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Global value chains and inward FDI: An empirical investigation of European firms

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Abstract

This paper empirically investigates whether and how the level of GVC integration of a given market may explain the presence of foreign-owned firms. Using firm-level data from 28 European Union countries during the period 2008–2014, we provide evidence that a greater country-sector-level GVC participation, via both backward and forward linkages, exerts a positive effect on a firm's likelihood to receive FDI. These findings appear particularly strong for new EU Member States and services industries when looking at the differences across countries and sectors. Interestingly, when exploring the role of country-sector position along the GVC, we find that FDI gains from backward GVC integration are more prominent if the markets are associated with the final stages of the supply chain, whereas those from forward GVC integration are greater when the markets are associated with the initial stages, in line with the smile curve hypothesis.

KEYWORDS
European Union, FDI, GVC, multinational firms

1 | INTRODUCTION

Over the past three decades, the production of goods and services has become increasingly fragmented internationally, giving rise to what is commonly referred to as global value chains (GVCs) or global supply chains (Antràs, 2020; Baldwin, 2013; Gereffi, 2018; Taglioni & Winkler, 2016).[1] Firms have adopted organisational models in which production processes have been fragmented into several stages carried out in various countries with the consequence that intermediate goods and services cross national borders several times before being assembled and sold as a final output. From the early 1990s to 2007, the share of GVC trade in world trade rose from around 40% to over 50%, only to decline slightly after the global financial crisis 2007–2008 (World Bank, 2020). At the same time, world trade has become increasingly concentrated in a few importing and exporting firms, in most cases multinational enterprises (MNEs), which represent 15% of all traders but account for about 80% of total trade (UNCTAD, 2013). Insofar as MNEs set up factories in several countries to produce intermediate goods that are used as inputs for their final products in a global production network, we may establish a mutually reinforcing dynamic between foreign direct investment (FDI) and the participation of given countries in GVCs (Baldwin, 2016).[2] However, although the role of MNEs in the international coordination of production and the creation of complex global production structures is widely recognised, empirical research on the relationship between FDI and GVCs is still scant.

Only recently has the empirical literature made some effort to analyse the main driving forces of GVCs, mainly how FDI influences countries' GVC integration. However, an empirical question not yet fully addressed is investigating the opposite direction of the causal link between FDI and GVCs, that is, how the GVC integration level of a given market can affect the presence of foreign-owned firms. MNEs' investment decisions might be driven towards firms operating in countries and sectors with high levels of GVC participation, as this can facilitate access to specific inputs or global markets, favouring the integration in the global economy. This paper aims to address this gap in the existing literature by investigating, from a microeconomic perspective, the impact of a country/sector's involvement in GVCs on a firm's probability of receiving FDI. More specifically, we examine both modes of GVC participation of country-sector pairs. On the one hand, backward GVC participation reveals that a country-sector pair imports many foreign inputs to produce final goods and services for its exports or final consumption. On the other hand, forward GVC participation refers to the degree of a country-sector's involvement as a producer and an exporter of intermediate goods and services that can be used in other countries' exports.

Using firm-level data from 28 EU countries during the period 2008–2014, we show that an increase in country-sector GVC participation, via both backward and forward linkages,

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[1]It is important to note how today, services not only contribute to manufacturing value chains but are also characterised by international fragmentation processes similar to those of goods. For instance, the software production process can be divided into architecting, code development, testing, implementation, marketing and distribution, maintenance, helpdesk support and training and education (Miroudot & Cadestin, 2017).

[2]For instance, the OECD (2018) reports that MNEs accounted for 36% of global output in 2016, as well as being responsible for about two-thirds of global exports and more than half of imports. Moreover, as the participation of MNEs in GVCs gained importance, international trade in goods and services became increasingly intra-firm trade: related-party trade accounted for 47.9% of total US imports for consumption and 34.0% of total US exports in 2020 (US Census Bureau, 2021).

positively affects a firm's likelihood to receive FDI. These results are robust when using different estimation methods (conditional logit model, dynamic model and instrumental variable approach), different definitions of foreign ownership and GVC integration and the post-crisis period only. However, some degree of heterogeneity exists between countries and sectors. Both GVC participation types positively impact a firm's probability of receiving FDI in the new EU countries (CEE). In contrast, only backward GVC participation has a positive and statistically significant effect for the old EU countries (EU15). Moreover, by splitting the two groups of countries between manufacturing and service sectors, we find that a greater involvement in GVCs based on forward linkages in services leads foreign firms to set up horizontal subsidiaries in the old EU countries and vertical subsidiaries in the CEE, while a greater involvement in forward GVC participation in manufacturing leads foreign firms to close horizontal subsidiaries in the EU15. In addition, higher participation in GVCs of intermediate service assemblers (associated with larger value added) leads foreign firms to establish horizontal affiliates in the EU15 and vertical affiliates in the CEE. In contrast, higher involvement in GVCs of intermediate goods assemblers (associated with smaller value added) does not significantly impact a firm's decision to invest abroad.

Subsequently, we explore whether the country-sector position along the supply chain plays any role in explaining the FDI gains from GVC participation. Consistent with the smile curve hypothesis (Baldwin & Evenett, 2015; Mudambi, 2007, 2008), we find that the impact of backward GVC integration on a firm's likelihood to receive FDI is positive if the country sectors are positioned along the last stages of the supply chain, and negative if they are located more upstream. Conversely, the effect of forward GVC integration on a firm's probability to receive FDI is positive when the country sectors are located along the initial stages, and negative if they are more downstream.

This paper mainly contributes to understanding the relationship between FDI and GVC integration. Most studies look at the role of FDI in explaining the establishment of global value chains, using data at the country (sector) level, and their findings suggest that a greater presence of MNEs may favour the GVC participation of the host economies, primarily through backward linkages (Adarov & Stehrer, 2021; Buelens & Tirpák, 2017; Del Prete et al., 2018; Kowalski et al., 2015). Unlike all this evidence, we focus on the inverse relationship between FDI and GVC, that is, whether and how GVC integration on a given market can affect inward FDI, using firm-level data. To some extent, we also contribute to the literature on host country determinants that may influence a firm's locational investment choice. Although this is extensive and varies in terms of the approaches and methodologies used (among the main studies using firm-level data, see: Blonigen, 2005; Crozet et al., 2004; Devereux & Griffith, 1998; Guimarães et al., 2000; Head et al., 1999; Head & Ries, 1996; Javorcik, 2004), there are few works, and all based on macro-level data, that have so far documented that a high GVC integration of a given market (country-sector pair) can favour the presence of MNEs (Carril-Caccia & Pavlova, 2020; Cipollina et al., 2021; Martínez-Galán & Fontoura, 2019). Differently from all these studies, we use firm-level data to explore, from a microeconomic perspective, whether and how a firm's probability of receiving FDI is affected by the involvement of its country/sector in GVCs.

To this end, we construct a unique panel dataset for European Union (EU28) firms over the period 2008–2014 using data from Bureau van Dijk's AMADEUS and Historical ORBIS. While the first dataset provides firm-level financial and economic information, the second allows information to be collected on a firm's yearly ownership structure. Subsequently, we merge this firm-level dataset with country-sector-level GVC measures, built using data from the World Input–Output Database (Timmer et al., 2015, 2016). We further contribute to this literature by

exploring the existence of heterogeneity in the impact of GVC participation in relation to the EU membership of the host country (old and new EU Member States) and the macro-sectors (manufacturing and services), as well as by assessing whether the GVC effect on inward FDI depends not only on the intensity of GVC participation but also on the position within the GVC. More generally, this paper contributes to the literature exploring how GVC integration may influence (other) firm-level outcomes – such as productivity, local sourcing and foreign technology acquisition – which generally finds a positive impact (Amendolagine et al., 2019; Giunta et al., 2022; Montalbano et al., 2018; Rigo, 2021).[3]

The rest of the paper is structured as follows: Section 2 discusses the conceptual background to highlight the main hypothesis on the impact of GVC integration on inward FDI. Section 3 introduces the data, sample and descriptive statistics. Section 4 describes the empirical strategy and discusses the results of the econometric analysis. Section 5 concludes.

2 | CONCEPTUAL BACKGROUND AND MAIN HYPOTHESES

To address how and why the GVC integration level of a given market can attract foreign firms, two key factors must be considered: (i) the way an economy participates in the GVC and (ii) the motivation behind inward FDI. Concerning the first factor, a country can participate in GVCs in two ways, reflecting both backward and forward linkages in the value chain. A high backward GVC participation reveals that the country sector plays a deeper role in the value chain by importing many foreign inputs to produce final goods and services for exports or final consumption. Conversely, a high forward GVC participation means that the country sector is strongly involved as a producer and an exporter of intermediate goods and services that can be used in other countries′ exports. Regarding the motivation behind the FDI, theories of MNEs traditionally distinguish between two types of FDI: horizontal and vertical FDI. In the first case, MNEs aim to satisfy local demand in the host market and avoid trade costs, whereas in the second case, MNEs are interested in acquiring specific resources not available at home.

Generally speaking, high participation in GVCs is expected to drive inward FDI. Indeed, applying an augmented gravity model framework, some studies have recently tested the participatory role of a country in GVCs as a destination location factor influencing inward FDI. Martínez-Galán and Fontoura (2019) use data on bilateral FDI inward stock of 40 OECD countries in the period from 2002 to 2011 and show that the higher the degree of participation of a country in GVCs, the higher the bilateral FDI inward stock. Focusing on cross-border mergers and acquisitions (M&A) in 28 EU countries and 14 other major economies for the period 2000–14, Carril-Caccia and Pavlova (2020) find that the participation of both origin and destination

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[3]Using firm-level cross-sectional data from 31 Latina-American countries, Montalbano et al. (2018) find evidence of productivity gains from GVC participation, which are relatively larger in industries operating in upstream stages of the GVC. Using firm-level data from France, Germany, Italy and Spain, during the period 2002–2014, Giunta et al. (2022) document that GVC participation via both forward and backward linkages entails improvement in labour productivity. Drawing on firm-level cross-sectional data from 19 Sub-Saharan countries and Vietnam, Amendolagine et al. (2019) demonstrate that heightened participation in GVCs correlates with increased levels of local sourcing by foreign investors. Furthermore, they emphasise the significance of a firm's position within the GVC, observing that specialisation in upstream stages of production is positively linked to a higher potential for foreign investor sourcing and a greater inclination to support local suppliers. Using similar data from 18 developing and emerging economies, Rigo (2021) finds that in some developing countries GVC participation fosters a firm's performance as a result of the acquisition of foreign technology.

countries in GVCs has a significant positive impact on bilateral M&As. Similarly, using M&A data for 22 investor countries and 47 host countries from 1985 to 2010, Cipollina et al. (2021) support the hypothesis that GVC participation (backward and/or forward) positively impacts cross-border M&A.[4]

In particular, higher participation of a country (and industry) in GVCs based on backward linkages is likely to attract both vertical and horizontal FDI. In the first case, inward FDI is driven by efficiency-seeking motives, and MNEs mainly aim to transform imported intermediate inputs to process exports to final destinations (Ekholm et al., 2007). At the same time, MNEs may invest abroad to satisfy local demand by opening a local distribution network or producing post-sales customer services in the host country (distribution-oriented FDI). For instance, this might be when a retailer invests in a host country to distribute products for final consumption imported from the retailer's home country (Hanson et al., 2001). Higher forward integration of a country (and industry) in GVCs is also expected to be conducive to vertical and horizontal inward FDI. In the first case, MNEs may relocate parts of their production process to the host country to secure complete control of a critical intermediate product. For instance, FDI driven by natural resource-seeking motives or the desire to improve or expand existing technologies (strategic asset-seeking FDI) is expected to be positively associated with forward GVC linkages. In addition, MNEs may be interested in acquiring local input producers to benefit from their market profit opportunities (market-oriented FDI).

Given these considerations, we propose the following hypothesis:

> **Hypothesis 1.** Following an increase in GVC participation of a given market, through either backward or forward linkages, firms are more likely to receive FDI (FDI gains from GVC integration).

It can be explored whether these GVC effects concern both horizontal and vertical FDI by considering separately advanced and emerging destinations. Since the majority of foreign-owned firms are from high-income countries and they generally tend to establish horizontal affiliates in other high-income countries and vertical affiliates in low-income countries, we can formulate the following hypothesis:

> **Hypothesis 2.** FDI gains from GVC integration are likely to occur in advanced countries (Horizontal FDI) and emerging countries (Vertical FDI).

To fully assess the FDI attractiveness of a given market, we should consider not only its degree of participation in GVCs but also its positioning along the supply chain. One indicator to measure the country-sector GVC position is that of upstreamness (Antràs et al., 2012), that is, the further away a country sector is located in the production chain from the final demand,

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[4]Moreover, the authors also explore whether the relationship between GVC participation and M&As depends on the level of a country's upstreamness. They find that backward participation in GVCs is positively linked to cross-border M&As when the investing country is specialised in a sector with a low level of upstreamness while the receiving country is in a sector with a high level of upstreamness, and when both countries are in a sector with a low level of upstreamness. Conversely, forward participation in GVCs has a positive impact on cross-border M&As when the investing country is specialised in a high-upstream sector and the receiving country in a low-upstream sector, and when they are both in a low-upstream sector.

the more upstream its GVC activities are.[5] Therefore, being positioned upstream in the value chain implies that production requires mostly primary inputs, and outputs are supplied to intermediate users. This is typical for producing raw materials or knowledge (e.g. R&D, design, etc.). Conversely, being positioned downstream means that production requires more intermediate inputs, and outputs are supplied to final rather than intermediate users. Downstream producers specialise in the assembly of processed products or post-sales customer services. In the literature on GVCs (Baldwin & Evenett, 2015; Baldwin & Ito, 2022; Mudambi, 2007, 2008), it has been stressed that the relationship between the supply chain position and value added takes a 'smile shape': most of the value added accrues in firms operating at the two ends of the supply chain (such as R&D/design in the upstream, and distribution/marketing in the downstream), while a smaller share of value added is captured in the intermediate stages (assembly). The smile curve hypothesis has been empirically confirmed by several studies using country-sector or firm-level data (Ito & Vézina, 2016; Meng et al., 2020; Rungi & Del Prete, 2018). Thus, we expect the backward GVC effect on the presence of foreign firms to be positive along the last stages (distribution) and negative along more upstream stages (production); conversely, the forward GVC effect on the presence of foreign firms is expected to be positive along the first stages (R&D) and negative along more downstream stages (production).

At the aggregate level, it has already been shown that service sectors, on average, exhibit larger value added than manufacturing sectors, and GVC integration over time shifted value added from manufacturing to service sectors (Baldwin & Ito, 2022). Therefore, we expect that following a larger GVC integration, the presence of foreign-owned firms may increase, especially in services sectors, at the expense of manufacturing sectors. We can, therefore, formulate the following hypothesis:

> **Hypothesis 3.** FDI gains from GVC integration are larger in services sectors (R&D & Distribution) than in manufacturing sectors (Production).

3 | DATA AND DESCRIPTIVE ANALYSIS

3.1 | Data source and sample

The empirical analysis is based on a firm-level panel dataset for European Union firms (EU28), built by merging data from three different sources: the AMADEUS and Historical ORBIS databases, both managed by Bureau Van Dijk, as well as the World Input–Output Database (Timmer et al., 2015; WIOD, 2016). The AMADEUS dataset includes detailed financial and economic information on European companies operating in the manufacturing and service sectors. In particular, we use data on turnover, cost of employees, number of employees, start-up year and sector of activity (NACE Rev. 2). Subsequently, we have integrated Amadeus data with information on the yearly ownership structure of firms (covering the period 2008–2014), collected from Historical ORBIS. For each firm and year, the latter dataset allows the identification of the

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[5]Note that these activities at both extreme ends of the supply chain are somewhat different, and specialising in these slices of the production process (or input components) depends on the type of supply chain a country is involved in. This, in turn, will determine how much value added a country can reach. For instance, producing post-sales customer services normally generates a higher value-added share for countries than specialising in assembly activities.

ownership status and, specifically, the owner's name and/or the identification number, the ownership share and the nationality. Finally, the firm-level dataset has been merged with the country-sector-level information on GVC participation and position, calculated using the World Input–Output Database (WIOD, 2016), which contains annual time-series of world input–output tables and factor requirements covering 43 countries plus the Rest of the World (high- and medium-income countries; all EU28 included). After excluding missing values and outliers, as well as dropping unusual changes in data that seemed to be errors (such as negative values of cost or number of employees), we obtained a dataset involving 677,233 Western European (EU15) firms and 183,190 Central and Eastern European (CEE) firms over the period 2008–2014. The final dataset accounts for around 3.5 million observations.[6] In the following subsection, we provide detailed information on the definition of foreign firms and details on the variables included in the empirical analysis.

3.2 | Foreign firms and GVC linkages

Different definitions of foreign firms are provided in the firm-level literature on FDI.[7] This study defines foreign firms as firms involving a single foreign investor directly owning at least 10% of shares in the given company. However, our sensitivity analysis also considers different percentages of foreign ownership control. Therefore, we identify three alternative groups of foreign firms:

- FMNEs: Firms where a foreign investor holds more than 10% of a company's shares.
- Majority FMNEs: Majority ownership exists when a foreign investor holds more than 50% of a company's shares.
- Total-controlled FMNEs: When a foreign investor holds a company's total shares.

Figure 1 describes the distribution of foreign firms from 2008 to 2014, considering the above-defined three ownership percentages. The figure shows that the share of foreign firms increases over time. This evidence is entirely in line with an elaboration based on Eurostat data (2022).[8] Additionally, it is worth noting that about 75% of firms are from the service sector, while the remaining firms are from the manufacturing sector.

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[6]Some industries have been dropped because they mainly refer to public administration or sectors that do not conform to the usual principles or behaviours observed within the market environment, that is, sectors 84 (Public administration and defence; compulsory social security), 90 (Creative, arts and entertainment activities), 91 (Libraries, archives, museums and other cultural activities), 98 (Undifferentiated goods- and services-producing activities of households for own use) and 99 (Activities of extraterritorial organisations and bodies). Some other industries have been dropped because they were aggregated within a single sector in WIOD data, although they are too heterogeneous or unspecified; namely, 94 (Activities of membership organisations), 95 (Repair of computers and personal and household goods) and 96 (Other personal service activities) which are within the sector S in WIOD data.

[7]Some authors consider foreign-owned MNEs to be all firms involving a single foreign investor directly owning at least 10% of shares in a company (Altomonte & Pennings, 2009). Some other scholars have relaxed this definition considering inward FDI when the share of foreign capital is more than 10% for a company (Ablov, 2015; Cieślik, 2013). Finally, other researchers define as foreign, all firms where the ultimate owner is foreign (Basile et al., 2005; Pittiglio & Reganati, 2019).

[8]https://ec.europa.eu/eurostat/databrowser/view/FATS_G1B_08.
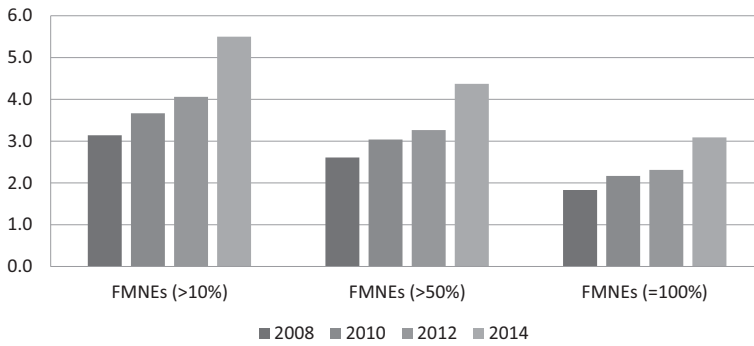
FIGURE 1 Share of foreign firms over time. *Source*: Own compilation based on Bureau van Dijk's data.

Regarding global value chain measures, following Wang et al. (2017), we consider backward and forward measures of GVC participation. The GVC participation index based on backward industrial linkage (GVC_b) assesses the percentage of final products produced by a country sector coming from GVC activities:

$$GVC\_b = (Y\_GVC)/Y \qquad (1)$$

while the GVC participation index based on forward industrial linkage (GVC_f) measures the percentage of production factors employed in a country sector that are further involved in cross-country production-sharing activities:

$$GVC\_f = (VA\_GVC)/VA \qquad (2)$$

where VA is the value added, Y is the final production and VA_GVC and Y_GVC correspond to the GVC-related components of each respectively. In particular, VA_GVC is the value added of the given country sector embodied in its intermediate exports, while Y_GVC stands for the production of final goods and services that represent the value added involved in GVC activities through upstream firms. It is worth noting that a country-sector pair may be involved in production fragmentation as a user (backward participation) and/or as a producer (forward participation) of intermediates. Some studies considering GVCs and their relation with productivity or labour market outcomes (Hagemejer, 2018; Szymczak & Wolszczak-Derlacz, 2022; World Bank and World Trade Organization, 2019) pointed out that to obtain a complete picture of GVC ties, it is important to know the position of a sector in the production chain. Therefore, in this study, we focus on the GVC position index by Wang et al. (2017). Specifically, the average production line position (GVC_p) in a global value chain can be defined as the ratio of forward production length and backward production length. Therefore, $GVC\_p = 1$ identifies a production stage in the middle of the global value chain, whereas $GVC\_p < 1$ ($GVC\_p > 1$) means that the production stage is at the end (the beginning) of the global value chain. Measuring GVC_p as a ratio allows to overcome potential problems related to using two separate indices in the spirit of 'upstreamness' and 'downstreamness', where differences in the total length of the chains are not considered. Figure 2 shows the average GVC participation for the EU15 and CEE countries and all countries. On average, forward participation is higher than backward one, and CEE countries are characterised by higher GVC participation than EU15 countries. The trend of both GVC participation measures over time is similar across country groups: we observe growing GVC involvement, except for a drop in 2009 due to the financial crisis. These stylised facts are confirmed for both the manufacturing and service sectors when looking at Figure A1, which further suggests that GVC participation via both backward and forward linkages
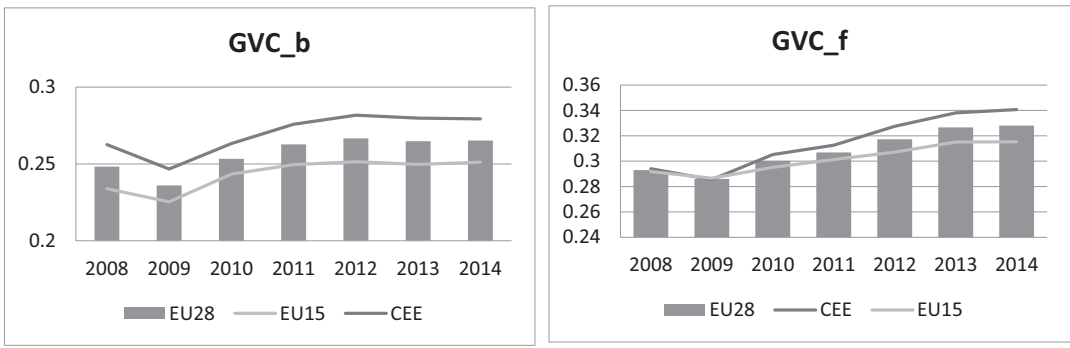
FIGURE 2 Forward and backward GVC participation in time, 2008–2014 (medians for the EU15 and CEE countries and the whole sample). *Source*: Own compilation based on data from WIOD (2016).
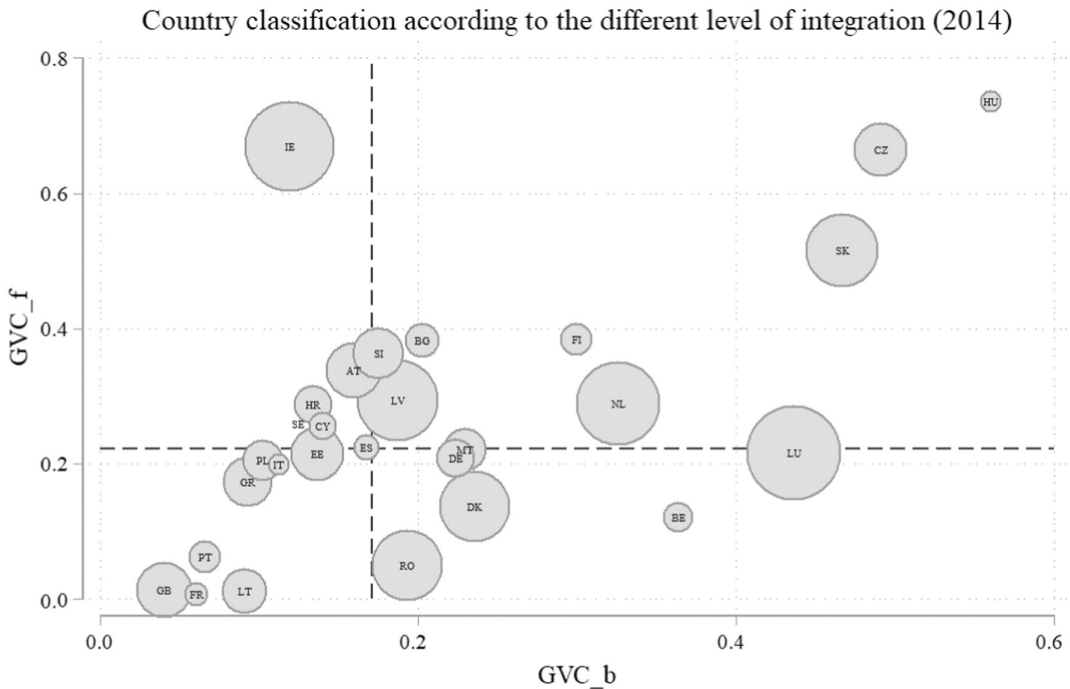

FIGURE 3 Country classification according to the different levels of integration (2014). The bubble size represents the relative capability of FDI attraction at the country (sector) level, as in equation (3). *Source*: Own compilation based on WIOD (2016) and Bureau van Dijk.

is, on average, greater in manufacturing than in the service sector. This picture aligns with previous findings (e.g. Parteka & Wolszczak-Derlacz, 2020). Figure 3 describes the distribution of destination countries according to their level of GVC participation concerning the sample median of GVC participation in 2014, the last year of our analysis. In the figure, the bubble size is measured as the relative capability of FDI attraction at the country (sector) level:

$$Relative\_capability\_FDI\_attraction_k = \frac{\frac{FMNEs_k}{\sum_k FMNEs_k}}{\frac{Firms_k}{\sum_k Firms_k}} \quad (3)$$

where $FMNEs_k$ represents country k's inward FDI and $Firms_k$ is the total number of firms in the country.

From the figure, we observe a relatively high capability of FDI attraction for Eastern European countries, such as Latvia, Romania, Slovakia or Czechia, as well as for selected Western European countries, for instance, Luxembourg, Denmark, the Netherlands or Ireland. This evidence is similar to what was reported by the UN (2007) using a set of inward FDI measures. Considering GVC participation, there seems to be a correlation between backward and forward indices, meaning that higher GVC involvement often means simultaneously engaging both types of linkages. An exception would be the case of Ireland, which has an average backward participation below the sample median and one of the highest forward participation levels. This means that Ireland has a low dependence on globally sourced intermediate goods and services, and plays an important role of supplier in GVCs. The highest GVC involvement through both linkages is observed in Eastern European countries, such as Hungary, Czechia and Slovakia.

In Figures A2 and A3 in the Appendix 1, we present the GVC involvement of industries and their relative capability of FDI attraction for the manufacturing and service sectors respectively. Generally perceived as less tradable, services show a smaller range and medians of both GVC participation indices and a higher concentration of values than the manufacturing sector. The examples of industries with above median GVC participation are the typical intermediate services, like water and air transport or wholesale trade, which also show a high capability of FDI attraction in our sample. Conversely, utilities' supply and waste management, also considered as relatively more tradable (OECD, 2018), and here exhibiting high GVC participation among services, does not show a high presence of FDI. For instance, we may observe the manufacturing of coke and refined petroleum products as having high backward GVC participation, which is characteristic of countries that are not direct petroleum producers, as in our sample. Without surprise, the production of food and beverages shows limited GVC connections, while the most attractive industries for foreign investors are those producing motor vehicles and electronics.

4 | ECONOMETRIC EVIDENCE

4.1 | Main analysis

To investigate whether GVC integration of a given market (country-sector pair) is a relevant driver for the presence of foreign-owned firms, we consider the following econometric specification:

$$IFDI_{ijct} = \beta_1 GVC\_b_{jct-1} + \beta_2 GVC\_f_{jct-1} + \beta_C C_{jct-1} + \beta_X X_{ict-1} + \alpha_i + \alpha_t + \varepsilon_{ijct} \qquad (4)$$

where the dependent variable $IFDI_{ijct}$ captures the inward FDI status of a given firm i operating in sector j and located in country c at time t, while the main explanatory variables are the country-sector-level GVC participation indices through backward (GVC_b_{jct-1}) and forward channels (GVC_f_{jct-1}). We also include control variables at both the country-sector level C_{jct-1} (i.e. *aggregate productivity*, measured as value added divided by the total number of hours worked) and the firm level X_{ict-1} (*productivity*, measured as turnover divided by the number of employees; *size*, measured as the number of employees; and *age*). Finally, we include firm and year fixed effects (α_i and α_t),[9] to

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[9]Note that industry–country fixed effects are omitted because they are captured by the firm fixed effects.

account for time-invariant firm characteristics and common macroeconomic shocks across firms, respectively, while ε_{ijct} denotes the idiosyncratic error term. Notice that all explanatory variables are lagged by 1 year to reduce the potential problems of reverse causality but also to account for the fact that a firm's FDI decision to adjust to GVC integration might not be immediate. Our results are based on the linear probability model and robust standard errors.

Considering hypotheses 1 and 2, we expect that:

(i) $\beta_1 > 0$, given that high globally integrated input buyers located within a given market jc can lead to a higher presence of foreign firms as input buyers (horizontal FDI) or input suppliers (vertical FDI). In other words, more sophisticated local input assemblers can be purchased by their foreign competitors to benefit from their profit opportunities (horizontal integration) or can be purchased by foreign upstream firms to benefit from their high-quality assembly capabilities (vertical integration).

(ii) $\beta_2 > 0$, given that high globally integrated input suppliers located within a given market jc can lead to a higher presence of foreign firms as input suppliers (horizontal FDI) or input buyers (vertical FDI). In other words, more sophisticated local input producers can be purchased by their foreign competitors (horizontal integration) to benefit from their profit opportunities or can be purchased by foreign downstream firms to benefit from their high-quality inputs (vertical integration).

Results related to Equation (4) are displayed in Table 1, considering the two GVC measures alternatively in columns 1 and 2, and jointly in column 3. In line with our hypothesis 1, the two coefficients turn out to be positive and statistically significant. Therefore, when a given market jc is relatively more involved in GVCs, in either a backward or forward manner, it can attract more foreign firms. We also find that a firm's probability of being involved in inward FDI is higher if the firm is, on average, older, larger and more productive, with production in a relatively more efficient sector. Our results are confirmed when considering the conditional logit model in column 4. The related odds ratios are reported in column 5 after rescaling the GVC measures from the range of [0,1] to the range of [0,100]% to quantify the effects more easily. They suggest that the odds of having inward FDI increase by 3.8% following a one-percentage-point increase in backward GVC integration, and 2.4% subsequent to a one-percentage-point increase in forward GVC integration. We keep considering our baseline econometric specification (the linear probability model) for the rest of the analysis.

4.2 | Country heterogeneity: EU15 versus CEE

Considering that most foreign-owned firms are from advanced countries, we can investigate our Hypothesis 2. The horizontal FDI channel can be explored by focusing on old EU destinations (EU15—advanced economies), whereas the vertical FDI channel can be explored by focusing on new EU destinations (CEE—emerging economies). In other words, we assume that foreign firms from a given advanced country tend to replicate the whole production process in *similar* foreign countries to supply foreign markets (horizontal FDI) and relocate only some stages of the supply chain in *dissimilar* foreign countries to exploit differences in production costs (vertical FDI). Therefore, we discern the sample between the old (EU15) and the new EU Member States (CEE), and by considering equation (4), we run our regression separately for each sub-sample. The results are, respectively, displayed in columns 6 and 7 of Table 1.

TABLE 1 Inward FDI and GVC linkages: Baseline results.

Dependent Variable: $IFDI_{ijct}$	Whole sample	Whole sample	Whole sample	Whole sample	Whole sample	EU15	CEE
	Linear probability model	Linear probability model	Linear probability model	Conditional logit model (coefficients)	Conditional logit model (odds ratio)	Linear probability model	Linear probability model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GVC_b_{jct-1}	0.121***		0.108***	0.037***	1.038***	0.028***	0.114***
	[0.007]		[0.007]	[0.003]	[0.003]	[0.008]	[0.012]
GVC_f_{jct-1}		0.066***	0.048***	0.024***	1.024***	0.005	0.062***
		[0.005]	[0.005]	[0.002]	[0.002]	[0.006]	[0.011]
$lnProd_{ijct-1}$	0.002**	0.003***	0.002**	0.010	1.010	0.004***	−0.004
	[0.001]	[0.001]	[0.001]	[0.048]	[0.048]	[0.001]	[0.004]
$lnAge_{ijct-1}$	0.022***	0.022***	0.022***	1.727***	5.622***	0.009***	0.038***
	[0.001]	[0.001]	[0.001]	[0.038]	[0.214]	[0.001]	[0.002]
$lnSize_{ijct-1}$	0.003***	0.003***	0.003***	0.097***	1.101***	0.002***	0.001
	[0.000]	[0.000]	[0.000]	[0.024]	[0.026]	[0.000]	[0.001]
$lnProd\_sect_{jct-1}$	0.017***	0.016***	0.016***	0.512***	1.669***	0.005***	0.009***
	[0.001]	[0.001]	[0.001]	[0.039]	[0.066]	[0.002]	[0.002]
Firm FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
R-squared	0.7324	0.7324	0.7324			0.773	0.658
Observations	3,573,909	3,573,909	3,573,909	212,349	212,349	2,735,555	838,354

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors were corrected for clustering at the firm level in parentheses. For conditional logit, GVC measures have been rescaled to the range 0–100.

Source: Own compilation.

We find that the positive effects of both GVC participation types are strongly confirmed for CEE Member States (column 7). These results suggest that higher GVC involvement of assemblers (input producers) located in a given market incentivises foreign firms to establish some upstream (downstream) stages of production in that market: the vertical FDI hypothesis is strongly confirmed. Regarding EU15 members (column 6), only the positive effect of backward GVC participation is statistically significant, given that the forward GVC effect is statistically insignificant. These findings suggest that only higher GVC involvement of assemblers in a given market leads foreign firms to establish affiliates for market-seeking purposes. In contrast, higher GVC involvement of input producers appears to have no effect. In other words, the horizontal FDI hypothesis is only partially confirmed: following the GVC integration of destination markets, foreign firms are more interested in supplying final consumers than intermediate producers in those markets.

4.3 | Sector heterogeneity: Manufacturing versus services

Moreover, considering that GVC integration leads to higher value added (VA) along the first and the last stages of the supply chain (mainly R&D and distribution services) and lower VA along the intermediate stages (mainly manufacturing production), according to the smile curve story, we expect that the positive GVC integration effects concern more the service than the manufacturing sector (Hypothesis 3). In the latter sector, GVC integration could even adversely affect the presence of foreign firms. Indeed, when interacting the main explanatory variables with two dummies capturing whether firms operate within the manufacturing sector (MAN) or service sector (SERV) in column 1 of Table 2, the positive effects of both GVC participation types are

TABLE 2 Inward FDI and GVC linkages: Manufacturing versus Services.

	Whole sample	EU15	CEE
Dependent variable: $IFDI_{ijct}$	**(1)**	**(2)**	**(3)**
$GVC\_b_{jct-1} \times MAN_j$	0.078***	0.017*	0.073***
	[0.010]	[0.010]	[0.020]
$GVC\_f_{jct-1} \times MAN_j$	0.005	−0.027***	0.034**
	[0.007]	[0.007]	[0.014]
$GVC\_b_{jct-1} \times SERV_j$	0.160***	0.064***	0.177***
	[0.010]	[0.014]	[0.016]
$GVC\_f_{jct-1} \times SERV_j$	0.069***	0.024***	0.047***
	[0.007]	[0.008]	[0.016]
Sectoral control	YES	YES	YES
Firm controls	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
R-squared	0.7328	0.7735	0.6574
Observations	3,140,214	2,400,349	739,865

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors were corrected for clustering at the firm level in parentheses. Sector control variables: $lnProd\_sect_{jct-1}$. Firm control variables: $lnAge_{ijct-1}$, $lnSize_{ijct-1}$, $lnProd_{ijct-1}$.

Source: Own compilation.

strongly confirmed for the services sectors. In contrast, only the positive impact of backward GVC participation is statistically significant for the manufacturing sectors but with a halved magnitude than the other sectors.

When exploring the sector heterogeneity within the two geo-economic EU sub-samples in columns 2 and 3, we find that the positive effects of both GVC integration modes are again confirmed relatively more for the services than the manufacturing sectors, in line with the smile curve story. For the EU15's manufacturing sector, we obtain even a negative and statistically significant coefficient for forward GVC participation. Indeed, we document that higher GVC involvement of intermediate service producers (associated with larger VA) pushes foreign firms to establish horizontal affiliates in advanced countries and vertical affiliates in emerging countries. Conversely, higher GVC involvement of intermediate goods producers (associated with smaller VA) leads foreign firms to open vertical affiliates in emerging countries and shut down horizontal affiliates in advanced countries. Moreover, higher GVC involvement of intermediate service assemblers (associated with larger VA) pushes foreign firms to establish horizontal affiliates in advanced countries and vertical affiliates in emerging countries. At the same time, higher GVC involvement of intermediate goods assemblers (associated with smaller VA) generates similar effects but with a smaller magnitude. Finally, we find evidence that positive GVC participation effects, primarily through backward linkages, on inward FDI are relatively larger in CEE compared to EU15 in the manufacturing and service sectors. This suggests that multinationals use EU emerging markets as an export platform.

4.4 | Robustness checks and further investigations

4.4.1 | Alternative foreign ownership measures

We run several robustness checks, as shown in Table 3. We utilise different thresholds regarding the foreign ownership share to define a foreign company. Our definition of inward FDI status is based on a foreign ownership share higher than 10%, which follows the standard IMF definition. However, when considering a stricter definition, that is, inward FDI firms are only those with a foreign ownership share higher than 50% (column 1) or equal to 100% (column 2), our main findings are confirmed, although with a smaller magnitude. We also consider the actual share of foreign ownership as a dependent variable through OLS in column 3, and we keep finding that firm-level inward FDI share is increasing in GVC participation of a given destination market via both backward and forward linkages.

4.4.2 | Alternative GVC integration measures

We employ alternative measures of GVC participation, namely, the measures by Borin and Mancini (2019) used in the World Bank's World Development Report (2020). These measures are obtained using a decomposition of bilateral exports following a country-level perspective with a source-based approach. We use the GVC backward participation index, computed as GVC backward participation (foreign and domestic value in imported inputs that are re-exported) divided by gross exports, and the GVC forward participation index, calculated as GVC forward participation (value of domestic productions re-exported by the bilateral partners) divided by gross exports. The related results are displayed in column 4 of Table 3 and corroborate our main

TABLE 3 Inward FDI and GVC linkages: Robustness checks.

Dependent variable: $IFDI_{ijct}$	IFDI status when foreign-ownership share>50%	IFDI status when foreign-ownership share =100%	Foreign ownership share	Alternative GVC measure	2010–2014	IFDI status dependence	Instrumental variable approach
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GVC_b_{jct-1}	0.079***	0.029***	0.082***	0.561***	0.170***	0.101***	0.075**
	[0.006]	[0.005]	[0.005]	[0.018]	[0.014]	[0.006]	[0.030]
GVC_f_{jct-1}	0.034***	0.025***	0.039***	0.552***	0.036***	0.046***	0.139***
	[0.005]	[0.004]	[0.004]	[0.026]	[0.009]	[0.005]	[0.018]
$IFDI_{ijct-1}$						0.062***	
						[0.002]	
Sector controls	YES	YES	YES	YES	YES	YES	YES
Firm controls	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
Idp							0.000
Widstat							11345.37
R-squared	0.74	0.74	0.8388	0.73	0.81	0.73	
Observations	3,573,909	3,573,909	3,573,909	3,548,929	2,577,312	3,573,909	3,573,909

Note: ***$p<0.01$, **$p<0.05$, *$p<0$. Standard errors were corrected for clustering at the firm level in parentheses. Sector control variables: $lnProd\_sect_{jct-1}$. Firm control variables: $lnAge_{ijct-1}$, $lnSize_{ijct-1}$, $lnProd_{ijct-1}$. Idp stands for the p-value of underidentification LM statistic, Widstat stands for the F statistic for weak identification (Cragg-Donald or Kleibergen-Paap).
Source: Own compilation.

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findings: foreign firms are more likely to be attracted to markets associated with higher GVC integration through both backward and forward linkages.

4.4.3 | Sensitivity tests

Our sample period (2008–2014) covers the financial crisis of 2008–2009, which may affect both firm-level FDI decisions and market-level GVC integration. Although common macroeconomic shocks are already captured by year-fixed effects, as robustness, we limit the period for the years 2010 onwards in column 3 of Table 3 and show that the positive effects of the two GVC integration measures on the firm's likelihood to receive FDI remain and appear even more evident for GVC backward participation.

Previous literature highlights that firms pay sunk fixed costs to establish affiliates abroad (Helpman et al., 2004; Kimura & Kiyota, 2006), which implies firm-level IFDI status dependence across time. Therefore, we add the lagged IFDI dummy to our baseline specification. The results in column 4 of Table 3 suggest that sunk costs, as reflected by the positive and statistically significant coefficient for the lagged IFDI dummy, appear to be an important factor when a foreign firm decides to invest in local firms in the host economies. It is worth noting that both GVC effects on inward FDI remain almost identical.

Next, we also check whether a specific industry might drive our results. Therefore, we run our baseline equation by considering several sub-samples and excluding one sector at a time. All results (available upon request) display positive and statistically significant coefficients of both backward and forward GVC participation. Therefore, our findings are not driven by a specific industry.

4.4.4 | Endogeneity issues

As mentioned in our literature discussion, using country (sector) level data, some studies documented that the presence of foreign-owned firms may enhance the GVC participation of given market (Antràs, 2020; Asian Development Bank, 2021). For instance, using an augmented gravity model with data from 40 developed and emerging countries during the period 1995–2011, Buelens and Tirpák (2017) illustrate the active role of inward FDI in shaping host economies' export structures and their participation in GVCs. They show that bilateral FDI stock is positively related to both gross bilateral trade and the bilateral import content of exports. Del Prete et al. (2018) analyse the involvement of North African GVCs at a country and sectoral level, and conclude that, despite high country heterogeneity, inward FDI and trade openness are positively associated with GVC participation. Fernandes et al. (2022) use data from more than 100 countries over the period 1990–2015 and find that inward FDI is a critical determinant in explaining GVC participation.

When exploring the two types of GVC participation, it has been shown that a higher inward FDI leads to a larger GVC integration of the destination market, especially via backward linkages. For instance, focusing on a group of developing countries from Asia and Africa/the Middle East, Kowalski et al. (2015) show a positive and significant relationship between backward linkage and inward FDI stock, while no significant impact of inward FDI stock on forward linkage is found. Based on a European sample of countries over the period 2000–2015, Adarov and Stehrer (2021) demonstrate not only that FDI is an essential driver of GVC

participation but also that its impact depends on the direction of investment and the position of a country sector in the GVC. More specifically, inward FDI encourages the formation of backward GVC linkages, while outward FDI facilitates forward GVC participation, mainly in high-tech manufacturing industries.

Therefore, our findings might be affected by reverse-causality problems. To check whether this is the case, we also explore this inverse relationship at the country-sector level in our context by regressing the change of our two measures of GVC participation over the whole sample period on the initial presence of foreign-owned firms, measured as foreign-owned firms' sales divided by overall firms' sales. The results are reported in Appendix Table A1. Columns 1 and 2 show that foreign-owned firms' initial presence may positively influence both backward and forward GVC participation. However, when including the country and sector fixed effects in columns 3 and 4, the statistical significance of both coefficients vanishes, and the sign of the forward participation coefficient switches to negative. First, these results are coherent with previous studies documenting that inward FDI may positively impact backward GVC participation and that there is an unclear impact on forward GVC participation. Second, the results in columns 3 and 4 are reassuring because when controlling for time-invariant country and sector characteristics (as we also did in our main analysis by considering firm fixed effects), the problem of reverse causality is dramatically reduced. However, to further reduce this concern and, more generally, the potential endogeneity problem, we also implemented an instrumental variable (IV) strategy as robustness. Considering the signs of the coefficients reported in columns 3 and 4 of Appendix Table A1, we possibly expect that the OLS coefficient is upward-biased for backward GVC participation and downward-biased for forward GVC participation. To implement our instrumental variables strategy, we adapt the IV approach used in previous studies (Autor et al., 2013) to our data. Specifically, the GVC participation of a given country sector is instrumented by the average value for countries from the same group (EU15 or CEE), excluding the country of interest. One might be concerned that the exclusion restriction could be violated if, for example, there are spillover effects from GVC integration between neighbouring countries. For instance, an Italian firm near the French border might receive more FDI due to both French and Italian GVC integration. To address this concern, we exclude all direct neighbours when computing our instrumental variable. For example, for Italy, we consider all the other old Member States (EU15) except its neighbours, France and Austria. Regarding the relevance, our first-stage results, reported in Appendix Table A2, indicate that our instruments are positively correlated with our main explanatory variables. The second-stage results reported in column 7 of Table 3 corroborate our main findings that both backward and forward GVC integration of a given market increase a firm's likelihood to receive FDI. Moreover, it is worth noting that the size of the IV coefficient is smaller for backward and larger for forward GVC participation compared to the OLS coefficient, in line with our expectations.

4.4.5 | Exploring further the smile curve story

To further explore the smile curve story, we analyse whether the GVC integration effects depend on the initial GVC positioning (GVC_p_{jc2008}), by considering the following equation:

$$
\begin{aligned}
IFDI_{ijct} = &\ \gamma_1 GVC_{bjct-1} + \gamma_2 GVC_{bjct-1} \times GVC\_p_{jc2008} + \gamma_3 GVC_{fjct-1} \\
&+ \gamma_4 GVC\_f_{jct-1} \times GVC\_p_{jc2008} + \beta_C C_{jct-1} + \beta_X X_{ict-1} + \alpha_i + \alpha_t + \varepsilon_{ijct}
\end{aligned}
\tag{5}
$$

TABLE 4 Inward FDI and GVC linkages: The role of market position along the GVC.

	Whole sample	EU15	CEE
Dependent variable: $IFDI_{ijct}$	(1)	(2)	(3)
GVC_b_{jct-1}	0.384***	−0.043	1.092***
	[0.046]	[0.050]	[0.098]
$GVC\_b_{jct-1} \times GVC\_p_{jc2008}$	−0.281***	0.076	−1.019***
	[0.047]	[0.052]	[0.101]
GVC_f_{jct-1}	−0.203***	−0.094**	−0.414***
	[0.038]	[0.040]	[0.082]
$GVC\_f_{jct-1} \times GVC\_p_{jc2008}$	0.260***	0.103**	0.494***
	[0.040]	[0.042]	[0.087]
Sector controls	YES	YES	YES
Firm controls	YES	YES	YES
Firm FE	YES	YES	YES
Year FE	YES	YES	YES
R-squared	0.73	0.77	0.66
Observations	3,573,909	2,735,555	838,354

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors were corrected for clustering at the firm level in parentheses. Sector control variables: $lnProd\_sect_{jct-1}$. Firm control variables: $lnAge_{ijct-1}$, $lnSize_{ijct-1}$, $lnProd_{ijct-1}$.

Source: Own compilation.

We expect that the backward GVC effect on foreign firm presence is positive along the last stages of the supply chain (distribution) and negative along more upstream stages (production), that is, $\gamma_1 > 0; \gamma_2 < 0$; conversely, the forward GVC effect on foreign firm presence is expected to be positive along the first stages (R&D) and negative along more downstream stages (production), that is, $\gamma_3 < 0; \gamma_4 > 0$.[10]

The results of Equation (5), shown in column 1 of Table 4, appear coherent with our expectations. The greater presence of foreign firms arising from backward GVC integration tends to decrease as we move towards country-sector pairs that are farther from the final consumers (i.e. from the final to intermediate stages). At the same time, the greater presence of foreign firms arising from forward GVC integration tends to decrease as we move towards country-sector pairs closer to the final consumers (i.e. from the initial to intermediate stages).

Our results are also strongly confirmed in column 3 when focusing on the subsample of CEE members (vertical FDI hypothesis). Foreign firms tend to establish vertical affiliates in country-sector pairs that outsource more intermediate inputs from global markets and are also positioned along the final stages of production (e.g. distribution). Indeed, they tend to reduce their presence if those country-sector pairs are positioned in more upstream stages (e.g. production). At the same time, foreign firms tend to establish vertical affiliates in country-sector pairs that supply more intermediate inputs to global markets and are also positioned along the initial stages of production (e.g. R&D). Indeed, they tend to reduce their presence if those country-sector pairs are positioned in more downstream stages (e.g. production).

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[10]Note that the variable GVC_P_{jc2008} alone is omitted because it is time invariant, and therefore, dropped by the country-sector fixed effects.
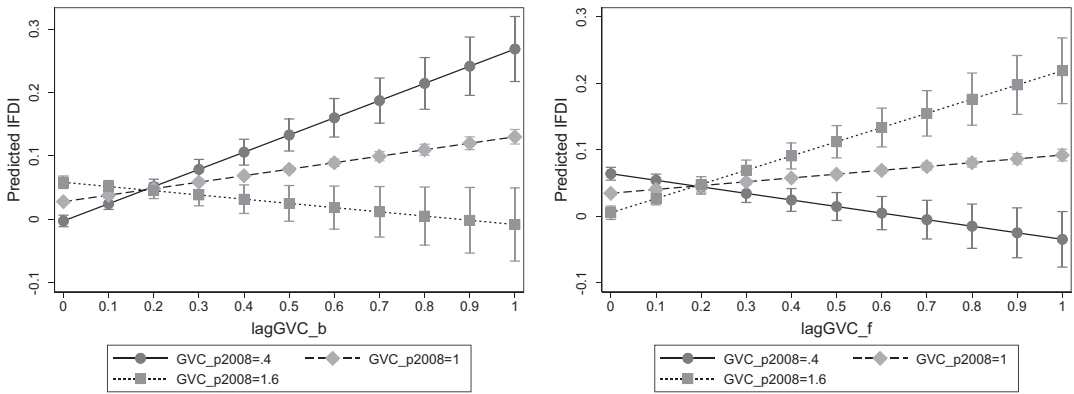
FIGURE 4 Marginal plots: Illustration of the result from Table 4: Column 1. *Source*: Own compilation based on data from WIOD (2016) and Bureau van Dijk.

Finally, as regards the subsample of EU15 members (horizontal FDI hypothesis) in column 2, only the forward GVC integration effects are confirmed. Foreign firms tend to open horizontal affiliates in country-sector pairs that supply intermediate inputs to international markets if they are positioned along the first stages of production (e.g. R&D). Conversely, they tend to shut down their horizontal affiliates if those country-sector pairs are positioned in more downstream stages (e.g. production).

To better illustrate the results, we present Figure 4, plotting the predictive margins for different GVC positions to address the question of how the firm's probability of receiving FDI changes depending on the interplay between GVC participation and GVC position. We report (either backward or forward) GVC participation on the horizontal axis and the predictive margins related to a firm's probability of receiving FDI. The three lines in each graph represent the different positions along the global value chain. It is worth remembering that GVC_p equals 1 for a production stage in the middle of the value chain; GVC_p lower than 1 means closer to the final demand (downstream country sector) and GVC_p higher than 1 means closer to the beginning of the value chain (upstream country-sector). For forward GVC participation, we observe a different effect, depending on whether the industry is downstream or upstream. As GVC participation via forward linkages increases, a firm's probability of receiving FDI decreases for country sectors closer to the final demand and increases for country sectors closer to the beginning or in the middle of the supply chain. For the other type of GVC integration, the findings are reversed. Indeed, as backward GVC participation increases, a firm's probability of receiving FDI increases for country sectors that are closer to the final demand, and declines for country sectors that are positioned at the beginning or in the middle of the supply chain.

We have used the time-invariant measure of GVC positioning to ensure that inward FDI effects arise from changes in GVC integration rather than changes in GVC position over time. Now, we additionally check what happens when considering the time-varying GVC position.[11] Again, we show the plots to illustrate better the results (Figure A4 in the Appendix 1). The sensitivity analysis confirms our baseline result along the 'smile curve' hypothesis.

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[11]More specifically, GVC_P_{jc2008} has been replaced by GVC_P_{jct-1} in equation 5. In this case, GVC_P_{jct-1} has been also included alone because it is time varying.

5 | CONCLUSION

In this study, we explore whether GVC participation of a given market, via both backward and forward linkages, is an important driver for inward FDI at the firm level.

Our baseline results suggest that a firm's probability of receiving FDI is higher when the firm is active in country sectors that are more involved in forward and backward GVC participation. However, if we divide the countries into old Member States (EU15) and new Member States (CEE) and split sectors between manufacturing and services, we find that the positive effects of both types of participation in GVCs are mostly confirmed for CEE countries, especially in the services sector. This shows that services are playing an increasing role in GVCs, as noted by the World Bank (2020). Multinational enterprises are increasingly shifting services to CEE. Commonly relocated services encompass ICT services, like software development, web development and ICT support; as well as business process outsourcing, such as customer support, technical support, back-office operations and call centre services. These countries attract FDI due to their lower labour costs for the same skill level of workers. As a result, foreign firms can leverage these cost advantages to deliver services more effectively, ultimately enhancing profitability and competitiveness in the global market. Regarding the manufacturing sector, we find that GVC integration, involving both backward and forward linkages, is associated with a lower level of FDI attractiveness than the services sector, especially in EU15 countries. Notably, forward GVC participation decreases the likelihood of a firm receiving FDI in these countries. These results suggest that multinational enterprises re-shore certain manufacturing stages from advanced to emerging EU countries, using the latter as export-platform markets.

More insights emerge when considering the GVC position of the destination market as an additional factor influencing the location choice of foreign firms. Indeed, we demonstrate that the magnitude of the positive GVC participation effect changes along different stages of the production line. More specifically, we find that as participation in forward GVCs increases, the probability of inward FDI decreases for country sectors closer to the final consumer and increases for country sectors closer to the beginning of the value chain. Conversely, the greater the participation in backward GVCs, the greater the likelihood of inward FDI in downstream sectors and the lower the likelihood in upstream sectors.

While MNEs, with their production fragmentation strategies, are one of the main actors in the creation of GVCs, their location choices are determined by the existence of GVCs. This last aspect has important implications for policymakers and policies to attract FDI. To attract MNEs, investment policies must not only reduce regulatory burdens on foreign investors and use firm incentives but also improve and showcase country's comparative advantages to multinationals and help domestic companies to internationalise and integrate into GVCs.

Finally, further investigation is needed into the relationship between FDI and GVCs. For instance, it would be interesting to extend this analysis to a more recent period in order to explore how the GVC effects on inward FDI adjust to recent global disruptions, such as COVID-19 and the Russia–Ukraine war.

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APPENDIX 1

TABLE A1 Change in GVC integration measures over 2008–2014 versus initial foreign presence at the country-sector level.

Dependent variables:	$\Delta GVC\_b_{jc}^{2008-2014}$ (1)	$\Delta GVC\_f_{jc}^{2008-2014}$ (2)	$\Delta GVC\_b_{jc}^{2008-2014}$ (3)	$\Delta GVC\_f_{jc}^{2008-2014}$ (4)
$FDIsh_{jc}^{2008}$	0.025***	0.013	0.008	−0.008
	[0.009]	[0.012]	[0.008]	[0.012]
Country FE	NO	NO	YES	YES
Sector FE	NO	NO	YES	YES
R-squared	0.0093	0.0011	0.2833	0.2966
Observations	1548	1549	1548	1549

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Robust standard errors in parentheses.

TABLE A2 First stage results.

Dependent variables	GVC_b_{jct-1} (1)	GVC_f_{jct-1} (2)
$IV\_GVC\_b_{jct-1}$	0.439***	0.156***
	[0.002]	[0.003]
$IV\_GVC\_f_{jct-1}$	0.104***	0.501***
	[0.001]	[0.002]
Sector controls	YES	YES
Firm controls	YES	YES
Firm FE	YES	YES
Year FE	YES	YES
F test of excluded instruments $F(2, 755,837)$	28997.22	33984.23
Sanderson–Windmeijer multivariate F test of excluded instruments: $F(1, 755,837)$	25486.04	25819.75
Observations	3,573,909	3,573,909

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Standard errors corrected for clustering at the firm level in parentheses. Sector control variables: $lnProd\_sect_{jct-1}$. Firm control variables: $lnAge_{ijct-1}$, $lnSize_{ijct-1}$, $lnProd_{ijct-1}$.
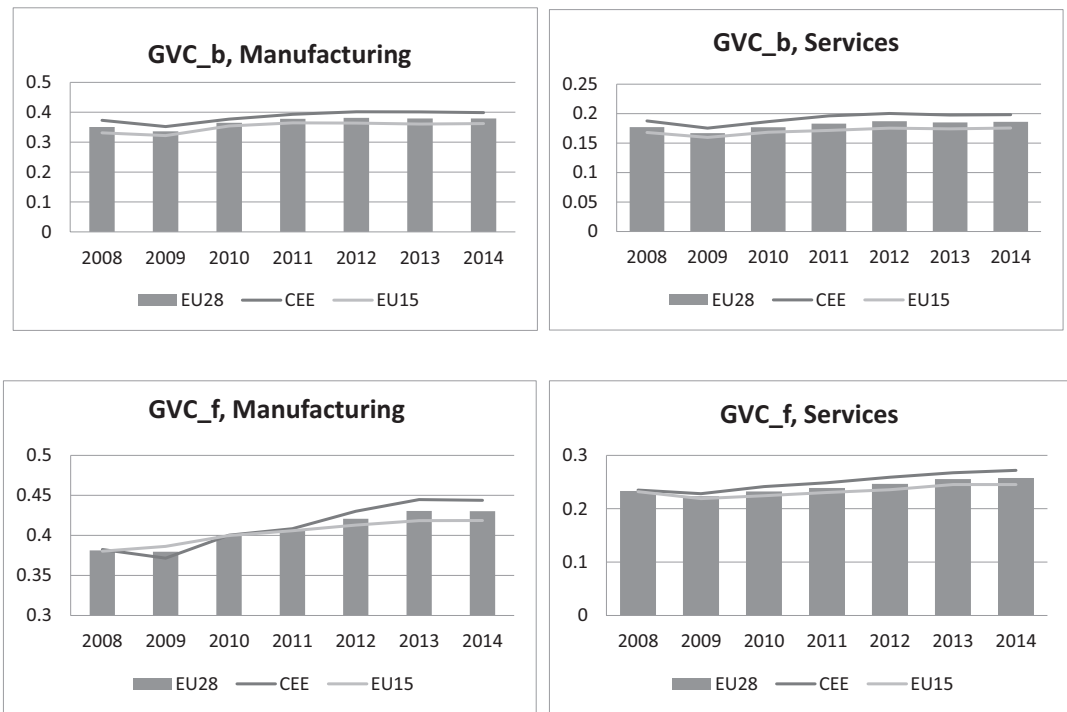
Source: Own compilation.

FIGURE A1 Forward and backward GVC participation in manufacturing and services sectors. *Source*: Own compilation based on WIOD (2016).
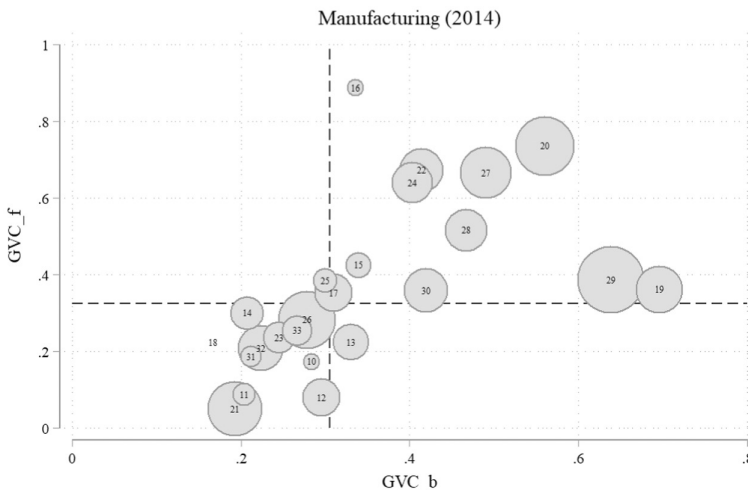

FIGURE A2 Sector classification according to the different levels of integration (2014): Manufacturing (Manufacture of: food products (10), beverages (11), tobacco products (12), textiles (13), wearing apparel (14), leather products (15), wood and products of wood and cork, except furniture, etc. (16), paper and paper products (17), printing and reproduction of recorded media (18), coke and refined petroleum products (19), chemicals and chemical products (20), basic pharmaceutical products and pharmaceutical preparations (21), rubber and plastic products (22), other non-metallic mineral products (23), basic metals (24), fabricated metal products, except machinery and equipment (25), computer, electronic and optical products (26), electrical equipment (27), machinery and equipment n.e.c. (28), motor vehicles, trailers and semi-trailers (29), other transport equipment (30), furniture (31), other manufacturing (32), Repair and installation of machinery and equipment (33)). *Source*: Own compilation based on WIOD (2016).
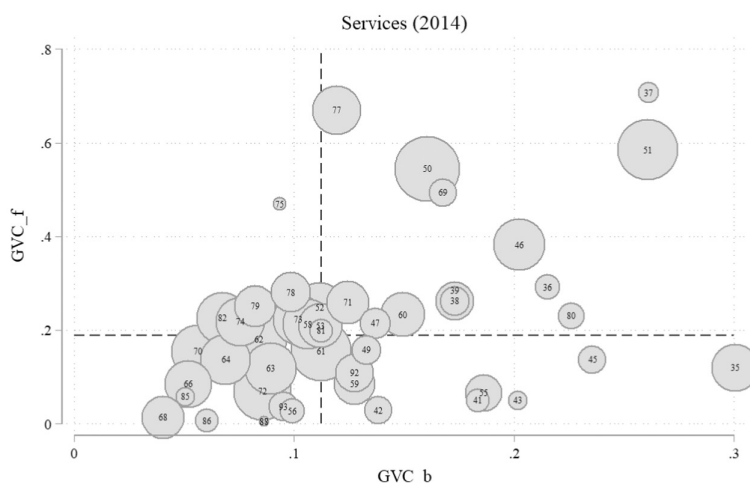
FIGURE A3 Sector classification according to the different levels of integration (2014): Services (Electricity, gas, steam and air conditioning supply (35); Water collection, treatment and supply (36); Sewerage (37); Waste collection, treatment and disposal activities; materials recovery (38); Remediation activities and other waste management services (39); Construction of buildings (41); Civil engineering (42); Specialised construction activities (43); Wholesale and retail trade and repair of motor vehicles and motorcycles (45); Wholesale trade, except motor vehicles and motorcycles (46); Retail trade, except motor vehicles and motorcycles (47); Land transport and transport via pipelines (49); Water transport (50); Air transport (51); Warehousing and support activities for transportation (52); Postal and courier activities (53); Accommodation (55); Food and beverage service activities (56); Publishing activities (58); Motion picture, video and television programme production, sound recording (59); Programming and broadcasting activities (60); Telecommunications (61); Computer programming, consultancy and related activities (62); Information service activities (63); Financial service activities, except insurance and pension funding (64); Insurance, reinsurance and pension funding, except compulsory social (65); Activities auxiliary to financial services and insurance activities (66); Real estate activities (68); Legal and accounting activities (69); Activities of head offices; management consultancy activities (70); Architectural and engineering activities; technical testing and analysis (71); Scientific research and development (72); Advertising and market research (73); Other professional, scientific and technical activities (74); Veterinary activities (75); Rental and leasing activities (77); Employment activities (78); Travel agencies, tour operators and other reservation services and related (79); Security and investigation activities (80); Services to buildings and landscape activities (81); Office administrative, office support and other business support activities (82); Education (85); Human health activities (86); Residential care activities (87); Social work activities without accommodation (88); Gambling and betting activities (92); Sports activities and amusement and recreation activities (93); Activities of households as employers of domestic personnel (97).). *Source*: Own compilation based on WIOD (2016).
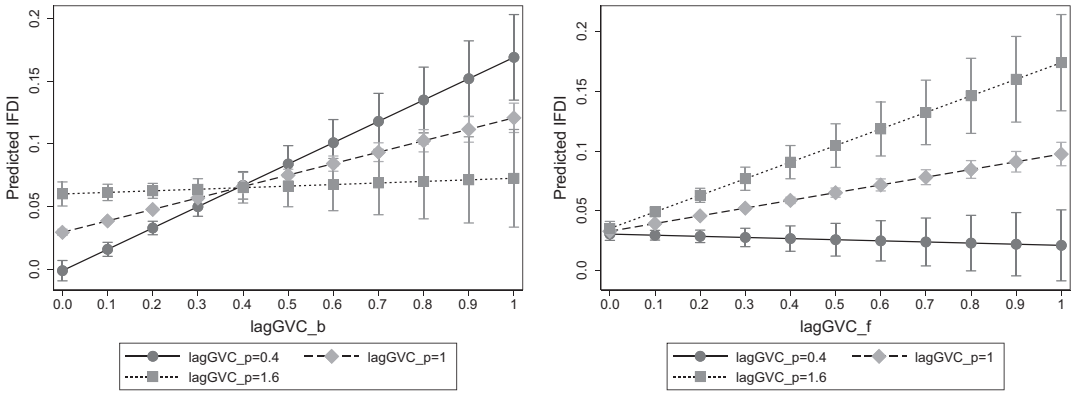
FIGURE A4 GVC participation backward and forward, interaction with GVC position (varying over time), total sample. *Source*: Own compilation based on data from WIOD (2016) and Bureau van Dijk's data.