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

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Abstract

Purpose – The study aims to examine the joint effects of foreign ownership (FO) and involvement in global value chains (GVCs) on the productivity performance of firms from a catching-up country (Poland) and a leader economy (Germany).

Design/methodology/approach – The authors use micro-level data on firms combined with several sector-level GVC participation measures. The authors investigate whether the link between productivity and the overall sectoral degree of involvement in global production structures depends on a firm's ownership. The authors verify the robustness of the obtained results by using an instrumental variables approach and weighted regression.

Findings – The results show that domestically owned firms are less productive than foreign ones, which is particularly true at low GVC participation levels. However, as GVC involvement increases, the FO productivity premium decreases, leading to productivity catching up between foreign and domestically owned firms. This mechanism is similar in Poland and Germany. However, in the leader country (Germany), the productivity performance of domestically owned firms is more stable along the distribution of GVC involvement.

Originality/value – This study contributes to the foreign direct investment (FDI)–productivity literature by comparing the catching-up and developed countries' perspectives and incorporating the productivity–GVC relationship into the FDI analysis. The authors show that the FO premium is not confined to the developing context but is also present in a leader country. Moreover, the link between productivity and the overall sectoral degree of involvement in global production structures depends on a firm's ownership.

Keywords GVC, FDI, Productivity, Firm-level data, Amadeus database

Paper type Research paper

1. Introduction

Amongst the several factors determining a firm's 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 a peak of over US$2 trillion in 2016 (Figure 1a in the online supplementary

JEL Classification — F23, F21, F61, D24, D22

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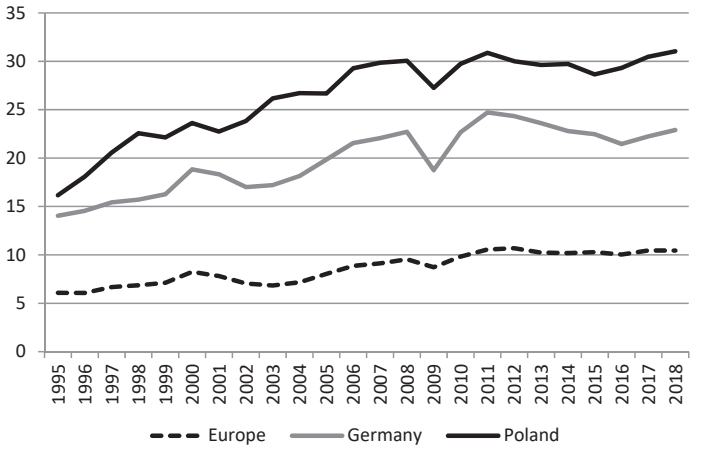
materials), with noticeable effects of economic downturns and, recently, the coronavirus disease 2019 (COVID-19) pandemic [1]. There has been hope for positive FDI spillovers via technology and knowledge transfer (e.g. Arnold and Smarzynska Javorcik, 2005; Chuang and Lin, 1999; Smarzynska Javorcik, 2004; Newman *et al.*, 2015). 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 (GVCs); see Antràs and Chor (2022) for a thorough review. The role of GVCs in global trade is crucial: the World Bank (2020) reports that GVCs account for half the global trade, whilst recent OECD (The Organisation for Economic Co-operation and Development) estimates show that even 70% of global trade involves GVCs because services, raw materials, parts and components cross-borders – often numerous times [2]. In Europe, the foreign value added (FVA) share in gross exports almost doubled between 1995 and 2018 (Figure 1). This tendency reinforced linkages between foreign companies and host economies, creating a complex trade–GVC–investment nexus (Adarov and Stehrer, 2021; Okah Efogo *et al.*, 2022; Qiang *et al.*, 2021). FDI is the primary form of global expansion for multinational companies (MNCs), which fuels trade and GVCs (World Bank, 2020).

This study's contribution is twofold. First, we focus on the productivity effects of the joint FDI–GVC connection. The key research question is: does the link between productivity and the overall sectoral degree of involvement in global production structures depend on a firm's ownership? To answer this question, we combine insights from two literature streams on the global organisation of production. The first is on the productivity effects of international production fragmentation and GVCs (Amador and Cabral, 2015; Criscuolo and Timmis, 2017; Del Prete *et al.*, 2017; Kordalska *et al.*, 2016). The second stream, which is much more abundant, is on the foreign ownership (FO) premium and FDI-driven productivity spillovers (amongst multiple others, Bruno and Cipollina, 2018; Fons-Rosen *et al.*, 2021; Mebratie and van Bergeijk, 2013; Wooster and Diebel, 2010). Instead of treating these mechanisms



Note(s): *GVC measured in terms of foreign value added (FVA) share in gross exports, in %

Source(s): own elaboration using data from OECD TiVA (2021) (Dataset: Trade in Value Added (TiVA) 2021 ed: Principal Indicators)

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separately, we integrate them within one framework, assessing the linkages between a firm's 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, 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-focussed 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 data on firms from more than one country. Whilst only four focussed on productivity, others analysed output growth or revenue efficiency. Among the recent multi-country studies on foreign investment and productivity, Fons-Rosen *et al.* (2021) analysed eight European countries. Still, they confined their interest to the advanced economies, whilst Gorodnichenko *et al.* (2014) and Hagemejer (2016) focussed on the European (and post-Soviet) transition economies. Extra-European evidence on FDI productivity spillovers abounds. However, this research is mainly on selected (typically developing) countries (e.g. Arnold and Smarzynska Javorcik, 2005, on Indonesia; Chuang and Lin, 1999, on Taiwan; Newman *et al.*, 2015, on Vietnam; Wang and Wang, 2015, on China). Overall, we lack a direct comparison for firms from countries located at distinct ends of productivity distribution.

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 European Union (EU) average by approximately 23%, which has remained largely unchanged over the past decade, starting in 2009. Poland is a catching-up economy with labour productivity of only 64% of the EU average, which used to be even lower at 53% in 2009 [3]. 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: the foreign content of Germany's exports is estimated to be equal to 23% (31% in the case of Poland – see Figure 1); 30.5% of Germany's domestic value added is driven by foreign final demand (36.4% in the case of Poland) [TiVA, 2021; data for 2018]. The two countries play different roles in the global investment context (Table 1A in the online supplementary materials). Germany was amongst 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 (CEE) in the early 1990s, Polish FDI was practically null and sharply increased after the transformation of the system [4]. FDI in Poland constitutes around 25% of all foreign capital invested in CEE countries. Germany is a key source of investment flows, with FDI outflow accounting for as much as 42–52% of Germany's GDP, approximately 10 times more than in the case of Poland (UNCTAD, 2022a, b, data for 2017–2021). It is important to notice that Germany is amongst the top source countries of foreign investment inflows to Poland (in 2021, Germany was the second, after Spain, biggest investor in Poland) [according to the National Bank of Poland]. Consequently, we believe a comparison of FO–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 MNCs and FDI/foreign-ownership productivity premium, linking this to the evidence on the productivity effects of GVCs. Section 3 describes our data, whilst Section 4

presents the empirical methods. Section 5 presents the key results, and the last section concludes the study and provides its implications for theory, research and practice.

2. Literature review

2.1 Theories of MNCs and FDI

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. The reason behind the outstanding performance of MNCs is that they are systems that support the creation and flow of knowledge between their units. Kogut and Zander (2003), introducing the knowledge-based evolutionary theory of MNCs, argue that international expansion is motivated by seeking the most effective way to transfer tacit, hardly codifiable technology and know-how. Establishing ownership relations with units abroad lowers the costs of such transfer compared to operating only as a joint venture. Their seminal work is also supported with empirical evidence based on a sample of innovating firms. Therefore, we expect to see higher productivity amongst foreign-owned enterprises, as they may gain access to the relevant knowledge and technology from the investing firm, which also seems to be efficient in transferring it. This is the ownership advantage known from Dunning's OLI (Ownership, Location, and Internalization) framework (Dunning, 1993) and further elaborated by Markusen (1995).

According to the network-based theory, close relationships and cooperation between units within multinational enterprises creates opportunities for new knowledge creation and building additional experience [5]. However, as Pesalj (2011) argues in a review of theoretical approaches of MNCs, there are certain conditions for this effect to appear and for the additional productivity gains to be shared with the dependent company. In particular, in the case of investment directed from a developed economy to a less-developed one, the inferior position of the FDI recipient may block the network-based productivity gains.

2.2 Literature on FDI determinants, spillovers and productivity effects

Developing economies attract FDI especially due to their earning potential, with lower costs of capital and a cheaper workforce. Among other location-specific determinants of FDI from Dunning's OLI framework (Dunning, 1993), lower factor prices may be an advantage that developing countries have over more advanced economies (for an empirical literature review see, for instance, Kok and Ersoy, 2009). Further location-specific determinants, determining which of the developing countries actually receive the interest of foreign investors, are, just to mention a few, infrastructure, labour productivity, local tax policy, or political environment (Kumari and Sharma, 2017). As Nunnenkamp (2002) argues, the list of FDI determinants did not change much in the presence of increased globalisation. However, there were shifts in the relative importance of these factors, in particular, seeking low costs became an even more important reason for FDI placement in developing countries (Dunning, 2003).

When FDI flow is directed to developing countries, the FO premium can be connected with the transfer of knowledge and technology, generating productivity spillovers (Newman *et al.*, 2015; Wooster and Diebel, 2010). 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 Newman *et al.*, 2015; Nicolini and Resmini, 2011).

A meta-analysis by Demena and van Bergeijk (2017) reports positive and statistically significant productivity spillovers of FDI in developing countries in approximately one-third of the studies published since the 1980s [6]. More recently, Wang and Wang (2015) found no evidence of additional productivity gains from FO amongst Chinese firms. In less frequently analysed advanced economies, the productivity-enhancing effects of FDI are also not so evident.

Fons-Rosen *et al.* (2021, pp. 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." Among works that actually found positive productivity spillovers due to FDI in developed countries, one could mention the study by Keller and Yeaple (2009) on USA manufacturing firms. A higher level of FDI in the sector (measured as a share of foreign-owned affiliates' employment in the total sectoral employment) leads to economically significant productivity gains for domestic firms, especially the small ones, with initially lower productivity levels and operating in high-tech industries.

Focussing on the European context, multiple FDI–productivity studies were provoked by the large inflow of foreign investment into 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 analysed either the case of specific transition CEE/SEE 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; 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; Italy: Borin and Mancini, 2016). Overall, the evidence is mixed and often contradicts the optimistic view on the impact of productivity-enhancing FDI 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 amongst 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 whilst 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 analysed 17 economies from 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 FO in firms from four out of six examined SEE countries, whilst the impact of openness depends on whether it involved trade with more or less advanced markets.

2.3 Literature on global value chains (GVCs)

Along with the burgeoning literature on FDI, a parallel stream of research was provoked by a well-documented increase in vertical specialisation (a notion introduced by Hummels *et al.* (2001), and significant developments in methods of GVC quantification, recently investigated in Antràs and Chor, 2022 or Johnson (2018). Although much of the GVC literature (see Amador and Cabral, 2015, for a review) focusses on labour market implications, a few studies have assessed the effects of GVCs on productivity. At the country-industry level, participation in GVCs is a significant driver of labour productivity (Kordalska *et al.*, 2016), operating mainly through backward participation (Constantinescu *et al.*, 2019). But understanding GVCs is crucial in the microeconomic context as they affect sourcing decisions, links between import and export participation and the organisation of the production networks of multinational firms (Johnson, 2018).

GVC-focussed productivity literature builds upon an earlier wave of empirical studies on the relationship between offshoring and industry–or firm-level productivity (Amiti and Wei, 2009; Hijzen *et al.*, 2010), 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 the performance of Canadian firms, even after controlling for selection bias, that is, when more productive firms enter the GVC. An 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, whilst Banh *et al.* (2020) confirm it in Estonian firms. Still, establishing the productivity–GVC link is not easy due to two-way mechanisms: a firm's performance results are amongst the key drivers of GVC participation (Amador and Cabral, 2015).

The effects of GVCs and cross-border investment flows are intertwined (World Bank, 2020). Okah Efogo *et al.* (2022) confirm the interaction between FDI and GVCs 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 3 decades. Still, few firm-level studies explicitly assess the joint effects of FO/FDI and GVC involvement on productivity. In particular, Hagemejer (2016) deals with productivity spillovers within GVCs in CEE 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 CEE and reveals a significant relationship between the foreign value content of exports and firm-level productivity, combined with backward productivity spillovers.

In view of all the above, we formulate the following hypotheses:

H1. Domestically-owned firms are less productive than foreign ones.

H2. A lower sectoral degree of involvement in global production structures is related to lower productivity.

H3. The link between productivity and involvement in global production structures depends on a firm's ownership.

3. Data and sample

3.1 Firm-level data

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 [7]. Data cleaning and preparation [8] are according to Kalemli-Ozcan *et al.* (2015) and Oestreicher *et al.* (2013). First of all, we use the variables needed for a firm-level estimation of total factor productivity (TFP). These are: operating revenue turnover as output (y), number of employees as labour input (l), tangible fixed assets as capital input (k) and material costs as intermediate input (m) [9].

In addition to the variables involved in the production function, we also utilise basic demographic information on firms: year of incorporation – used to derive the firm-level variable *age*; location – NUTS 2 region; sector – NACE Rev. 2 (2-digit code of primary activity); and number of patents – used to proxy research and development (*r&d*) [10]. The NUTS 2 geographical region is further used to assign to each firm the GDP per capita (in purchasing power parity, PPP) of the region where the firm is located (variable *gdp*). Information on a firm's main sector of activity is further needed for a merge with sectoral-level data.

On the firm level, we also explore the ownership information provided by Amadeus. To obtain the binary variable indicating FO status, 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 ownership shares are owned by a foreign company/ies.

We decided on the particular set of control variables for our baseline model on the basis of the literature review and the availability of the data in our data sources. For a general literature review on possible determinants of TFP, please see, for instance, Isaksson (2007), or Wagner (2007) for a review of studies on the relationship between export activities and productivity. Similar control variables are used in studies such as, amongst others, Altomonte and Colantone (2008), Pittiglio and Reganati (2019) and Hallward-Driemeier *et al.* (2002).

3.2 Sector-level data

Firm-level data are merged with country-sector (International Standard Industrial Classification of All Economic Activities (ISIC) Rev 4. industry classification) [11] -level variables, calculated using the World Input-Output Database (WIOD) (Timmer *et al.*, 2015), 2016 release, which is available for 2000–2014. The WIOD provides data for 56 industries and 43 countries (plus the Rest of the World) including variables such as value added, gross exports or total number of hours worked in the country-sector, which are necessary for the sectoral-level measures used in our regression model. For instance, we define sectoral productivity (*prod*) as sectoral value added divided by the total number of hours worked in the sector. In the robustness section, we also take into account export-based sectoral openness (variable *openness*) calculated as exports divided by value added.

More importantly, the WIOD also provides input-output (I-O) tables of intermediate flows between country-sectors. These I-O tables are used for calculations of the four different GVC measures. Our baseline specification uses vertical specialisation expressed as a share of gross exports (variable *VS/Exp*) or the global import intensity (GII, variable *GII*) index [12]. VS is well-rooted in production fragmentation literature (amongst others: Hummels *et al.*, 2001) and comes from Wang *et al.* (2013)'s gross exports decomposition. VS incorporates FVA embodied in exports 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); thus, it accounts both for a greater number of production stages or larger import inputs at a given stage. FVA expressed as a share of gross exports (variable *FVA\Exp*) is employed in our model as a robustness check and so is the classic offshoring index, i.e. a share of imports of intermediate goods in the value of the final production (variable *OFF*).

3.3 Descriptive statistics

The definitions and summary statistics of all the variables are provided in Table 1. Table 2A and Table 3A in the online supplementary materials present the sample with the overall population of firms in the two countries. There are approximately 213,000 observations on 68,000 companies for Germany and 190,000 observations on 57,000 firms for Poland in the final sample. Despite the significant loss of observations due to data availability with respect to the initial dataset (a common problem in firm-level studies), the final sample includes all varieties of firms. They differ by size and the distribution of the age of the firms is also wide. For both countries, the majority of firms are domestically-owned enterprises and demonstrate null patenting activity.

Table 2 reports the key characteristics of firms included in the final sample. As expected, foreign-owned companies are, on average, larger and more productive than domestic ones. This is true in both of the analysed countries. Furthermore, the average R&D activity of domestic and foreign companies in Poland is distinctly lower than can be observed for

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	Variable		Germany Mean	Germany Std Dev	Germany Min	Germany Max	Poland Mean	Poland Std Dev	Poland Min	Poland Max
production function	*y*	operating revenue turnover	9.05	1.92	0	18.86	7.41	1.92	−1.00	15.68
	k	tangible fixed assets	6.31	2.62	0	16.90	5.12	2.63	−0.30	15.02
	l	number of employees	3.72	1.62	0	10.57	3.30	1.38	0	10.49
	m	material costs	7.66	2.57	0	20.44	6.18	2.48	−0.77	15.45
	tfp	total factor productivity (Levinsohn–Petrin)	4.14	1.09	−3.98	13.36	2.62	0.94	−4.32	10.30
	Wrdg_tfp	total factor productivity (Wooldridge)	4.10	1.50	−4.40	24.33	2.42	1.07	−6.35	13.34
control variables	*age*	age of a firm in years	2.87	0.91	0	6.57	2.44	0.75	0	6.48
	k_l	capital (*k*) to labour (*l*) ratio	2.79	1.63	0	14.15	2.22	1.59	−0.05	12.66
	r&d	number of patents	0.42	1.06	0	9.48	0.08	0.40	0	8.19
	gdp	GDP per capita (in PPP) of the NUTS2 region	10.34	0.24	9.76	10.96	9.69	0.28	8.98	10.30
	prod	sectoral value-added divided by total number of hours worked in the sector	3.89	0.51	3.10	6.49	2.85	0.61	0.97	5.69
	FO	foreign ownership (=1 if min. 10% of direct ownership shares are foreign; = 0 else)	0.11	0.31	0	1	0.14	0.34	0	1
GVC	*GII*	global import intensity	0.23	0.14	0.03	0.99	0.25	0.13	0.06	0.88
	VS/Exp	vertical specialisation as a share of gross exports	0.17	0.09	0.03	0.75	0.18	0.09	0.05	0.59
	OFF	share of imports of intermediate goods in the value of the final production	0.10	0.07	0.01	0.70	0.10	0.07	0.02	0.53
	FVA/Exp	foreign value-added embodied in exports as a share of gross exports	0.12	0.06	0.02	0.45	0.13	0.06	0.04	0.48
other	*TOT_FO*	foreign ownership (=1 if ≥ 99% of direct ownership shares are foreign; = 0 else)	0.08	0.28	0	1	0.10	0.30	0	1
	openness	sectoral exports divided by value-added	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		

Note(s): All production function variables and control variables (except *FO*) are expressed in logs
Source(s): Own elaboration based on Amadeus and WIOD data

German companies. Moreover, there is little difference in the age of the two types of firms within a given country, with about two years difference in the mean age between domestic and foreign-owned firms, for both Poland and Germany. The means of age are, however, greater for companies located in Germany. It is worth noticing that the capital intensity of foreign-owned firms in Poland is much higher than the capital intensity of domestically-owned firms in this country, whilst the opposite is typical for firms in Germany. This implies different characteristics of companies with various ownership structures, motivating the inclusion of this aspect in our study.

4. Empirical methods

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

To estimate firm-level TFP, we use the Levinsohn and Petrin (2003) approach [13] for the following Cobb–Douglas production function:

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

where i denotes the firm and t time; the variables *y, l, k and m* are 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 Smarzynska Javorcik (2005).

Figure 2A in the online supplementary materials presents density plots of the 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.

In the second step, the estimated TFP (ω from Eq. 1) serves as the dependent variable in the following regression [14] estimated to verify the determinants of a firm's productivity, including GVC participation and FO:

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

where i denotes the firm, j – sector, r – NUTS 2 geographic region and t – time. Our main variables of interest are the FO identifier and the sectoral measure of GVC participation (GVC). As control variables (all expressed in logs), we consider the following: a firm's size

	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(s): Own elaboration on Eurostat and Amadeus data. The table reports mean values over the sample period (2004–2014)

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

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

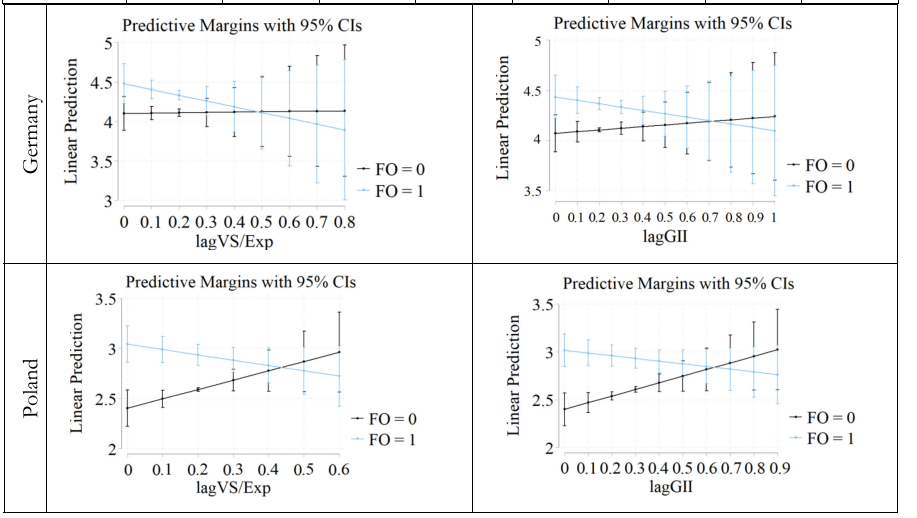

Table 3.
Estimation of eq.2 and eq.3 for Germany and Poland and esponding figures redicted luctivity due to the ges in GVC strating the results eq.3)

Note(s): 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(s): Own elaboration based on data from Amadeus and WIOD

measured by the number of employees (l); the age of a firm in years (age); capital (k) -to-labour (l) ratio (k_l); the number of patents [15] ($r\&d$); NUTS 2 GDP per capita (gdp); and sectoral productivity ($prod$). We add time and sector fixed effects to account for unobservable specificity in these dimensions.

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 firm's 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 analysed 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 variable 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.

5. Results

5.1 Benchmark results

In line with the predictions, the results reported in Table 3 show that irrespective of the model formulation (with or without the interaction term), foreign-owned firms are characterised 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 the sample composition and the overall firm population.

The key results refer to the productivity differences between domestic and foreign-owned firms combined with information on the degree of GVC participation. The convenient interpretation of the interaction between GVC and 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), the productivity difference between domestic and foreign-owned firms is considerable. As suggested by the theory (Dunning, 1988; Markusen, 2002), foreign-owned firms demonstrate higher productivity levels than purely domestic ones. However, as GVC involvement increases, the FO productivity 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 where 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. Clearly, there is a two-way relation between productivity and GVC involvement, similar to that between productivity and FDI. Namely, domestic firms that participate in GVCs are likely to be more productive at the outset but operating in a sector with higher GVC involvement helps them to increase productivity even further. Such an environment is characterised by high competition, which stimulates firms to be more productive. Being a supplier or a buyer of internationally produced intermediates is an opportunity to cooperate with other GVC

participants, gain new experience and obtain access to inputs of better quality. All these features are similar to those "offered" by FO (Markusen, 1995; Isaksson, 2007). Therefore, our results suggest that domestic firms compensate for the lack of FO productivity premium by entering international production-sharing processes. We show that GVC involvement and FDI are two alternative paths that may lead to high productivity. This is in line with the literature suggesting that GVCs and FDI are examples of different channels of international economic involvement (Dunning, 2015), where FDI may set a background for GVCs (Amador and Cabral, 2016) or, adversely, GVCs may explain FDI (Giroud and Mirza, 2015).

The obtained results are similar in the case of both Polish and German firms. However, in the leader country (Germany), the productivity performance of domestically-owned firms is more stable along the GVC distribution. On the contrary, in the catching-up economy (Poland), the effect of rising TFP along the movement towards higher GVC intensity is more pronounced. It may be explained by the shorter history of involvement in international production of firms located in Poland, due to which high GVC participation seems to create a greater advantage in an environment where it is still a relatively new phenomenon.

5.2 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 the TFP generalized method of moments (GMM) estimation by Wooldridge (2009), recently employed by Fons-Rosen *et al.* (2021) (see Table 4A in the online supplementary materials). Secondly, we repeat the estimation using the total [16] 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: *(1)* FVA embodied in exports, expressed as a share of gross exports (*FVA\Exp*); and *(2)* the classic offshoring index (*OFF*) (Table 7A) [17]. 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) [18]. Finally, we changed the estimation method, switching to instrumental variables (IV) regression (Table 9A) and weighted IV regression [19] (Table 10A). In IV regression, we build an instrument for GVC that takes into account possible endogeneity in the model: the two-way relationship between productivity and GVC (the change in a firm's productivity due to involvement in GVCs and the presence of more productive firms in more GVC-intensive sectors).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 neighbours). 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 neighbouring countries). Thanks to the IV approach, we can consider (with caution) the causal effect of GVC involvement on the productivity of German and Polish firms. Additionally, we built three-dimensional weights (size-sector-year) based on Eurostat data on the population of enterprises in each country [20]. None of these modifications significantly alters our results.

6. Conclusions

This study provides a comparative view of the relationship between firm-level productivity, foreign investment and the sectoral integration of production processes within GVCs. The extant literature on FDI productivity addresses either developing or developed countries' perspectives and is separate 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: these countries are geographically close but located at opposite extremes of the European productivity spectrum. Overall, Poland is two times less productive than Germany and the countries play different roles in the European investment and production network.

We argue that models of MNCs and/or FDI cannot be analysed in isolation from global production fragmentation mechanisms. The recent literature proves that multinational companies, FDI and GVCs are closely related (Antràs and Chor, 2022; World Bank, 2020; Okah Efogo *et al.*, 2022; Adarov and Stehrer, 2021; Qiang *et al.*, 2021), but to the best of our knowledge, none of the firm-level studies has simultaneously analysed this phenomenon comparing firms from countries at different productivity levels (here: Poland and Germany). We thus provide specific empirical evidence supporting the GVC-FDI framework in a leader-follower setting. We demonstrate that mechanisms of productivity growth in the contemporary world go beyond traditional trade or MNCs models because GVC effects and FDI-related upgrading forces are intertwined.

Our results are based on a firm-level estimation of TFP and joint assessment of the linkages between a firm's productivity, ownership type and sectoral GVC participation. First, TFP differences between domestic and foreign-owned firms exist in the two countries. Thus, we show that the FO 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 FO and involvement in global production. As GVC involvement (proxied by different measures) increases in both countries, the FO 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 examined by our study. Broad productivity-FDI literature shows rather contrasting results regarding the FO premium, whilst firm-level evidence relating GVCs 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 domestically-owned firms, observed along with 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 a comparison of the FO–GVC–productivity nexus in firms from more than one transition economy will enrich this picture.

One of the possible limitations of this study is the measurement of GVC involvement on the sectoral level. Detailed trade data on the firm level are still scarcely available and thus the approach of merging individual data with sectoral trade/GVC measures (as in our study) is quite common in the literature (e.g. the abovementioned productivity studies: Banh *et al.*, 2020; Damijan *et al.*, 2009; or Montalbano *et al.*, 2018; FDI studies: Okah Efogo *et al.*, 2022). In particular, Montalbano *et al.* (2018) discuss the validity of such an approach with sufficient disaggregation of industry data, as it is in our case.

Our empirical results have several important policy implications. Specifically, the increasing importance of GVCs can speed up the convergence process, hindering the productivity gap between domestic and foreign enterprises. By comparing firms in Poland and Germany, we have additionally confirmed that international production-sharing can decrease the gap between foreign and domestic firms, especially in the catching-up countries. In well-developed economies, the situation is more established, the FO premium is stable. In catching-up countries, policy intervention can be directed at enhancing the inflow of foreign capital or/and encouraging firms to engage in GVCs.

Nevertheless, further studies employing firm-level GVCs in a similar model could bring more insights into within-firm productivity effects due to both GVCs and ownership. In particular, it would be insightful to dedicate more attention to the interplay between the FO productivity premium and GVCs in other countries, especially in the context of developing countries. It would also be insightful to analyse these effects by the type of sector where FDI and GVCs are concentrated (e.g. technology-intensive versus labour-intensive sectors).

Notes

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 (UNCTAD, 2022c).
2. Source: https://www.oecd.org/trade/topics/global-value-chains-and-trade/ [accessed on 23 February 2023].
3. Labour productivity per hour worked (EU27_2020 = 100). Source of data: Eurostat (online data code: TESEM160) [date of access: 20.02.2023].
4. At the beginning of the Polish transformation (1990s), fourteen Special Economic Zones were established in order to enhance Polish and foreign investment there. Later, they were extended into the Polish Investment Zone covering the whole country. The programme is based on possible income tax exemption for new investments fulfilling specific entry criteria. In our analysis, we take into account the regional dimension and control the location of the firm in the NUTS 2 region.
5. Lo and Tan (2020) provide empirical evidence for productivity gains of subsidiary companies due to the set of their own and their parent companies' characteristics, underlining that MNCs are systems that thrive due to joint effort.
6. Demena and van Bergeijk (2017) analysed 69 empirical studies published within 1983–2013, dealing with 31 developing countries and providing 1,450 estimates of spillover parameters.
7. The initial number of firms in the Amadeus database is high (2,010,186 firms from Poland and 1,689,890 firms from Germany). The number of firms in the final sample is given in Table 1. We minimised the number of additional conditions that our data had to meet, since only the data availability of the crucial variables (especially those needed for TFP estimation such as material costs) severely limited the number of observations.
8. The Amadeus wave provides up to a ten-year-long time series for a given company; however, the time series may often be shorter, with possible missing values within, and the availability may also differ depending on a particular variable. We drop from the sample records marked as consolidated statements, observations with negative number of employees or on any of the crucial financial variables. Incomplete employment data was filled using linear interpolation. We filled in some of the missing information on NUTS 2 codes using company address to avoid further observation loss. The final sample covers sectors listed in Table 2A in the online supplementary materials. Sectoral coverage results from the initial data availability of the Amadeus data and the merge with weights built on Eurostat data. We did not force any additional constraints on the sector of activity of firms.
9. This set of variables for TFP estimation is recommended by, e.g. Anos-Casero and Udomsaph (2009). On the other hand, Pittiglio and Reganati (2019) use value-added data instead of operating revenue turnover, but we prefer revenues due to the lower number of missing observations in this variable. Company financial data are 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 of gross output; for material costs–Price levels of intermediate inputs. In the case of Poland, the data are additionally converted into EUR using the 2010 exchange rate from Eurostat.
10. We chose the number of patents as the best available proxy for R&D activity in our data, because information on R&D expenses was missing for Poland and only residual for Germany. Patent data are one of the possible measures of knowledge creation being a determinant of TFP (Isaksson, 2007).

The use of patents as innovation indicator has a long tradition and is widely accepted (Nagaoka *et al.*, 2010).

11. Merging sector classifications in Amadeus and in the WIOD were straightforward thanks to the use of ISIC-NACE correspondence tables.
12. We calculate the GVC measures with the use of R packages/codes provided by Quast and Kummritz (2015) (for gross export decomposition) and Szymczak *et al.* (2022) (for GII and traditional offshoring measure).
13. We use Stata command *prodest* (Rovigatti and Mollisi, 2016). The Levinsohn-Petrin method has been proved in the related literature to be appropriate for data such as ours (Anos-Casero and Udomsaph, 2009). For robustness, we also consider the GMM TFP estimation method by Wooldridge (2009), also available in *prodest*. This method, also used for robustness by, e.g. Pittiglio and Reganati (2019), is able to address the potential problem of correlation between the errors and produces robust standard errors.
14. Among studies on similar topics using regression models, one could mention Pittiglio and Reganati (2019) who use firm-level data to examine the determinants of TFP with the ownership identifier as one of the regressors. Gorodnichenko *et al.* (2014) run regression with the firm-level Solow residual as a dependent variable and a set of trade-related factors (e.g. sector-level backward and forward linkages measured by sales' shares) as explanatory variables. The important element of our model specification is the use of the interaction term. As an example of a study that also uses interactions between FDI and GVC, Hagemejer (2016) uses firm-level data to regress TFP-related variable on the GVC-FDI interaction term.
15. Before taking the log of the number of patents, we add 1 to the value, to avoid the creation of missing values, since most of the companies own zero patents. The number of patents was available for the last year only.
16. Total foreign ownership, defined as the presence of ≥99% of foreign shares.
17. FVA is part of VS, which consists of the FVA embodied in exports and pure double-counting from foreign sources components. 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).
18. We do not use this setting as our base specification because the correlation between GVC and openness is high (up to 0.8, depending on the choice of GVC measure).
19. The sample underrepresents the smallest companies and over-represents the largest ones, and deviates from the population sectoral distribution. However, this should not be a source of estimation bias because foreign ownership is more typical for the companies which are well represented in our sample: larger firms, and active in particular industries. For instance, amongst small Polish enterprises employing up to 9 employees, only about 1% of entities had foreign capital participation (data for 2014). 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—about 67% (of all enterprises in the total business economy; repair of computers, personal and household goods; except financial and insurance activities).
20. Data source: https://ec.europa.eu/eurostat/databrowser/view/bd_9bd_sz_cl_r2/default/table?lang=en

References

Adarov, A. and Stehrer, R. (2021), "Implications of foreign direct investment, capital formation and its structure for global value chains", *The World Economy*, Vol. 44 No. 11, pp. 3246-3299.

Altomonte, C. and Colantone, I. (2008), "Firm heterogeneity and endogenous regional disparities", *Journal of Economic Geography*, Vol. 8 No. 6, pp. 779-810.

Amador, J. and Cabral, S. (2015), "Global value chains, labour markets and productivity", in Amador, J. and di Mauro, F. (Eds), *The Age of Global Value Chains, Maps and Policy Issues*, CEPR Press, London, pp. 107-120.

Amador, J. and Cabral, S. (2016), "Global value chains: a Survey of drivers and measures", *Journal of Economic Surveys*, Vol. 30 No. 2, pp. 278-301.

Amiti, M. and Wei, S.J. (2009), "Service offshoring and productivity: evidence from the US", *World Economy*, Vol. 32 No. 2, pp. 203-220.

Anos-Casero, P. and Udomsaph, C. (2009), "What Drives Firm Productivity Growth ?", Policy Research Working Papers 4841, The World Bank.

Antràs, P. and Chor, D. (2022), in Gopinath, G., Helpman, E. and Rogoff, K. (Eds), *Handbook of International Economics*, Elsevier, Amsterdam, Vol. 5, pp. 297-376.

Arnold, J.M. and Smarzynska Javorcik, B. (2005), "Gifted kids or pushy parents? Foreign acquisitions and plant performance in Indonesia", The Policy Research Working Paper Series 3597.

Autor, D.H., Dorn, D. and Hanson, G.H. (2013), "The China syndrome: local labor market effects of import competition in the United States", *American Economic Review*, Vol. 103 No. 6, pp. 2121-2168.

Baldwin, J.R. and Yan, B. (2014), *Global Value Chains and the Productivity of Canadian Manufacturing Firms*, Statistics Canada, Ottawa.

Banh, H.T., Wingender, P. and Gueye, C.A. (2020), *Global Value Chains and Productivity: Micro Evidence from Estonia*, IMF Working Papers No. 20/117.

Borin, A. and Mancini, M. (2016), "Foreign direct investment and firm performance: an empirical analysis of Italian firms", *Review of World Economics*, Vol. 152 No. 4, pp. 705-732.

Bruno, R.L. and Cipollina, M. (2018), "A meta-analysis of the indirect impact of foreign direct investment in old and new EU member states: understanding productivity spillovers", *The World Economy*, Vol. 41 No. 5, pp. 1342-1377.

Bureau van Dijk (2017), Amadeus, available at: https://www.bvdinfo.com/en-gb/our-products/data/international/amadeus

Chuang, Y.C. and Lin, C.M. (1999), "Foreign direct investment, R&D and spillover efficiency: evidence from Taiwan's manufacturing firms", *The Journal of Development Studies*, Vol. 35 No. 4, pp. 117-137.

Constantinescu, C., Mattoo, A. and Ruta, M. (2019), "Does vertical specialisation increase productivity?", *The World Economy*, Vol. 42 No. 8, pp. 2385-2402.

Criscuolo, C. and Timmis, J. (2017), "The relationship between global value chains and productivity", *International Productivity Monitor*, Vol. 32, pp. 61-83.

Damijan, J.P., De Sousa, J. and Lamotte, O. (2009), "Does international openness affect the productivity of local firms? Evidence from south-eastern Europe", *Economics of Transition*, Vol. 17 No. 3, pp. 559-586.

Del Prete, D., Giovannetti, G. and Marvasi, E. (2017), "Global value chains participation and productivity gains for North African firms", *Review of World Economics*, Vol. 153 No. 4, pp. 675-701.

Demena, B.A. and van Bergeijk, P.A. (2017), "A meta-analysis of FDI and productivity spillovers in developing countries", *Journal of Economic Surveys*, Vol. 31 No. 2, pp. 546-571.

Djankov, S. and Hoekman, B. (2000), "Foreign investment and productivity growth in Czech enterprises", *The World Bank Economic Review*, Vol. 14 No. 1, pp. 49-64.

Dunning, J.H. (1988), "The eclectic paradigm of international production: a restatement and some possible extensions", *Journal of International Business Studies*, Vol. 19 No. 1, pp. 1-31.

Dunning, J.H. (1993), *Multinational Enterprises and the Global Economy*, Addison-Wesley Publishing Company, Wokingham.

Dunning, J.H. (2003), "Determinants of foreign direct investment: globalization-induced changes and the role of policies", in Tungodden, B., Stern, N. and Kolstad, I. (Eds), *Toward Pro-poor Policies: Aid, Institutions, and Globalization*, World Bank, Washington, pp. 279-290.

Dunning, J.H. (2015), "The eclectic paradigm of international production: a restatement and some possible extensions", in Cantwell, J. (Ed.), *The Eclectic Paradigm*, Palgrave Macmillan, London, pp. 50-84.

Fons-Rosen, C., Kalemli-Ozcan, S., Sørensen, B.E., Villegas-Sanchez, C. and Volosovych, V. (2021), "Quantifying productivity gains from foreign investment", *Journal of International Economics*, Vol. 131, 103456.

Giroud, A. and Mirza, H. (2015), "Refining of FDI motivations by integrating global value chains' considerations", *The Multinational Business Review*, Vol. 23 No. 1, pp. 67-76.

Görg, H., Hijzen, A. and Muraközy, B. (2009), "The role of production technology for productivity spillovers from multinationals: firm-level evidence for Hungary", Kiel Working Paper No. 1482, pp. 1-27.

Gorodnichenko, Y., Svejnar, J. and Terrell, K. (2014), "When does FDI have positive spill overs? Evidence from 17 transition market economies", *Journal of Comparative Economics*, Vol. 42 No. 4, pp. 954-969.

Grossman, G.M. and Rossi-Hansberg, E. (2008), "Trading tasks: a simple theory of offshoring", *American Economic Review*, Vol. 98 No. 5, pp. 1978-1997.

Hagemejer, J. (2016), "*Productivity Spillovers in the GVC: The Case of Poland and the New EU Member States*", *EcoMod2016*, EcoMod, Northampton, Vol. 9250.

Hagemejer, J. and Kolasa, M. (2011), "Internationalisation and economic performance of enterprises: evidence from Polish firm-level Data", *The World Economy*, Vol. 34 No. 1, pp. 74-100.

Hallward-Driemeier, M., Iarossi, G. and Sokoloff, K.L. (2002), "Exports and manufacturing productivity in east asia : a comparative analysis with firm-level data", NBER Working Paper Series No. 8894. Cambridge, MA.

Higón, D.A. and Vasilakos, N. (2011), "Foreign direct investment spillovers: evidence from the British retail sector", *The World Economy*, Vol. 34, pp. 642-666.

Hijzen, A., Inui, T. and Todo, Y. (2010), "Does offshoring pay? Firm-level evidence from Japan", *Economic Inquiry*, Vol. 48 No. 4, pp. 880-895.

Hummels, D., Ishii, J. and Yi, K.M. (2001), "The nature and growth of vertical specialization in world trade", *Journal of International Economics*, Vol. 54, pp. 75-96.

Isaksson, A. (2007), *Determinants of Total Factor Productivity: A Literature Review*, Research and Statistics Branch, UNIDO, Vienna.

Johnson, R.C. (2018), "Measuring global value chains", *Annual Review of Economics*, Vol. 10, pp. 207-236.

Kalemli-Ozcan, S., Sørensen, B.E., Villegas-Sanchez, C., Volosovych, V. and Yesiltas, S. (2015), "How to construct nationally representative firm level data from the ORBIS global database", NBER Working Paper Series 21558.

Keller, W. and Yeaple, S.R. (2009), "Multinational enterprises, international trade, and productivity growth: firm-level evidence from the United States", *Review of Economics and Statistics*, Vol. 91 No. 4, pp. 821-831.

Kogut, B. and Zander, U. (2003), "Knowledge of the firm and the evolutionary theory of the multinational corporation", *Journal of International Business Studies*, Vol. 34 No. 6, pp. 516-529.

Kok, R. and Ersoy, B.A. (2009), "Analyses of FDI determinants in developing countries", *International Journal of Social Economics*, Vol. 36 Nos 1/2, pp. 105-123.

Kordalska, A., Wolszczak-Derlacz, J. and Parteka, A. (2016), "Global value chains and productivity gains: a cross-country analysis", *Collegium of Economic Analysis Annals*, No. 41, pp. 11-28.

Kumari, R. and Sharma, A.K. (2017), "Determinants of foreign direct investment in developing countries: a panel data study", *International Journal of Emerging Markets*, Vol. 12 No. 4, pp. 658-682.

Levinsohn, J. and Petrin, A. (2003), "Estimating production functions using inputs to control for unobservables", *The Review of Economic Studies*, Vol. 70 No. 2, pp. 317-341.

Lo, F.Y. and Tan, R. (2020), "Determinants of international subsidiaries' performances: a multi-level perspective of the subsidiary and parent company", *International Journal of Emerging Markets*, Vol. 15 No. 4, pp. 746-766.

Markusen, J.R. (1995), "The boundaries of multinational enterprises and the theory of international trade", *Journal of Economic Perspectives*, Vol. 9 No. 2, pp. 169-189.

Markusen, J.R. (2002), *Multinational Firms and the Theory of International Trade*, MIT Press, Cambridge, MA.

Mebratie, A.D. and van Bergeijk, P.A.G. (2013), "Firm heterogeneity and development: a meta-analysis of FDI productivity spillovers", *The Journal of International Trade and Economic Development*, Vol. 22 No. 1, pp. 53-74.

Merlevede, B., Schoors, K. and Spatareanu, M. (2014), "FDI spillovers and time since foreign entry", *World Development*, Vol. 56, pp. 108-126.

Montalbano, P., Nenci, S. and Pietrobelli, C. (2018), "Opening and linking up: firms, GVCs, and productivity in Latin America", *Small Business Economics*, Vol. 50 No. 4, pp. 917-935.

Nagaoka, S., Motohashi, K. and Goto, A. (2010), "Patent statistics as an innovation indicator", in Hall, B. and Rosenberg, N. (Eds), *Handbook of the Economics of Innovation*, North-Holland, Amsterdam, Vol. 2, pp. 1083-1127.

Newman, C., Rand, J., Talbot, T. and Tarp, F. (2015), "Technology transfers, foreign investment and productivity spillovers", *European Economic Review*, Vol. 76, pp. 168-187.

Nicolini, M. and Resmini, L. (2011), "Productivity spillovers, regional spillovers and the role of by multinational enterprises in the new EU member states", in Kourtit, K. (Ed.), *Drivers of Innovation, Entrepreneurship and Regional Dynamics, Advances in Spatial Science*, Springer-Verlag, Berlin, pp. 105-120.

Nunnenkamp, P. (2002), "Determinants of FDI in developing countries: has globalization changed the rules of the game?", Kiel Working Paper No. 1122, Kiel Institute for World Economics (IfW), Kiel.

Oestreicher, A., Koch, R., Vorndamme, D. and Hohls, S. (2013), "Assert - assessing the effects of reforms in taxation - a micro-simulation approach", FAT Working Paper 14-001.

Okah Efogo, F., Wonyra, K.O. and Osabuohien, E. (2022), "Foreign direct investment and participation of developing countries in global value chains: lessons from the last decade", *International Review of Applied Economics*, Vol. 36 No. 2, pp. 264-284.

Pesalj, B. (2011), "Competitive advantages of multinational companies: a review of theoretical approaches", *Medjunarodni Problemi*, Vol. 63 No. 2, pp. 237-259.

Pittiglio, R. and Reganati, F. (2019), "Foreign direct investment productivity premium and foreign affiliates' heterogeneity: a comparison between advanced and emerging market overseas investments in the EU", *The World Economy*, Vol. 42 No. 10, pp. 3030-3064.

Qiang, C.Z., Liu, Y. and Steenbergen, V. (2021), "Multinational corporations shape global value chain development", *An Investment Perspective on Global Value Chains*, World Bank, Washington, DC, pp. 62-107.

Quast, B.A. and Kummritz, V. (2015), "Decompr: global value chain decomposition in R", CTEI Working Papers, 1.

Rovigatti, G. and Mollisi, V. (2016), "PRODEST: stata module for production function estimation based on the control function approach", available at: https://ideas.repec.org/c/boc/bocode/s458239.html

Sinani, E. and Meyer, K.E. (2004), "Spillovers of technology transfer from FDI: the case of Estonia", *Journal of Comparative Economics*, Vol. 32 No. 3, pp. 445-466.

Smarzynska Javorcik, B. (2002), "Does foreign direct investment increase the productivity of domestic firms?", *Policy* Research Working Paper No. 2923, The World Bank, Washington.

Smarzynska Javorcik, B. (2004), "Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages", *American Economic Review*, Vol. 94 No. 3, pp. 605-627.

Syverson, C. (2011), "What determines productivity?", *Journal of Economic Literature*, Vol. 49 No. 2, pp. 326-365.

Szymczak, S., Parteka, A. and Wolszczak-Derlacz, J. (2022), "Position in global value chains and wages in Central and Eastern European countries", *European Journal of Industrial Relations*, Vol. 28 No. 2, pp. 211-230.

Timmer, M.P., Dietzenbacher, E., Los, B., Stehrer, R. and De Vries, G.J. (2015), "An illustrated user guide to the world input-output database: the case of global automotive production", *Review of International Economics*, Vol. 23 No. 3, pp. 575-605.

Timmer, M.P., Los, B., Stehrer, R. and De Vries, G.J. (2016), "An Anatomy of the Global Trade Slowdown Based on the WIOD 2016 Release", *GGDC Research Memorandum, GGDC Research Memoranda*, Groningen Growth and Development Centre, University of Groningen, Groningen, Vol. 162.

TiVA (2021), "Trade in value added, TiVA country notes (2021 edition)", available at: https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm#access (assessed on 20 February 2023).

UNCTAD (2022a), "World investment report 2022. CountryFact sheets – Germany", available at: https://unctad.org/system/files/non-official-document/wir_fs_de_en.pdf (assessed on 20 February 2023).

UNCTAD (2022b), "World investment report 2022. CountryFact sheets –Poland", available at: https://unctad.org/system/files/non-official-document/wir_fs_pl_en.pdf (assessed on 20 February 2023).

UNCTAD (2022c), "FDI database. Foreign direct investment: inward and outward flows and stock", annual, available at: https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=96740 (accessed 10 March 2022).

Wagner, J. (2007), "Exports and productivity: a Survey of the evidence from firm-level data", *World Economy*, Vol. 30 No. 1, pp. 60-82.

Wang, J. and Wang, X. (2015), "Benefits of foreign ownership: evidence from foreign direct investment in China", *Journal of International Economics*, Vol. 97 No. 2, pp. 325-338.

Wang, Z., Wei, S.-J. and Zhu, K. (2013), "Quantifying international production sharing at the bilateral and sector levels", NBER Working Paper Series 19677.

Wooldridge, J.M. (2009), "On estimating firm-level production functions using proxy variables to control for unobservables", *Economics Letters*, Vol. 104 No. 3, pp. 112-114.

Wooster, R.B. and Diebel, D.S. (2010), "Productivity spillovers from foreign direct investment in developing countries: a meta-regression analysis", *Review of Development Economics*, Vol. 14 No. 3, pp. 640-655.

World Bank (2020), *World Development Report: Trading For Development in the Age of Global Value Chains*, World Bank Publications, Washington.

Supplementary materials

The supplementary material for this article can be found online.

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