximately one-third of the studies published

[3] Earlier meta-analyses include: Demena (2015), Görg and Strobl (2001), Mebratie and van Bergeijk (2013), Meyer and Sinani (2009), Wooster and Diebel (2010).

since the 1980s[4]. More recently, Wang and Wang (2015) found no evidence of additional productivity gains from foreign ownership among Chinese firms. In less frequently analyzed advanced economies, the productivity-enhancing effects of FDI are also not so evident. Fons-Rosen et al. (2021: 1-2) state that "the existing results from the literature on the magnitude of productivity gains from FDI vary widely from nil to a high of 16% across studies conducted for different developed countries."

Focusing on the European context, multiple FDI-productivity studies were provoked by the large inflow of foreign investment into Central and Eastern Europe (CEE) or Southern-Eastern Europe (SEE) that started in the early 1990s. As a result, CEE became a hub for FDI from Western European countries. Accordingly, the first wave of research analyzed either the case of specific transition CEE/SEA countries (e.g., Romania: Merlevede et al., 2014; Hungary: Görg et al., 2009; Poland: Hagemejer and Kolasa, 2011, Lithuania: Smarzynska Javorcik, 2002; Estonia: Sinani and Meyer, 2004; Czech Republic: Djankov and Hoekman, 2000) or their small groups (e.g., Bulgaria, Poland, and Romania: Nicolini and Resmini, 2011; Konings, 2001; Damijan et al., 2009 on six SEE). Less frequently, firms from single Western European economies have been examined (e.g., UK: Higón and Vasilakos, 2011; Liu et al., 2000; McVicar, 2002; Driffield et al., 2009; Girma et al., 2007; Italy: Reganati and Sica, 2007; Borin and Mancini, 2016). Overall, the evidence is mixed and often contradicts the optimistic view on productivity-enhancing FDI impact on firms in host European countries (Bruno and Cipollina, 2018).

Fons-Rosen et al. (2021), Pittiglio and Reganati (2019), and Gorodnichenko et al. (2014) stand out among firm-level studies providing a multi-country European perspective. Fons-Rosen et al. (2021) exploit the Orbis dataset to construct a database for eight Western European economies. They show that foreign investment increases productivity while foreign divestment has no significant effect. Additionally, Pittiglio and Reganati (2019) show that the origin of investment matters. Foreign affiliates from advanced countries have productivity superiority over foreign affiliates located in the EU from emerging countries. A cross-country study on European transition countries is provided by Gorodnichenko et al. (2014). They used the Business Environment and Enterprise Performance Survey (BEEPS) data and analyzed 17 economies from

[4] Demena and van Bergeijk (2016) analyzed 69 empirical studies published within the 1983–2013, dealing with 31 developing countries and providing 1450 estimates of spillover parameters.

CEE and the former Soviet Union. They found positive backward productivity spillovers from foreign companies to domestically owned firms, but horizontal and forward linkages are insignificant. Damijan et al. (2009) found positive productivity gains from foreign ownership in firms from four out of six examined SEE countries, while the impact of openness depends on whether it involved trade with more or less advanced markets.

Along with a burgeoning literature on FDI, a parallel stream of research was provoked by a well-documented increase in vertical specialization (a notion introduced by Hummels et al., 2001, and significant developments in ways of GVC quantification (Timmer et al., 2014, 2015; recently surveyed in Antràs and Chor, 2021 or Johnson, 2018). Although much of the GVC literature (see Amador and Cabral, 2015 for a review) focuses on labor market implications, few studies have assessed the effects of GVC on productivity. At the country-industry level, participation in GVCs is a significant driver of labor productivity (Kordalska et al., 2016; Pahl and Timmer, 2020), operating mainly through backward participation (Constantinescu et al., 2019). But understanding GVC is crucial in the microeconomic context as they affect sourcing decisions, links between import and export participation, and multinational firms' organization of production networks (Johnson, 2018).

GVC-focused productivity literature builds upon an earlier wave of empirical studies on the relationship between offshoring and industry- or firm-level productivity (Görg et al., 2008; Hijzen et al., 2010; Amiti and Wei, 2009), a mechanism that is one of the key elements in the trading tasks model (Grossman and Rossi-Hansberg, 2008). Baldwin and Yan (2014) confirm a positive relationship between becoming part of a GVC and Canadian firms' performance, even after controlling for the selection bias, that is, when more productive firms enter the GVC (a mechanism similar to the self-selection into exporting in new-new trade theory of Melitz (2003) and self-selection into offshoring (Antràs and Helpman, 2004). The analogous result has been confirmed in less-developed countries. For instance, Del Prete et al. (2017) document productivity gains of GVC participation for firms from North Africa, while Banh et al. (2020) confirm it in Estonian firms. Still, establishing the productivity-GVC link is not easy due to two-way mechanisms: firm performance results are among the key drivers of GVC participation (Reddy et al., 2021; Amador and Cabral, 2016).

GVC and cross-border investment flow effects are intertwined (World Bank, 2020). Okah et al. (2021) confirm the interaction between FDI and GVC in a panel of 43 developing countries

(2010–2019). Adarov and Stehrer (2021) use country-industry level data for a European sample of countries (2000–2014) and find a strong impact of FDI and capital accumulation on GVC participation. Qiang et al. (2021) report how MNCs have driven the rise of GVCs in the past three decades. Still, few firm-level studies explicitly assess the joint effects of foreign ownership/FDI and GVC involvement on productivity. In particular, Hagemejer (2016) deals with productivity spillovers within GVC in Central and Eastern European countries, arguing that FDI alone does fully explain the reallocation and upgrading processes in the countries from the former Eastern bloc (including Poland, the country of analysis in this study). He finds noticeable productivity differences between domestic and foreign firms located in Central and Eastern Europe and reveals a significant relationship between the foreign value content of exports and firm-level productivity, combined with backward productivity spillovers.

3. Data and methods

Our analysis is based on the Amadeus micro-level database on firms, containing financial information for several public and private companies across Europe, provided by Bureau van Dijk (2017). We use the 2017 release of Amadeus data, which initially (before cleaning) contained information from the period between 2002 and 2017. Data cleaning and preparation[5] follow Kalemli-Ozcan et al. (2015) and Oestreicher et al. (2013). In addition to the basic demographic information on firms (year of incorporation – used to derive firm's age, location – NUTS 2 region, sector – NACE Rev. 2 2-digit code of primary activity), we utilize variables needed for firm-level estimation of total factor productivity (TFP) (number of employees, operating revenue turnover, tangible fixed assets, material costs) [6] and additional control variables (number of patents – used to proxy research and development (R&D)). To obtain the binary variable indicating foreign ownership status (*FO*), we explore the information on the origin of the parent company and the percentage of direct shares owned. Thus, $FO=1$ if at least 10% of direct

[5] Amadeus wave provides up to ten-year-long time series for a given company. We drop from the sample records marked as consolidated statements (to avoid double counting in the final sample), observations with negative number of employees or on any of the crucial financial variables. Incomplete employment data was filled using linear interpolation.

[6] Companies' financial data is downloaded in the national currency and then transformed into real terms (base year 2010) using country-sector level price indexes from WIOD Socio Economic Accounts. For operating revenue turnover we use Price levels of gross value added; for tangible fixed assets - Price levels gross output; for material costs - Price levels of intermediate inputs. In case of Poland the data is additionally converted into EUR using 2010 exchange rate from Eurostat.

ownership shares are owned by a foreign company/ies). The summary statistics of all the variables are provided in Table 1A in the appendix. Table 2A and Table 3A confront the sample with the overall population of firms in the two countries. We have approximately 213,000 observations on 68,000 companies for Germany and 190,000 observations on 56,000 firms for Poland in the final sample. Table 2 reports their key characteristics. As expected, foreign-owned companies are, on average, larger and more productive than domestic ones (see eq. 1). This is true in both the analyzed countries. Further, the average R&D activity of domestic and foreign companies in Poland is distinctly lower than we observe for German companies. Moreover, there is not much difference in the age of the two types of firms. Regardless of the choice of the country, foreign firms are slightly younger, on average.

[Table 2 about here]

Firm-level data is merged with country-sector (ISIC Rev 4. industry classification)[7] GVC-related variables, calculated using World Input-Output Database (WIOD; Timmer et al., 2015). Our baseline specification uses vertical specialization expressed as a share of gross exports (VS/Exp) and global import intensity (GII) index. VS is well-rooted in production fragmentation literature (among others: Hummels et al., 2001) and comes from Wang et al. (2013)'s gross exports decomposition. VS incorporates foreign value-added embodied in exports (FVA) and pure double-counting from foreign sources. The GII index (Timmer et al., 2016), in turn, measures intermediate imports needed at all production stages (as a share of the final product value), so it accounts both for a greater number of production stages or larger import inputs at a given stage.

The empirical analysis is divided into two main steps: 1) estimation of TFP and 2) assessment of the linkages between the firm's productivity, ownership type, and GVC participation.

To estimate firm-level TFP, we use the Levinsohn-Petrin approach (Levinsohn and Petrin, 2003)[8] for the following Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 m_{it} + (\omega_{it} + \eta_{it}) \quad (1)$$

[7] To match sector identification in Amadeus and in WIOD we use ISIC-NACE correspondence tables (European Commission, 2008).

[8] We use Stata command *prodest* (Rovigatti and Mollisi, 2016). As robustness, we also consider gmm TFP estimation method by Wooldridge (2009), also available in *prodest*.

where: *i* denotes firm and *t* time; output variable *y* is measured by operating revenue turnover and capital *k* via tangible fixed assets. The number of employees serves as labor input *l*, and material costs are used to get intermediate input *m* (all variables in logs). The unobserved productivity term is denoted by ω (and this is how the TFP is obtained) and so η is the error term (uncorrelated with the input choices). The estimation is performed separately for firms from each country sector, assuming that they differ in technology. A similar approach is presented in Pittiglio and Reganati (2019) and Arnold and Javorcik (2005).

Figure 3 presents density plots of estimated TFP by country and ownership type: domestic or foreign. We observe the expected productivity difference between firms from Poland and from Germany (the latter being more productive) for both types of companies—domestic and foreign-owned.

[Figure 3 about here]

In the second step, the estimated TFP (ω from eq. 1) serves as the dependent variable in the following regression estimated to verify the determinants of firms' productivity, including GVC participation and foreign ownership:

$$tfp_{ijrt} = \gamma_0 + \gamma_1 l_{it} + \gamma_2 age_{it} + \gamma_3 k\_l_{it} + \gamma_4 r\&d_i + \gamma_5 gdp_{rt} + \gamma_6 prod_{jt} + \gamma_7 FO_i + \gamma_8 GVC_{jt-1} + D_t + D_j + \varepsilon_{ijrt} \quad (2)$$

where *i* denotes firm, *j* – sector, *r* – NUTS 2 geographic region, and *t* – time. Our main variables of interest are foreign ownership identifier (FO) and the sectoral measure of GVC participation (GVC). As control variables (all expressed in logs), we consider the following: firm's size measured by the number of employees (*l*); the age of a firm in years (*age*); capital (tangible fixed assets) to labor (number of employees) ratio (*k_l*); the number of patents as a proxy for R&D activity[9] (*r&d*); GDP per capita (in purchasing power parity (PPP)) of the region where a firm is located (*gdp*); and sectoral productivity measured as a sectoral value-added divided by total number of hours worked in the sector (*prod*). We add time and sector fixed effects to account for unobservable specificity in these dimensions.

[9] Before taking log of number of patents we add 1 to the value, to avoid missing values creation, since most of the companies own zero patents. The number of patents available for the last year only.

We expand the model, adding an interaction term, to test whether the association between the degree of involvement in global production sharing and productivity depends on the firms' ownership.

$$tfp_{ijrt} = \gamma_0 + \gamma_1 l_{it} + \gamma_2 age_{it} + \gamma_3 k\_l_{it} + \gamma_4 r\&d_i + \gamma_5 gdp_{rt} + \gamma_6 prod_{jt} + \gamma_7 FO_i + \gamma_8 GVC_{jt-1} + \gamma_9 FO_i \times GVC_{jt-1} + D_t + D_j + \varepsilon_{ijrt} \quad (3)$$

We treat the sample as cross-sectional data (the panel is highly unbalanced) and estimate the models separately for each analyzed country (Poland, Germany). Next, we consider possible endogeneity problems concerning the GVC variable. Therefore, we first introduce its lag in Eq.2 and Eq.3 and, later, perform instrumental variables estimations. Finally, being aware that the final sample may not perfectly reflect the population structure, we also run weighted regression, which allows us to interpret the results from a broader perspective (i.e., beyond the sample). These extensions are described in the robustness checks section.

4. Results

4.1 Benchmark results

In line with the predictions, the results reported in Table 3 show that irrespective of the model formulation (with or without interaction term), foreign-owned firms are characterized by higher TFP. This is true in both Poland and Germany. This result is also confirmed once we consider endogeneity between productivity and FDI and the differences between sample composition and the overall firm population[10].

[Table 3 about here]

The key results refer to productivity differences between domestic and foreign owned firms combined with the information on the degree of GVC participation. The convenient interpretation of the interaction between *GVC* with the ownership variable (estimates of eq. 3) is possible via figures showing predicted TFP in relation to changes in *GVC* (measured either in terms of *VS/Exp* or *GII*), separately for foreign owned and domestic firms in the two countries. All four graphs lead to a similar conclusion. In a situation with low involvement in global production structures (i.e. GVC close to 0), productivity difference between domestic and foreign-owned firms is considerable. However, as GVC involvement increases, the foreign ownership productivity

[10] IV regression results are reported in Table 9A while weighted IV regression results in Table 10A in the Appendix.

premium decreases. This is visible via the negatively inclined line for foreign-owned firms. In other words, at low GVC participation levels, domestically owned firms are less productive than foreign ones, but as integration with global production networks rises, productivity convergence occurs. This mechanism takes place up to the point when domestic firms catch up with foreign-owned ones. After that point, there is no statistically significant difference between the two groups of firms, as shown by the overlapping confidence intervals. These results are similar in the case of Polish and German firms. However, in the leader country (Germany), domestically-owned firms' productivity performance is more stable along the GVC distribution. On the contrary, in a catching-up economy (Poland), the effect of rising TFP along the movement towards higher GVC intensity is more pronounced.

4.2 **Robustness checks**

We run numerous checks to confirm the robustness of our results. First, we change the way our dependent variable (TFP) is measured: as an alternative to the Levinsohn-Petrin method, we use TFP GMM estimation by Wooldridge (2009), recently employed by Fons-Rosen et al. (2021) (see Table 4A in the Appendix). Secondly, we repeat the estimation using the total[11] foreign direct shares definition to construct the FDI variable (Tables 5A). To check if the results are not driven by extreme values (outliers in the firm sample), we trim the sample excluding the observations with turnover above three standard deviations from the country mean (Table 6A). Next, we consider two alternative measures of production fragmentation. Foreign value-added embodied in exports *(i)* expressed as a share of gross exports (*FVA\Exp*) by Wang et al. (2013) and *(ii)* a classic offshoring index, i.e., a share of imports of intermediate goods in the value of the final production (*OFF*) (Table 7A).[12] Moreover, to account for the possibility that GVC participation accounts for other trade-related characteristics of the sector, we run our models also employing a sectoral measure of openness (export-based) (Table 8A)[13]. Finally, we changed the

[11] Total foreign ownership defined as presence of ≥99% of foreign shares.
[12] *FVA* is part of *VS* which consists of foreign value added embodied in exports (FVA) and pure double counting from foreign sources component. The latter is said to reflect multiple border crossings of intermediates. *OFF*, in turn, reflects the component of *GII* measured at the last stage of production only, ignoring the remaining backward stages (Timmer et al., 2016; Szymczak et al., 2022).
[13] We do not use this setting as our base specification because the correlation between GVC and openness is high (up to 0.8, depends on a choice of GVC measure).

estimation method, switching to IV regression (Table 9A) and weighted IV regression[14] (Table 10A). We instrument the GVC variable for a given country *i* -sector *j* pair using an instrument inspired by the approach of Autor et al. (2013) and based on the average GVC indicator in the same sector *j* but in similar countries (excluding *i* and *i*'s geographical neighbors). For Germany, the instrument is based on average GVC data typical for EU15 countries remote from Germany. Concurrently, for Poland, we use CEE as a reference group (in both cases, excluding the neighboring countries). We built three-dimensional weights (size-sector-year) based on Eurostat data on the population of enterprises in each country[15]. None of these modifications significantly alters our results.

5. Conclusions

This study provides a comparative view of the relationship between firm-level productivity, foreign investment, and integration of production processes within global value chains. The extant literature on FDI-productivity addresses either the developing or developed countries' perspective and is separated from the evidence on productivity–GVC analysis. We exploit firm-level data on companies from two European countries, Poland and Germany, to address this shortcoming. The choice is not accidental: they are geographically close but located at opposite extremes of the European productivity spectrum. Overall, Poland is two times less productive than Germany and plays different roles in the European investment and production network.

Our results are based on firm-level estimation of TFP and joint assessment of the linkages between firms' productivity, ownership type, and GVC participation. First, TFP differences between domestic and foreign-owned firms exist in the two countries. Thus, we show that foreign ownership premium is not confined to the developing context but is also present in a leader country. Secondly, we reveal some interesting results once we compare firms located in the leader and the follower country in terms of the interplay between foreign ownership and the

[14] The sample underrepresents the smallest companies and overrepresents the largest ones, and deviates from the population sectoral distribution. However, foreign ownership is more typical for the companies which are well represented in our sample: larger and active in particular industries, like manufacturing or wholesale and retail trade. For instance, among small Polish enterprises employing up to 9 employees, there is only about 1% of entities with foreign capital participation (data for 2014). The same share for enterprises with 10 or more employees is over 11%. In Germany, almost 50% of foreign controlled enterprises (Eurostat definition: https://ec.europa.eu/eurostat/cache/metadata/en/fats_esms.htm) operated in manufacturing, and wholesale and retail trade in 2014; in Poland, this was even more—about 67% (of all enterprises in the total business economy; repair of computers, personal and household goods; except financial and insurance activities").

[15] Data source: Eurostat, Business demography by size class: https://ec.europa.eu/eurostat/databrowser/view/bd_9bd_sz_cl_r2/default/table?lang=en

involvement in global production. As GVC involvement (proxied by different measures) increases in both countries, the foreign ownership productivity premium decreases.

The comparison of our findings to the previous literature is not straightforward because (to the best of our knowledge) there is no other comparative firm-level study on the GVC-productivity link conditional upon ownership type as our study does. Broad productivity-FDI literature shows rather contrasting results regarding foreign ownership premium, while firm-level evidence relating GVC to productivity is much more limited. We believe that the catching-up effect can explain the loss of productivity premium by foreign-owned companies with respect to the domestically owned firms, observed along with the GVC intensification. Domestic companies, initially less involved in GVCs, are likely to benefit from a bigger productivity rise than foreign-owned companies that are already well established within international production networks. Further comparative research encompassing the comparison of foreign ownership-GVC-productivity nexus in firms from more than one transition economy will enrich this picture.

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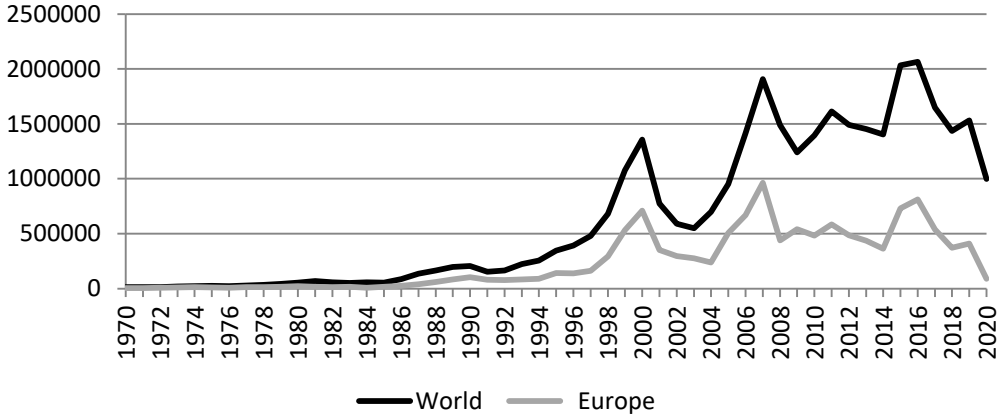
Tables and Figures

Figure 1. Foreign Direct Investment inflows (in millions US dollars), World and Europe (1970-2020)



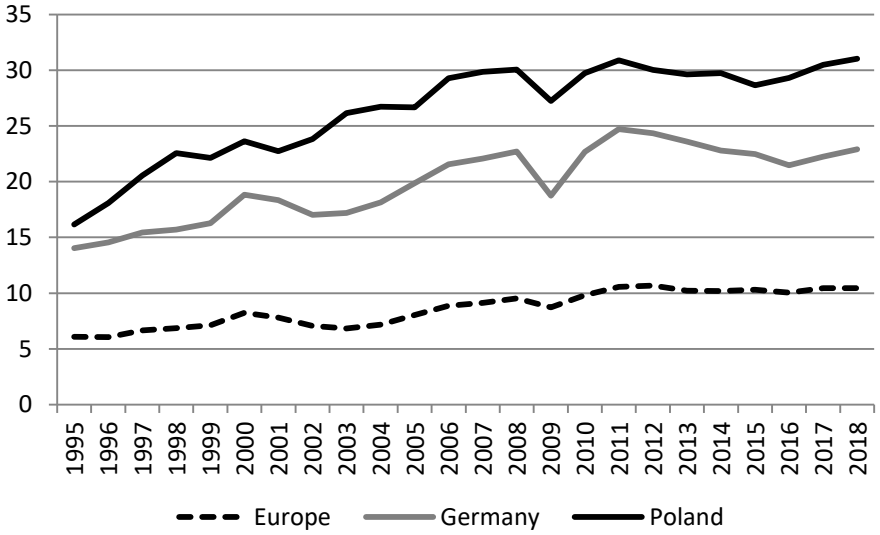
Source: own elaboration based on data from UNCTAD FDI database (2022)

Table 1. FDI – Poland versus Germany (1990 and 2020)

	Poland		Germany	
	as % of world total	as % of GDP	as % of world total	as % of GDP
FDI inward stock - 2020	0.6	41.8	2.5	27.9
FDI outward stock - 2020	0.06	4.5	5	52.2
FDI inward stock - 1990	0.005	0.17	10	12.8
FDI outward stock - 1990	0.004	0.14	13.7	17.4

Source: own elaboration using data from UNCTAD FDI database (2022)

Figure 2. GVC trends (FVA share in gross exports in %) – Europe, Germany, Poland (1995-2018)



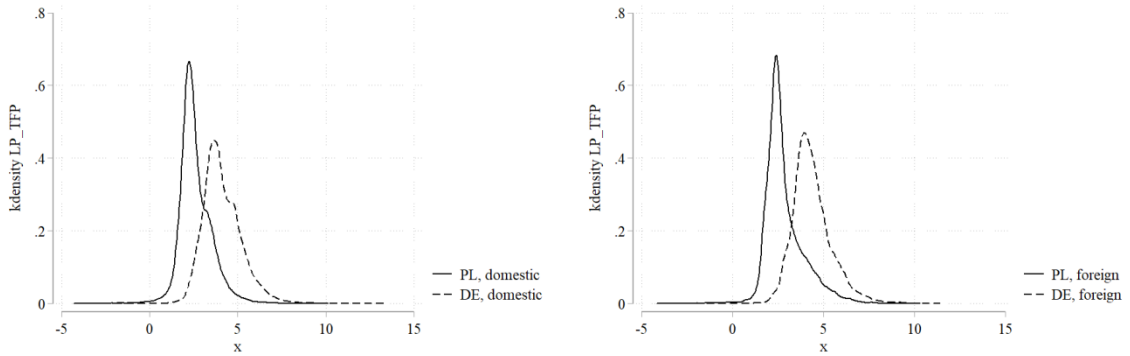
Note: *GVC measured in terms of foreign value added (FVA) share in gross exports, in %.
Source: own elaboration using data from OECD TiVA (2021) (Dataset: Trade in Value Added (TiVA) 2021 ed: Principal Indicators)

Table 2. Key characteristics of domestic and foreign owned firms - Poland versus Germany

	Germany		Poland	
	domestic	foreign	domestic	foreign
Firm size (no. of employees)	143	216	78	156
Firm age (in years)	25.79	23.88	14.53	12.12
Productivity (TFP)	155.77	196.01	24.59	44.51
Capital to labour ratio (thousand EUR per employee)	232.65	187.90	202.93	393.27
R&D (no. of patents)	6.19	17.65	1.03	0.31

Source: own elaboration on Eurostat and Amadeus data. The table reports mean values over the sample period (2004-2014).

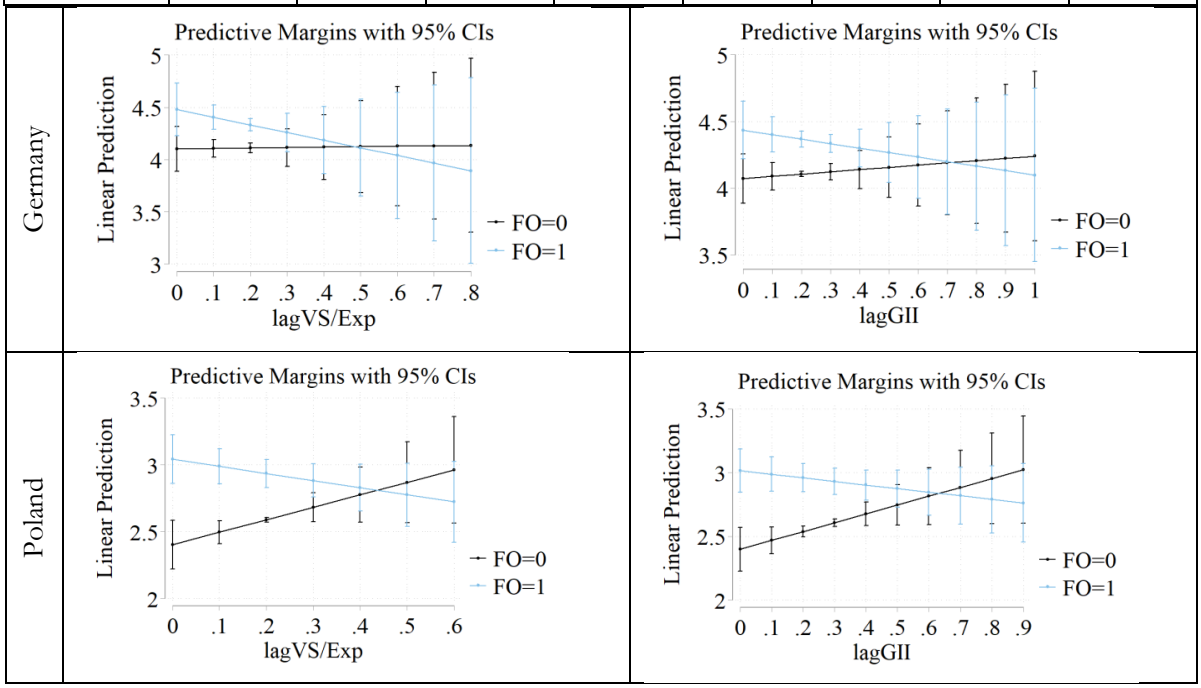
Figure 3. Density plots of total factor productivity, by country and ownership (left – domestic firms, right – foreign owned firms)



Source: own elaboration based on Amadeus and WIOD data

Table 3. Estimation of eq.2 and eq.3 for Germany and Poland and corresponding figures of predicted productivity due to the changes in GVC (illustrating the results from eq.3)

dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
l_{it}	0.103***	0.102***	0.103***	0.102***	0.050***	0.052***	0.050***	0.052***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.014]	[0.014]	[0.014]
age_{it}	-0.007	-0.008	-0.007	-0.008	-0.012	-0.015	-0.012	-0.015
	[0.006]	[0.006]	[0.006]	[0.006]	[0.012]	[0.011]	[0.012]	[0.011]
k_l_{it}	0.055***	0.055***	0.055***	0.055***	0.054***	0.056***	0.054***	0.056***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.018]	[0.019]	[0.018]	[0.019]
$r\&d_{it}$	0.015*	0.015*	0.015*	0.015*	0.031**	0.026**	0.031**	0.026**
	[0.009]	[0.009]	[0.009]	[0.009]	[0.012]	[0.012]	[0.012]	[0.012]
gdp_{rt}	0.486***	0.481***	0.486***	0.481***	0.301***	0.288***	0.301***	0.288***
	[0.032]	[0.032]	[0.032]	[0.032]	[0.036]	[0.035]	[0.036]	[0.035]
$prod_{jt}$	0.633***	0.630***	0.639***	0.637***	0.174***	0.183***	0.170***	0.179***
	[0.098]	[0.098]	[0.101]	[0.101]	[0.047]	[0.047]	[0.048]	[0.048]
FO_i	0.238***	0.375***	0.238***	0.363***	0.344***	0.639***	0.344***	0.617***
	[0.028]	[0.057]	[0.028]	[0.055]	[0.046]	[0.115]	[0.046]	[0.109]
GVC_{jt-1}	-0.044	0.041	0.1	0.168	0.643	0.933*	0.490*	0.694**
	[0.665]	[0.650]	[0.414]	[0.408]	[0.430]	[0.482]	[0.289]	[0.326]
$FO_i \times GVC_{jt-1}$		-0.771***		-0.504***		-1.463***		-0.976***
		[0.242]		[0.162]		[0.351]		[0.230]
R2	0.59	0.59	0.59	0.59	0.32	0.32	0.32	0.32
N	212976	212976	212976	212976	189537	189537	189537	189537



Notes: TFP estimated by Levinsohn-Petrin method. All control variables expressed in logs. Year and industry dummies included, robust standard errors clustered at the industry level. FO – foreign ownership (domestic firm if FO=0). Source: own elaboration based on data from Amadeus and WIOD

Appendix

Table 1A. Descriptive statistics of variables used in the analysis

		Germany				Poland			
	Variable	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
production function	*y*	9.05	1.92	0	18.86	7.41	1.92	-1.00	15.68
	k	6.31	2.62	0	16.90	5.12	2.63	-0.30	15.02
	l	3.72	1.62	0	10.57	3.30	1.38	0	10.49
	m	7.66	2.57	0	20.44	6.18	2.48	-0.77	15.45
	tfp	4.14	1.09	-3.98	13.36	2.62	0.94	-4.32	10.30
	Wooldridge_tfp	4.10	1.50	-4.40	24.33	2.42	1.07	-6.35	13.34
control variables	*age*	2.87	0.91	0	6.57	2.44	0.75	0	6.48
	k_l	2.79	1.63	0	14.15	2.22	1.59	-0.05	12.66
	rd	0.42	1.06	0	9.48	0.08	0.40	0	8.19
	gdp	10.34	0.24	9.76	10.96	9.69	0.28	8.98	10.30
	prod	3.89	0.51	3.10	6.49	2.85	0.61	0.97	5.69
	FO	0.11	0.31	0	1	0.14	0.34	0	1
GVC	*GII*	0.23	0.14	0.03	0.99	0.25	0.13	0.06	0.88
	VS/Exp	0.17	0.09	0.03	0.75	0.18	0.09	0.05	0.59
	OFF	0.10	0.07	0.01	0.70	0.10	0.07	0.02	0.53
	FVA/Exp	0.12	0.06	0.02	0.45	0.13	0.06	0.04	0.48
other	*TOT_FO*	0.08	0.28	0	1	0.10	0.30	0	1
	openness	0.52	0.69	0.00	6.62	0.49	0.72	0.00	5.57
No of observations		212,976				189,537			
No of firms		67,793				56,630			

Notes: all production function variables and control variables (except *FO*) are expressed in logs

Source: own elaboration based on Amadeus and WIOD data.

Table 2A. Sample vs. population structure – sectoral distribution

Sector		Germany		Poland	
NACE Rev.2	Sector description	sample	population	sample	population
B	Mining and quarrying	0.36%	0.07%	0.46%	0.07%
C	Manufacturing	26.66%	7.64%	21.92%	8.10%
DE	Electricity, gas, steam, air conditioning and water supply; sewerage, waste management and remediation activities	5.20%	1.22%	3.04%	5.88%
F	Construction	12.88%	10.60%	9.08%	8.73%
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	25.48%	19.78%	30.89%	22.73%
H,J	Transportation and storage. Information and communication	7.61%	7.35%	8.38%	7.14%
I	Accommodation and food service activities	1.65%	6.01%	1.93%	2.47%
K	Financial and insurance activities except activities of holding companies	0.52%	1.68%	1.67%	2.21%
LN	Real estate, professional, scientific, technical, administrative and support service activities	10.85%	27.36%	17.03%	11.24%
P	Education	0.60%	1.94%	1.12%	4.65%
Q	Human health and social work activities	5.51%	6.69%	3.22%	15.49%
RS	Arts, entertainment and recreation. Other service activities	2.67%	9.66%	1.25%	11.29%

Source: own elaboration based on Eurostat and Amadeus data. Reported percentages for population are means over the sample period (2004-2014).

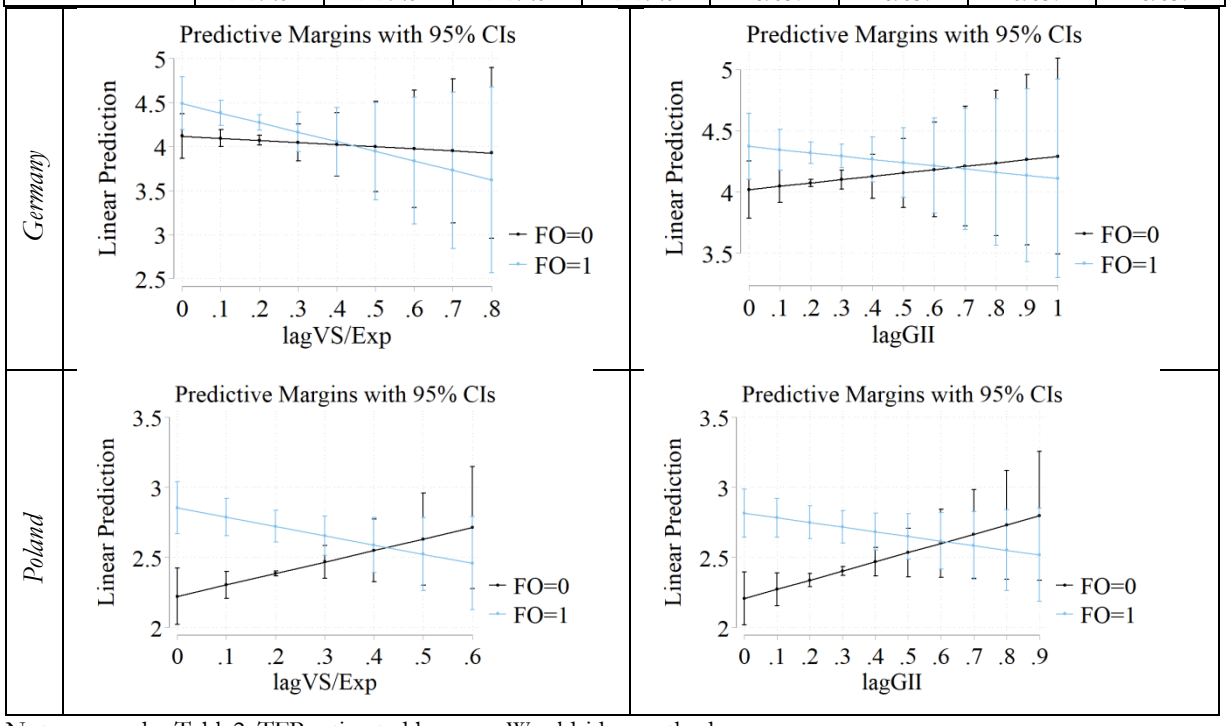
Table 3A. Sample vs. population structure – distribution by size of the companies.

	Germany		Poland	
size of enterprise (no. of empl.)	sample	population	sample	population
<5	8.99%	82.24%	2.51%	67.42%
5-9	10.03%	8.61%	21.96%	13.50%
>=10	80.98%	9.15%	75.53%	19.08%

Source: own elaboration on Eurostat and Amadeus data. Reported percentages for population are means over the sample period (2004-2014).

Table 4A. Robustness - estimation of eq.2 and eq.3 for Germany and Poland; alternative method of TFP estimation (Wooldridge gmm); and corresponding figures (for eq. 3).

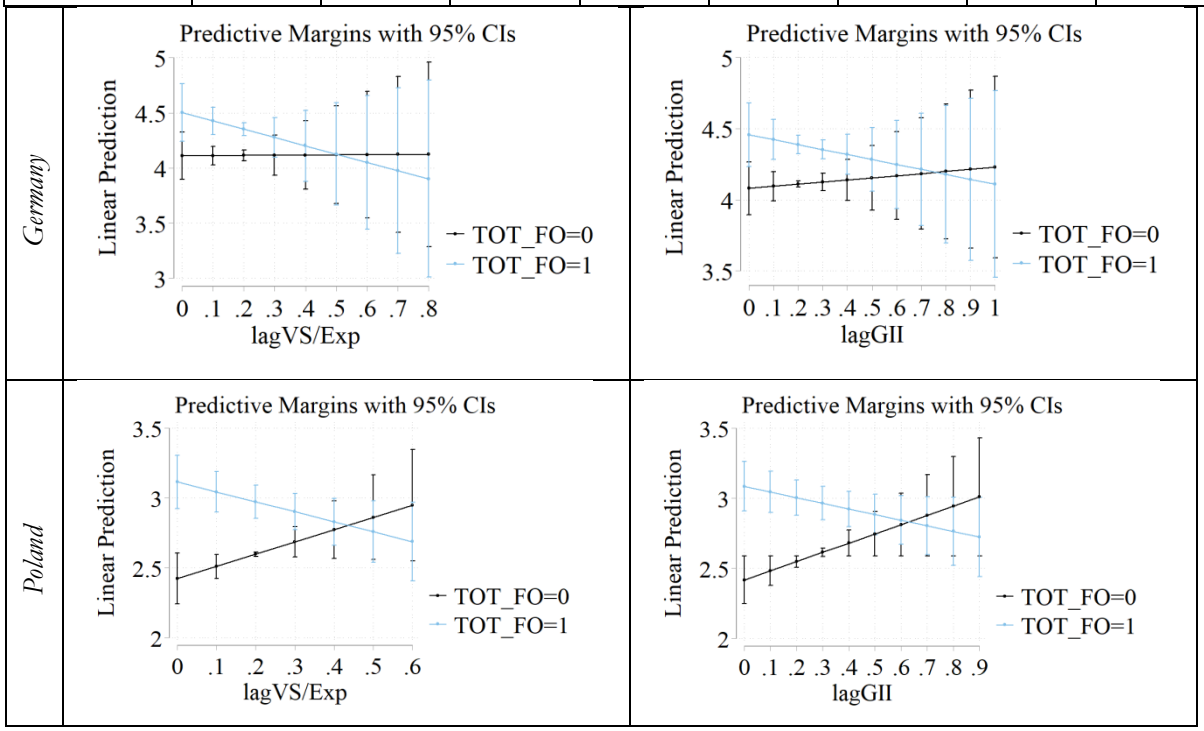
dep. variable: Wooldridge_ tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
l_{it}	0.119***	0.118***	0.119***	0.118***	0.025	0.028	0.025	0.028
	[0.019]	[0.018]	[0.019]	[0.018]	[0.017]	[0.017]	[0.017]	[0.017]
age_{it}	-0.007	-0.007	-0.007	-0.007	-0.007	-0.009	-0.007	-0.009
	[0.010]	[0.010]	[0.010]	[0.010]	[0.013]	[0.013]	[0.013]	[0.013]
k_l_{it}	0.068***	0.068***	0.068***	0.068***	0.054**	0.055**	0.053**	0.055**
	[0.019]	[0.019]	[0.019]	[0.019]	[0.021]	[0.021]	[0.021]	[0.021]
$r\&d_{it}$	0.003	0.003	0.003	0.003	0.029*	0.024	0.029*	0.024
	[0.022]	[0.022]	[0.022]	[0.022]	[0.015]	[0.015]	[0.015]	[0.015]
gdp_{rt}	0.509***	0.503***	0.509***	0.504***	0.299***	0.286***	0.299***	0.286***
	[0.053]	[0.053]	[0.053]	[0.053]	[0.038]	[0.036]	[0.037]	[0.036]
$prod_{jt}$	0.609***	0.606***	0.630***	0.628***	0.177***	0.186***	0.173***	0.181***
	[0.118]	[0.119]	[0.122]	[0.122]	[0.048]	[0.047]	[0.049]	[0.049]
FO_i	0.221***	0.371***	0.221***	0.353***	0.333***	0.631***	0.333***	0.609***
	[0.035]	[0.089]	[0.035]	[0.084]	[0.049]	[0.126]	[0.049]	[0.119]
GVC_{jt-1}	-0.334	-0.24	0.201	0.273	0.524	0.817	0.45	0.657*
	[0.759]	[0.760]	[0.506]	[0.513]	[0.470]	[0.526]	[0.317]	[0.358]
$FO_i \times GVC_{jt-1}$		-0.846**		-0.535**		-1.477***		-0.987***
		[0.364]		[0.241]		[0.389]		[0.255]
R2	0.66	0.66	0.66	0.66	0.42	0.42	0.42	0.42
N	212945	212945	212945	212945	189537	189537	189537	189537



Notes: as under Table2; TFP estimated by gmm Wooldridge method.

Table 5A. Robustness - estimation of eq.2 and eq.3 for Germany and Poland (as Table 4)– total foreign ownership); and corresponding figures (for eq.3).

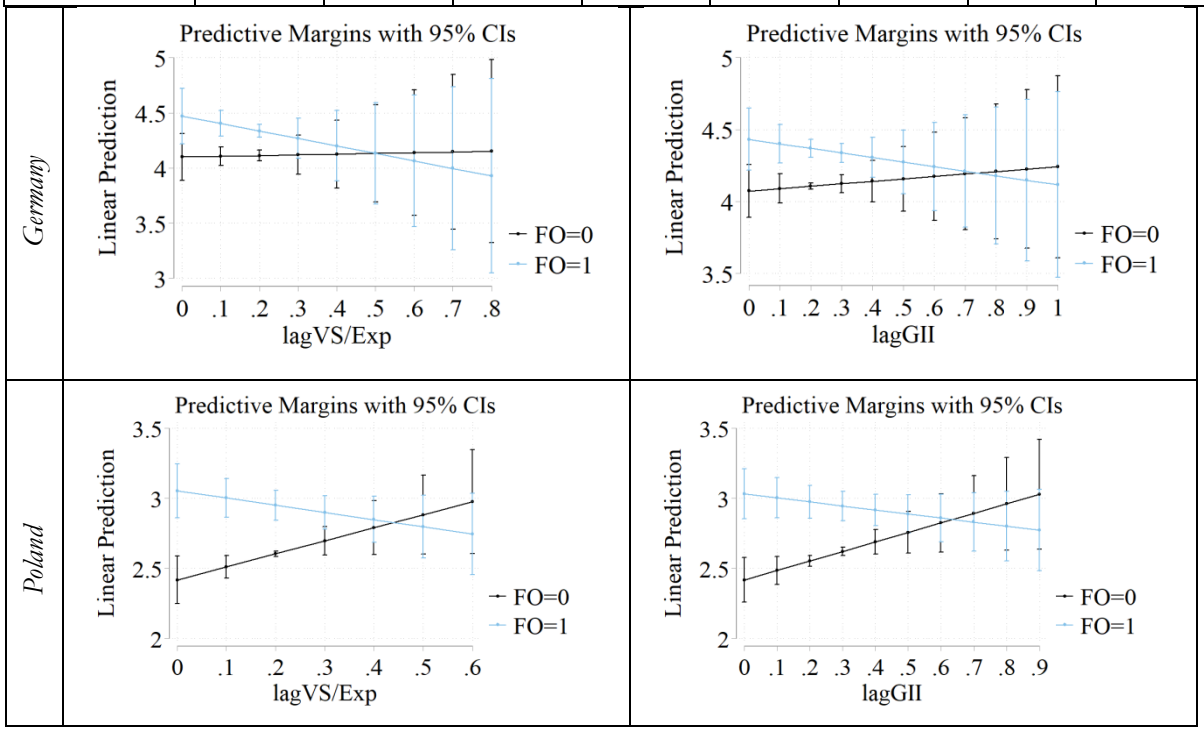
dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
l_{it}	0.102***	0.102***	0.102***	0.102***	0.049***	0.052***	0.049***	0.052***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.013]	[0.014]	[0.013]
age_{it}	-0.008	-0.008	-0.008	-0.008	-0.014	-0.017	-0.014	-0.017
	[0.006]	[0.006]	[0.006]	[0.006]	[0.012]	[0.011]	[0.012]	[0.011]
k_l_{it}	0.055***	0.055***	0.055***	0.055***	0.308***	0.297***	0.308***	0.297***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.036]	[0.035]	[0.036]	[0.035]
$r\&d_{it}$	0.016*	0.017*	0.016*	0.017*	0.055***	0.056***	0.055***	0.056***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.018]	[0.018]	[0.018]	[0.018]
gdp_{rt}	0.489***	0.485***	0.489***	0.485***	0.035***	0.029**	0.035***	0.029**
	[0.033]	[0.033]	[0.033]	[0.033]	[0.012]	[0.012]	[0.012]	[0.012]
$prod_{jt}$	0.635***	0.630***	0.641***	0.638***	0.174***	0.182***	0.170***	0.178***
	[0.098]	[0.098]	[0.101]	[0.101]	[0.047]	[0.047]	[0.048]	[0.048]
TOT_FO_i	0.256***	0.391***	0.256***	0.378***	0.367***	0.692***	0.367***	0.667***
	[0.029]	[0.060]	[0.029]	[0.058]	[0.048]	[0.132]	[0.048]	[0.125]
GVC_{jt-1}	-0.041	0.017	0.103	0.149	0.649	0.878*	0.492*	0.658**
	[0.666]	[0.653]	[0.416]	[0.409]	[0.432]	[0.481]	[0.290]	[0.326]
TOT_FO_i × GVC_{jt-1}		-0.767***		-0.498***		-1.589***		-1.058***
		[0.245]		[0.165]		[0.409]		[0.268]
R2	0.59	0.59	0.59	0.59	0.31	0.32	0.31	0.32
N	212976	212976	212976	212976	189537	189537	189537	189537



Notes: as under Table 2. Total foreign ownership defined as presence of ≥99% of foreign direct shares.

Table 6A. Robustness - estimation of eq.2 and eq.3 for Germany and Poland - trimmed sample); and corresponding figures (for eq.3).

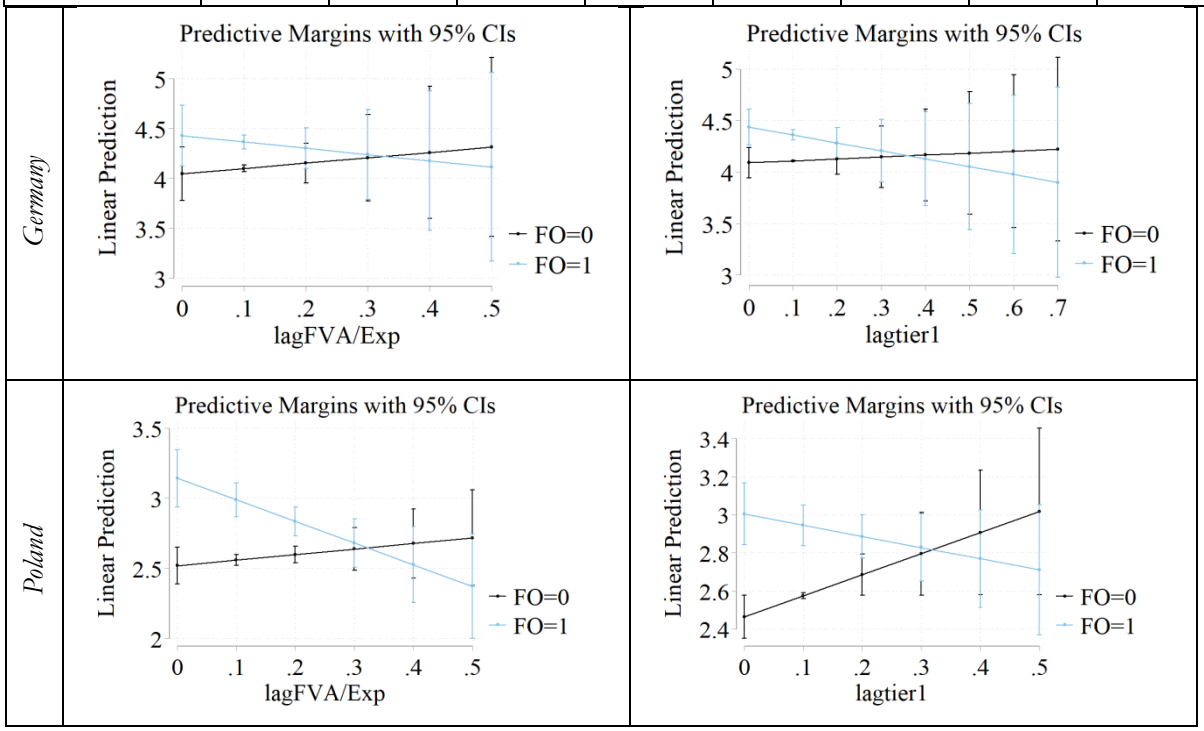
dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
l_{it}	0.094***	0.094***	0.094***	0.094***	0.043***	0.046***	0.043***	0.046***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.014]	[0.014]	[0.014]
age_{it}	-0.006	-0.007	-0.006	-0.007	-0.024*	-0.026**	-0.024*	-0.026**
	[0.006]	[0.006]	[0.006]	[0.006]	[0.013]	[0.013]	[0.013]	[0.013]
k_l_{it}	0.053***	0.053***	0.053***	0.053***	0.316***	0.303***	0.316***	0.303***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.041]	[0.039]	[0.041]	[0.039]
$r\&d_{it}$	0.015*	0.015*	0.015*	0.016*	0.050***	0.052***	0.050***	0.052***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.018]	[0.018]	[0.018]	[0.018]
gdp_{rt}	0.479***	0.475***	0.479***	0.475***	0.035***	0.030**	0.035***	0.030**
	[0.032]	[0.032]	[0.032]	[0.032]	[0.011]	[0.011]	[0.011]	[0.011]
$prod_{jt}$	0.626***	0.623***	0.631***	0.629***	0.164***	0.172***	0.161***	0.169***
	[0.098]	[0.098]	[0.101]	[0.101]	[0.048]	[0.048]	[0.049]	[0.048]
FO_i	0.240***	0.371***	0.240***	0.360***	0.345***	0.636***	0.345***	0.615***
	[0.028]	[0.059]	[0.028]	[0.056]	[0.047]	[0.119]	[0.047]	[0.113]
GVC_{jt-1}	-0.016	0.066	0.104	0.169	0.66	0.930**	0.489*	0.680**
	[0.662]	[0.648]	[0.412]	[0.406]	[0.405]	[0.449]	[0.272]	[0.304]
$FO_i \times GVC_{jt-1}$		-0.744***		-0.486***		-1.443***		-0.967***
		[0.245]		[0.164]		[0.362]		[0.238]
R2	0.6	0.6	0.6	0.6	0.34	0.34	0.34	0.34
N	212180	212180	212180	212180	188256	188256	188256	188256



Notes: as under Table 2. Sample trimmed to keep only the observations with turnover within three standard deviations from the country mean.

Table 7A. Robustness - estimation of eq.2 and eq.3 for Germany and Poland – GVC participation measured by alternative indices; and corresponding figures (for eq.3).

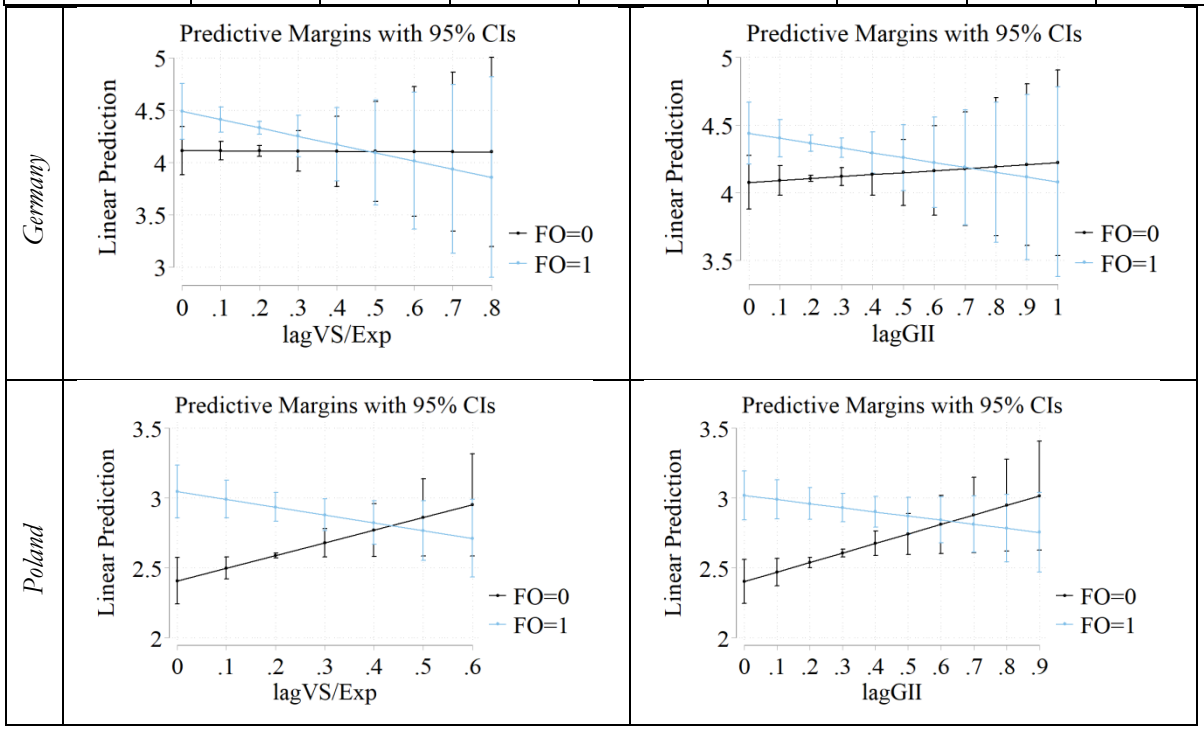
dep. variable: tfp	*Germany*				*Poland*			
	GVC=FVA/Exp		*GVC=OFF*		*GVC=FVA/Exp*		*GVC=OFF*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
l_{it}	0.103***	0.103***	0.103***	0.102***	0.050***	0.052***	0.050***	0.052***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.013]	[0.014]	[0.014]
age_{it}	-0.007	-0.008	-0.007	-0.008	-0.012	-0.015	-0.012	-0.015
	[0.006]	[0.006]	[0.006]	[0.006]	[0.012]	[0.011]	[0.012]	[0.011]
k_l_{it}	0.055***	0.055***	0.055***	0.055***	0.054***	0.056***	0.054***	0.056***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.018]	[0.019]	[0.018]	[0.019]
$r\&d_{it}$	0.015*	0.015*	0.015*	0.015*	0.031**	0.027**	0.031**	0.026**
	[0.009]	[0.009]	[0.009]	[0.009]	[0.012]	[0.012]	[0.012]	[0.012]
gdp_{rt}	0.486***	0.481***	0.486***	0.481***	0.302***	0.290***	0.301***	0.289***
	[0.032]	[0.032]	[0.032]	[0.032]	[0.037]	[0.036]	[0.037]	[0.035]
$prod_{jt}$	0.643***	0.640***	0.637***	0.633***	0.182***	0.191***	0.175***	0.184***
	[0.102]	[0.102]	[0.100]	[0.099]	[0.045]	[0.045]	[0.047]	[0.047]
FO_i	0.238***	0.380***	0.238***	0.346***	0.344***	0.623***	0.344***	0.541***
	[0.028]	[0.061]	[0.028]	[0.048]	[0.046]	[0.118]	[0.046]	[0.095]
GVC_{jt-1}	0.427	0.532	0.074	0.187	0.024	0.397	0.699	1.108**
	[1.178]	[1.156]	[0.750]	[0.737]	[0.405]	[0.467]	[0.478]	[0.547]
$FO_i \times GVC_{jt-1}$		-1.156***		-0.955***		-1.937***		-1.695***
		[0.378]		[0.289]		[0.551]		[0.406]
R2	0.59	0.59	0.59	0.59	0.32	0.32	0.32	0.32
N	212976	212976	212976	212976	189537	189537	189537	189537



Notes: as under Table 2.

Table 8A. Robustness - estimation of eq.2 and eq.3 for Germany and Poland – additional variable openness; and corresponding figures (for eq.3).

dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
l_{it}	0.103***	0.102***	0.103***	0.102***	0.050***	0.052***	0.050***	0.052***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.013]	[0.014]	[0.013]
age_{it}	-0.007	-0.008	-0.007	-0.008	-0.012	-0.015	-0.012	-0.015
	[0.006]	[0.006]	[0.006]	[0.006]	[0.011]	[0.011]	[0.012]	[0.011]
k_l_{it}	0.055***	0.055***	0.055***	0.055***	0.054***	0.056***	0.054***	0.056***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.018]	[0.019]	[0.018]	[0.019]
$r\&d_{it}$	0.015*	0.015*	0.015*	0.015*	0.031***	0.027**	0.031***	0.026**
	[0.009]	[0.009]	[0.009]	[0.009]	[0.011]	[0.012]	[0.011]	[0.012]
gdp_{rt}	0.486***	0.481***	0.486***	0.481***	0.301***	0.288***	0.301***	0.288***
	[0.032]	[0.032]	[0.032]	[0.032]	[0.036]	[0.035]	[0.036]	[0.035]
$prod_{jt}$	0.638***	0.635***	0.643***	0.640***	0.187***	0.196***	0.183***	0.192***
	[0.098]	[0.098]	[0.100]	[0.100]	[0.046]	[0.045]	[0.047]	[0.046]
$openness_{jt}$	0.021	0.021	0.013	0.014	0.067**	0.068**	0.067**	0.068**
	[0.085]	[0.084]	[0.084]	[0.083]	[0.029]	[0.029]	[0.029]	[0.029]
FO_i	0.238***	0.375***	0.238***	0.363***	0.344***	0.640***	0.344***	0.617***
	[0.028]	[0.057]	[0.028]	[0.055]	[0.046]	[0.115]	[0.046]	[0.109]
GVC_{jt-1}	-0.1	-0.016	0.078	0.145	0.614	0.904**	0.478*	0.682**
	[0.720]	[0.705]	[0.446]	[0.440]	[0.392]	[0.439]	[0.267]	[0.302]
$FO_i \times GVC_{jt-1}$		-0.772***		-0.504***		-1.464***		-0.976***
		[0.242]		[0.162]		[0.350]		[0.230]
R2	0.59	0.59	0.59	0.59	0.32	0.32	0.32	0.32
N	212976	212976	212976	212976	189537	189537	189537	189537



Notes: as under Table 2

Table 9A. Estimation of eq.2 and eq.3 for Germany and Poland – instrumental variable approach for GVC participation

dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
l_{it}	0.102***	0.102***	0.102***	0.102***	0.050***	0.053***	0.050***	0.052***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.014]	[0.014]	[0.014]	[0.014]
age_{it}	-0.007	-0.007	-0.007	-0.008	-0.013	-0.016	-0.013	-0.016
	[0.006]	[0.006]	[0.006]	[0.006]	[0.011]	[0.011]	[0.011]	[0.011]
k_l_{it}	0.054***	0.055***	0.054***	0.055***	0.053***	0.055***	0.053***	0.055***
	[0.012]	[0.012]	[0.012]	[0.012]	[0.018]	[0.018]	[0.018]	[0.018]
$r\&d_{it}$	0.015*	0.016*	0.015*	0.015*	0.031***	0.027**	0.031***	0.027**
	[0.009]	[0.009]	[0.009]	[0.009]	[0.012]	[0.011]	[0.011]	[0.011]
gdp_{rt}	0.485***	0.481***	0.485***	0.481***	0.295***	0.282***	0.297***	0.284***
	[0.032]	[0.032]	[0.032]	[0.032]	[0.035]	[0.033]	[0.035]	[0.033]
$prod_{jt}$	0.783***	0.780***	0.695***	0.691***	0.078	0.086	0.085	0.096
	[0.142]	[0.142]	[0.115]	[0.114]	[0.146]	[0.145]	[0.121]	[0.117]
FO_i	0.238***	0.358***	0.238***	0.344***	0.343***	0.641***	0.343***	0.619***
	[0.028]	[0.059]	[0.028]	[0.051]	[0.045]	[0.153]	[0.045]	[0.134]
GVC_{jt-1}	4.428	4.509	1.207*	1.230*	8.077	8.395	3.797	3.932
	[2.810]	[2.832]	[0.660]	[0.650]	[6.680]	[6.768]	[2.441]	[2.485]
$FO_i \times GVC_{jt-1}$		-0.676***		-0.428***		-1.477***		-0.986***
		[0.253]		[0.154]		[0.535]		[0.321]
Under-identification p-value	0.00	0.00	0.00	0.00	0.16	0.16	0.04	0.04
Weak identification test stat.	9.23	4.61	49.59	24.83	1.77	0.89	4.46	2.23
N	212976	212976	212976	212976	189537	189537	189537	189537

Notes: TFP estimated by Levinsohn-Petrin method. All control variables expressed in logs. Year and industry dummies included, robust standard errors clustered at industry level. Under-identification p-value refers to the Kleibergen-Paap rk LM test statistic, where a rejection of the null indicates that the instruments are not under-identified. The weak identification test statistic refers to the Kleibergen-Paap Wald rk F test for the presence of weak instruments
Source: own elaboration based on data from Amadeus and WIOD

Table 10A. Estimation of eq.2 and eq.3 for Germany and Poland – IV and weighted regression

dep. variable: tfp	*Germany*				*Poland*			
	GVC=VS/Exp		*GVC=GII*		*GVC=VS/Exp*		*GVC=GII*	
	eq. 2	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*	*eq. 2*	*eq.3*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
l_{it}	0.065***	0.065***	0.065***	0.065***	0.017	0.018*	0.017	0.018*
	[0.015]	[0.015]	[0.015]	[0.015]	[0.011]	[0.010]	[0.011]	[0.010]
age_{it}	0.029*	0.029*	0.029*	0.029*	0.008	0.007	0.009	0.008
	[0.017]	[0.017]	[0.017]	[0.017]	[0.021]	[0.021]	[0.020]	[0.020]
k_l_{it}	0.081***	0.081***	0.081***	0.081***	0.036**	0.037**	0.036**	0.037**
	[0.018]	[0.019]	[0.018]	[0.019]	[0.016]	[0.017]	[0.016]	[0.017]
$r\&d_{it}$	0.017*	0.018*	0.017*	0.018*	0.041**	0.038**	0.041**	0.038**
	[0.010]	[0.010]	[0.010]	[0.010]	[0.017]	[0.016]	[0.017]	[0.016]
gdp_{rt}	0.508***	0.505***	0.508***	0.505***	0.223***	0.217***	0.224***	0.218***
	[0.047]	[0.047]	[0.047]	[0.047]	[0.050]	[0.049]	[0.050]	[0.050]
$prod_{jt}$	0.633**	0.631**	0.536**	0.530**	0.086	0.1	0.084	0.098
	[0.300]	[0.300]	[0.251]	[0.251]	[0.097]	[0.091]	[0.091]	[0.087]
FO_i	0.283***	0.405***	0.283***	0.398***	0.313***	0.516***	0.313***	0.501***
	[0.047]	[0.113]	[0.047]	[0.100]	[0.048]	[0.169]	[0.048]	[0.147]
GVC_{jt-1}	3.963	4.078	1.281	1.324	2.917	3.1	1.201	1.329
	[3.556]	[3.589]	[1.107]	[1.107]	[5.894]	[5.984]	[1.583]	[1.628]
$FO_i \times GVC_{jt-1}$		-0.761		-0.516*		-1.053*		-0.704**
		[0.484]		[0.288]		[0.618]		[0.349]
Under-identification p-value	0.01	0.01	0.00	0.00	0.20	0.20	0.03	0.03
Weak identification test stat.	10.24	5.12	49.43	24.74	0.80	0.40	7.03	3.52
N	212976	212976	212976	212976	189537	189537	189537	189537

Notes: TFP estimated by Levinsohn-Petrin method. All control variables expressed in logs. Year and industry dummies included, robust standard errors clustered at industry level. Weights based on annual data of firms distribution by size (three classes: <5; 5-9; >= 10 employees) and sector (main 12 sectors: B, C, DE, F, G, HJ, I, K, LN, P, Q, RS). For PL, due to lack of size-sector distribution for P, Q and RS, to create weights for these sectors we use all companies distribution by sector, without size dimension.

Source: own elaboration based on data from Amadeus and WIOD.

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