Foreign direct investments and participation in global value chains: New evidence from advanced manufacturing industries in Central and Eastern Europe

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Abstract: *Foreign direct investments (FDIs) and trade within global value chains (GVC) have been considered one of the most important vehicles of economic development and competitiveness, especially for countries in transition. The countries of Central and Eastern Europe are competing to attract not only high amounts of FDI inflows but they also put emphasis on the FDIs' sectoral structure. FDI inflows into advanced industries can represent the basis of technological development that will lead to the creation of a greater number of high-skill jobs and a higher level of innovation, thereby influencing the reduction of the economic gap in relation to developed countries. This study aims to explore the importance of FDI inward stock for GVC participation in the advanced manufacturing industries in eleven EU member states that transferred to market economies in the 1990s and attracted vast amounts of FDI inflows since then. The dynamic panel data analysis results indicate the importance of FDI inward stock in the manufacturing industry for the GVC participation in advanced manufacturing industries across this set of countries while also stressing the important implications of manufacturing share in GDP changes for these industries' backward GVC participation. The findings confirm a positive association between attracting FDI in the manufacturing sector and GVC integration in advanced manufacturing industries. Such FDI targeting can be a vehicle for internationalization and development of high-tech and knowledge-based industries.*

Keywords: *Foreign direct investment, global value chains, Central and Eastern Europe, advanced industries, manufacturing.*

JEL Classification: *F12, F14, F21.*

APA Style Citation: Kersan-Skabic, I. & Barisic, A. (2023). Foreign direct investments and participation in global value chains: New evidence from advanced manufacturing industries in Central and Eastern Europe. *E&M Economics and Management, 26*(4), 4–16. https://doi.org/10.15240/tul/001/2023-4-001

Introduction

Foreign direct investments (FDIs) and global value chains (GVCs) have been key features of economic liberalization and globalization. After the introduction of the market economy and their liberalization in the very beginning of the 1990s, the Central and East European (CEE) countries (EU new member states, EU CEE countries) needed fresh capital to privatize the majority of their state-owned

companies and to establish new ones with the main aim to boost their economic growth. The CEE countries have attracted a cumulative amount of EUR 842,964.4 million FDI inward stock from the beginning of the 1990s until 2021, varying from 5,268 EUR per capita in Romania to 22,321 EUR per capita in Estonia (10,545 EUR per capita on average), representing from 35% of GDP in Slovenia to 94.5% of GDP in Estonia (58.4% of GDP on average) (WIIW, 2022).

In these countries, FDI inflows were promoted as a vehicle of technological development with the potential to spur the development of knowledge-based industries and further lead to their specialization in higher-value-added industries, enabling their convergence to developed economies (Jurcic & Barisic, 2018). Capital accumulation and technological progress spillover effects deriving from FDI inflows have been emphasized as important contributors to economic growth (Borensztein, 1998; Iamsiraroj, 2016; Wan, 2010). However, several pieces of research point out diverse economic growth and export outcomes of FDI inflows across countries. They show that positive effects have not materialized through FDI channels evenly, which is often attributed to the importance of absorptive capacity, underlying motives of FDI and the industries receiving it (Almfraji & Almsafir, 2013; Damijan et al., 2013b; Kersan-Skabic & Zubin 2009). The impact of FDI thus continues to be the focus of academic debates, especially across these economies (Bilas, 2020; Gaspareniene et al., 2020).

At the same time, GVC participation paths in these countries have shown to be diverse, especially in manufacturing industries which are considered an important source of economic development (Barisic, 2020; Kersan-Skabic, 2017). Although in developed economies the importance of services has raised, it is hard to find a successful development story of a country without it being driven by the industrialization (Szirmai, 2013).

Economic liberalization and deregulation allowed this set of countries to join GVCs and receive FDI inflows, which are often regarded to be important determinants of GVC trade as the foreign subsidiaries are often more connected to their parent company (MNE headquarter) and often use established downstream networks. Although some researches point out to the reverse causation (GVC participation leading to FDI) (Carril-Caccia & Pavlova 2020; Cipollina et al., 2021; Martinez-Galan & Fontoura, 2018), FDI is more often seen as one of the most important determinants of establishing GVCs (Amador & Cabral, 2016) as it allows the shaping of these production networks to exploit the opportunities in foreign markets, and is expected to be followed by the international production fragmentation and increase in GVC trade.

Accordingly, FDI inflows have often been proclaimed beneficial for fostering GVC participation in this set of countries, but empirical research is very limited. FDI inward stock and high-tech product share in exports have proven to be an important driver of economy-wide GVC participation in EU NMS (13) (Kersan-Skabic, 2019), and a positive connection has been found between bilateral FDI stock and gross bilateral trade and bilateral import-content of exports in the case of CEE countries in the period from 2000–2011 (Buelens & Tirpak, 2017).

Specialization in advanced industries in manufacturing (i.e., industries considered more technology intensive), which often entail geographically a highly fragmented production process, is frequently in the focus of middle-income countries as technological upgrading, and GVC integrations are often considered facilitators of catch-up and avoiding the middle-income trap (Gill & Kharas, 2015). Although integration in GVCs is believed to bring an increase in productivity and foster the specialization in higher value-added activities, which can reap the economies of scale, to the authors' knowledge, no recent research in this set of countries has been conducted to explore the effects of FDI inflows in the manufacturing industry on advanced manufacturing industries' participation in GVCs. Given the specific development path of these countries since the 1990s, accompanied by high levels of FDI inflows and integration in international production networks, exploring the determinants of GVC integration in the industries considered important for their development provides an interesting case for analysis.

Thus, to fill this literature gap and provide valuable contribution for government policies relevant for attracting FDI, this paper aims to explore the importance of FDI inward stock in the manufacturing industry for GVC participation in advanced industries in manufacturing in post-transition countries in the CEE region

(Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia). The advanced industries in manufacturing included in the analysis were chosen as they are considered vital for increasing competitiveness of economies. To empirically explore these relationships, dynamic panel data models are estimated using the system GMM estimator. The analysis includes the data for the period from 2005 to 2018.

The paper is structured as follows. Section 1 presents the theoretical background together with the literature review of related scientific papers. Section 2 explains the methodology and data used in the empirical research, while section 3 presents the results of the empirical research and provides a discussion of the findings. The last section offers the conclusion and policy recommendations.

1. Theoretical background

Multinational companies' growing and dispersing activities resulted in increased trade in intermediate products, indicating the production process has been fragmented into many phases taking place in different places across different countries. In this way, the production processes create the global value chains (GVCs). Countries (i.e., producers) can participate as exporters of raw materials and intermediate products (forward linkages) and as importers of intermediate products from abroad (backward linkages). GVC participation can result from companies' efforts and networks built with business partners (suppliers, customers). It is also an indicator of specialization and innovation, as it refers to participation in international production chains with the focus on the production of specific parts of products (or services).

Many factors can influence the country's involvement in GVCs, but for emerging economies and/or ex-socialist economies, the easiest way for inclusion in such chains is through the attraction of FDIs. In this way, foreign companies invest vast amounts of money in brownfield or greenfield projects. Even though the FDI in general can impact GVC participation, the impact depends on the investors' motivation. This link is especially evident for efficiency seeking motivated FDI. If the main motives lie in selling in the foreign markets, the FDI will replace the export and no particular influence on production chain is likely to occur. On the other hand, if the investors seek resources, or cheaper production factors, they will move a part of the production abroad causing the creation of vertical linkages between home companies and foreign ones. In that case, intra-company trade emerges and a big impact of FDI on GVC participation can be expected. UNCTAD (2013) estimated that about 80% of global trade (in terms of gross exports) is related to international production networks.

In recent empirical research, the connection between FDI and GVC participation has been explored in various ways. The analysis can be done by investigating the connection between inward (or inflows of) FDI and trade (especially trade in intermediates); outward FDI and GVC (Li et al., 2021; Wang & Chen, 2020); GVC participation and regional (preferential trade) integration because integration can create a favourable environment for boosting intra-regional trade and investments as a consequence of which participation in the global (regional) value chain can be expected as well (Park & Kim, 2020). Some papers used the gravity approach in explaining the links between trade and FDI flows as well as trade in intermediates and FDI flows (Buelens & Tirpak, 2017; Carril-Caccia & Pavlova, 2020).

The literature review including relevant papers that analyzed the impact of FDI on GVC participation in the global context, followed by those which focused on the sample of EU countries, is presented in addition.

Amador and Cabral (2016) found that the role of FDI is instrumental in setting up GVCs run by multinational corporations. MNEs have a crucial role in expanding international business and trade: they account for one third of the global output and world GDP, and are responsible for half of the global exports (OECD, 2018). They contributed to the growing fragmentation of production seen within GVCs in the past decades (OECD, 2018). Efogo et al. (2021) applied the panel data analysis on the sample of developing countries for the period 2010–2019 and found a positive impact of FDI inflows on GVC participation regardless of whether the FDI is in the primary, secondary or tertiary sector. It is important to point out that Cingolani et al. (2017) found that emerging and developing countries mostly positioned centrally at upstream and midstream production stages, while high-income countries were positioned at downstream stages.

Specifically, the Central and Eastern Europe (CEE) countries have often been separately researched due to their accession

process to the EU which pushed considerable amounts of FDI inflows from EU15 to their Eastern neighbours that started joining the EU in 2004 (followed by the enlargement in 2007 which included Bulgaria and Romania and in 2013 which included Croatia). Although these countries have experienced profound changes since the beginning of 1990s, research do not point out to clear evidence of their catching-up behaviour towards the "old" EU member states, but stress that their integration is a lengthy and non-linear process (Cieslik & Wcislik, 2020). Additionally, it is important to note they have substantial disparities in both the levels of FDI and degree of integration in GVCs across sectors and industries (Barisic, 2020; Kersan Skabic, 2019). Also, these countries have experienced distinct paths of industrialization/deindustrialization. Notably, the Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia have maintained relatively high shares of manufacturing industries in the overall GDP, while Bulgaria, Croatia, Estonia and Latvia exhibit lower levels (WIIW, 2020)

The following research include evidence related to this topic from this region. Damijan et al. (2013a) found that inward FDI in CEEC has changed and defined their export composition and positively impacted the development of production networks in CEEC. Kaminsky and Ng (2005) found that FDI leads to increased regional trade integration. Behar and Freund (2011) also indicated that intra-EU trade in intermediate goods has become more sophisticated after their accession to the EU, pointing to the increasing role of new members as suppliers of intermediate goods for the incumbent countries. Ambroziak (2018) pointed out the great importance of Germany for the integration of new EU member states (CEECs) in GVCs in the period from 1995–2011. He found that Germany became the main driver for GVC participation growth, where its importance is higher in the backward linkages (as suppliers of intermediates) than in forward linkages. Nikolovova (2013) researched the impact of FDI on the sectoral level on the sample of EU27 countries and found that an increase in FDI is related to higher production and a higher demand for intermediate goods. This indicated that FDI is primarily vertical and related to outsourcing activities. Hagemejer (2017) explored the sources of value added and productivity growth in the EU NMS in the period 1995–2009. They found an important contribution of trade (30–40%) to GDP growth, while connecting the sectoral productivity growth with FDI, exporting, and the position of a sector/country in GVCs, especially stressing the importance of imported intermediate goods for higher productivity across sectors. Productivity growth was also found in sectors distant from the final demand and those exporting intermediate goods.

Several studies explored the integration of this region in GVCs. Leitner and Stehrer (2014) found that vertical specialization intensified in most of the EU NMS and that stronger participation in global production processes enhanced their performance between 1995 and 2007. Their results indicate that export growth and the degree of vertical specialization tend to reinforce each other. Cieslik et al. (2016) calculated participation and position of these post-socialist countries along GVCs in 2009 and found mixed results. Countries with stronger links with Western European countries were more integrated in GVCs, and most of the exporters from CEE are positioned in the downstream part of the production process. In addition, they found the highest internationalization in transport equipment and electronics where some of the countries were among the global leaders in the upstream segment. Grodzicki and Geodecki (2016) explained the core-periphery model in Europe based on the contribution of groups of countries to GVCs, while warning that GVC participation can accelerate the deindustrialization process and that CEE countries are in a better position than the Southern European countries, due to their continued dependence on foreign capital and technology. Besides economic determinants of FDI inflows, some research pointed out to importance of institutional determinants including investment policy design, evaluation, and monitoring across Southeast Europe for attracting FDI flows (Silajdzic & Mehic, 2022).

Adarov and Stehrer (2021) focused their research on European countries covering the period from 2000 to 2014 by investigating impact of FDI inflows on the formation of GVCs. Inward FDIs have shown to be very influential in the formation of backward linkages and on the other hand, outward FDIs boost forward participation in GVC. They also provided a sectoral analysis, and their findings are strongly relevant for high-tech manufacturing sectors.

European Commission (2020) also stressed the importance of synergies between GVCs, FDI and national, regional and EU-level development trajectories. They conducted an analysis of three GVC-sensitive manufacturing industries (computer and electronics, automotive and textiles and apparel) and grouped EU member states into four groups according to their participation levels: i) High GVC integration (Belgium, Czech Republic and Slovenia); ii) Low GVC integration (Croatia, Cyprus, Greece, Italy, Portugal, Spain and Latvia); iii) Backward GVC integration (Lithuania, Estonia, Slovak Republic, Hungary, Bulgaria, and Ireland, Denmark, Luxembourg and Malta); and iv) Forward GVC integration (Germany, Austria, Sweden, France, Finland, the United Kingdom, the Netherlands, and Poland and Romania). This report demonstrated the importance of attractiveness for foreign capital and its coordination on the national and regional levels with other policies. Moreover, economies listed in the Forward GVC integration group received and sent a total value of FDI significantly larger than the other three groups combined. Carril-Caccia and Pavlova (2020) provided an extensive overview of papers dealing with the connection between FDI and trade and especially between vertical FDI and trade. They pointed out the necessity to deepen the existing analysis by including the structure (determinants) of both. Chang et al. (2021) presented an overview of 80 papers that connect in(out)flows or in(out)ward FDIs on GVC participation, and emphasized the gaps not covered by existing research.

Following the findings of the literature review, we strive to go a step further and empirically explore the connection between FDI inflow in the manufacturing industry and GVC participation in advanced manufacturing industries in the new EU member states excluding island economies – Cyprus and Malta (EU NMS-11). Thus, this subset of countries includes CEE countries which have experienced the transition to market economy in the 1990s and in the following two decades have joined the EU (CEE countries).

2. Research methodology

The primary aim of this empirical analysis is to explore the importance of FDI inward stock in the manufacturing industry for GVC participation of advanced manufacturing industries across EU CEE countries. The gross exports decomposition enabling the calculation of GVC participation indicators is explained in detail in Koopman et al. (2010). Given its methodological characteristics, the most frequently used databases for export decomposition in scientific research have been the World Input-Output database (WIOD) (Timmer et al., 2015) and OECD Trade in Value Added database (TiVA). Both enable the analysis of modern trade patterns through GVCs, as they provide data on direct and indirect inter-sectoral connections across and within countries (De Backer & Miroudot, 2014).

The most common measure of GVC participation is the sum of forward and backward GVC participation, where backward GVC participation is the share of foreign value added in gross exports, while forward GVC participation is domestic value added which direct trade partners further reexport, expressed as the share of domestic gross exports. If a country is downstream in the production networks, i.e., focused on the last stages of production, it is likely to have a large share of imported intermediate goods, which leads to high values of backward participation relative to forward, as it is the case with this set of countries (Barisic, 2020; Kersan-Skabic, 2017). The opposite would be true for countries focused on the upstream GVCs activities.

This empirical analysis includes all three mentioned key variables of GVC participation (backward participation in GVCs, forward participation in GVCs and total participation in GVCs) as dependent variables. The data for main dependent variables include yearly data for 11 CEE countries (Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) in six advanced industries: Manufacture of pharmaceutical products and preparations (C21), Manufacture of computer, electronic and optical products (26), Manufacture of electrical equipment (C27), Manufacture of machinery and equipment (C28), Manufacture of motor vehicles, trailers and semi-trailers (C29) and Manufacture of other transport equipment (C30). Listed industries are classified as high-technology or medium-high-technology according to Eurostat (2022) high-tech classification and are in general considered to be highly integrated in GVCs, as previously elaborated.

The FDI inward stock in the manufacturing industry is the main independent variable

in the model. The study covers the period from 2005 to 2018, i.e., from the first (and largest) EU accession wave of these countries until the last available TiVA data. This analysis focuses on a particular timeframe driven by the availability of data related to GVCs, selecting the database that provides the most up-to-date data. As pointed out in the literature review, recent research has used both stock and flows FDI data in exploring this relationship. In this model, stock data are chosen given their more long-term perspective on the accumulation of FDI in a country thus providing a better understanding of their cumulative impact on the host economies' GVC participation.

Other control variables listed in Tab. 1 are included in the model to explore their association with the GVC participation. Share of research and development in GDP is used as a measure of centrality of innovation across economies, as R&D expenditures volume has shown to be associated with higher manufacturing industry exports, particularly in the case of high-tech manufacturing (Hammar & Belarbi, 2021; Sandu & Ciocanel, 2014). As connection between GVCs and industrialization levels of countries has shown to be important (Baldwin & Okubo, 2019), the share of manufacturing industry in GDP is also included as a measure of countries' industrialization level. Real effective exchange rate is used to assess the cost competitiveness of economies relative to 42 trading partners. Also, following Adarov and Stehrer (2021) GDP per capita is used as a measure of development level and GDP as a measure of the size of the economies. Thus, we explore the relationship between the level of economic development and the integration of high-tech industries in GVCs, as well as relationship between the size of economies and levels of GVC participation given that smaller economies are typically characterized by greater openness. The list and explanation of variables included in the analysis, together with data sources used is provided in Tab. 1 and the correlation matrix is available upon request.

All listed variables are included in the model in the natural logarithm form, except the GVC_FL, given its relatively small values and very small changes over time. Thus, GVC_FL was kept in its original form (expressed as the share of sector's exports). The number of observations is not

Tab. 1: Description of variables

Variable label	Description	Source
GVC_BL	Backward participation in GVCs is the foreign value added embodied in exports, expressed as the share of total gross exports of the exporting country – data at the advanced manufacturing industry level (%)	OECD (2022) TiVA database
GVC_FL	Forward participation in GVCs is the "domestic value added embodied in foreign exports, expressed as the share of total gross exports of the value-added source country" – data at the advanced manufacturing industry level (%)	OECD (2022) TiVA database
GVC_TOT	Total participation in GVCs (%) is calculated as the sum of backward (GVC_BL) and forward participation (GVC_FL) in GVCs – data at the advanced manufacturing industry level (%)	OECD (2022) TiVA database
FDI_{manuf}	FDI inward stock in the manufacturing industry (million EUR)	WIIW (2022)
RDinGDP	Gross domestic expenditure on research and development expressed as the share of GDP (%)	Eurostat (2022)
$Manuf_{GDP}$	Share of manufacturing industry in GDP (%)	WIIW
REER	Real effective exchange rate relative to 42 trading partners (index 2015 = 100)	Eurostat (2022)
GDP_{pc}	GDP per capita (EUR, chain linked volumes 2010)	Eurostat (2022)
GDP	GDP (million EUR, current prices)	WIIW (2022)

Source: own

Tab. 2: Descriptive statistics of variables included in the model (2005–2018)

Variable	Number of observations	Mean	Standard deviation	Median	Minimum	Maximum
ln GVCBL	924	3.66	0.34	3.70	2.06	4.37
GVC_FL	924	1.11	0.99	0.90	0.16	5.54
ln GVC_TOT	924	3.68	0.34	3.73	2.10	4.39
ln FDI_{manuf}	714	8.84	1.22	8.72	6.19	11.06
ln RDinGDP	924	−0.11	0.48	−0.15	−0.97	0.94
ln $Manuf_{GDP}$	924	2.80	0.23	2.84	2.26	3.18
ln REER	924	4.61	0.06	4.62	4.36	4.76
ln GDP	924	11.03	0.91	10.73	9.34	13.12
ln GDP_{pc}	924	9.27	0.34	9.28	8.34	9.92

Note: All variables except the GVC_FL (given the characteristics of data with low values and very low yearly changes) are expressed in natural logarithms.

Source: own

the same for all variables across countries, making this data set unbalanced. Descriptive statistics are provided in Tab. 2.

The cross-sectional dimension in this panel data analysis is created by grouping 6 advanced manufacturing industries with 11 countries included in the model, thus creating 66 country-industry groups, while the time dimension includes 14 years (2005–2018). The estimation based on the dynamic model, using the lagged dependent variable, allows the dynamics of the underlying processes, which can be crucial in obtaining consistent estimates of the remaining parameters (Bond, 2002). The endogeneity problem that can appear in the static analysis is overcome by applying the generalized method of moments (GMM) estimation using instrumental variables. Considering the other characteristics and advantages of the GMM estimators, system GMM estimator is used in this research (Arellano & Bover, 1995; Blundell & Bond, 1998), using the xtabond2 user written command (Roodman, 2009) in STATA 17. Given the heteroskedasticity of the data, the two-step system GMM estimator is employed in the analysis. The dynamic panel model is defined in the following form:

$$Y_{it} = \delta Y_{it-1} + \lambda X'_{it} + d_t + \varepsilon_{it} \quad (1)$$

where: Y_{it} – the dependent variable vector, which is also included in the model in the lagged form (Y_{it-1}) as an independent variable; X'_{it} – a matrix of main independent and control variables; d_t – a vector of year dummy variables created to explore the time specific effects; ε_{it} – the error term; δ and λ – unknown parameters which are estimated through the model; i – the country-industry groups; t – the year.

3. Results and discussion

3.1 Results

Three models including dependent variables for forward, backward, and total GVC participation are separately estimated. As variables are included in the model in the natural logarithm form, the interpretation of the results is expressed in the form of elasticity, except in the case of the dependent variable in the model including forward GVC participation, where interpretation is thus different and refers to a percentage point increase of the dependent variable. The robust estimation results of the two-step system GMM model given by the Equation (1) are presented in Tab. 3.

All relevant diagnostic tests were estimated for this model, as shown in Tab. 3. To check the validity of the set of instruments used in the estimations, we applied the Arellano and Bond autocorrelation test (Arellano & Bond, 1991), which shows that models do not suffer from second-order autocorrelation. The Hansen test of over-identifying restrictions results show that the instruments used in the models are not

Tab. 3: Two-step system GMM results, robust

	ln GVC_TOT	ln GVC_BL	GVC_FL
ln L1	0.66** (0.07)	0.65** (0.07)	1.00** (0.02)
ln FDI_{manuf}	0.12** (0.03)	0.12** (0.03)	–0.01 (0.02)
ln RDinGDP	0.08* (0.04)	0.09* (0.04)	0.00 (0.02)
ln $Manuf_{GDP}$	–0.16* (0.07)	–0.18* (0.07)	0.04 (0.05)
ln REER	0.10 (0.15)	0.12 (0.15)	0.14 (0.11)
ln GDP_{pc}	0.04 (0.05)	0.05 (0.05)	–0.03 (0.03)
ln GDP	–0.11** (0.04)	–0.12** (0.04)	0.02 (0.02)
Time dummies	Yes	Yes	Yes
F-statistic	31,292.41	29,931.23	17,795.02
Groups/instruments	66/32	66/32	66/58
AR (2)	0.45	0.46	0.65
Hansen statistic	0.79	0.79	0.11

Note: ** and * denote 1% and 5% statistical significance levels respectively; standard errors are stated in parenthesis; all variables except the GVC_FL and GVC_FL lagged value (given the characteristics of data with low values and very low changes year over year) are expressed in natural logarithms.

Source: own

over-identified, i.e., there is no misspecification in the models. So, the econometric tests confirm the robustness of the presented results.

The estimates of the model covering the period from 2005 to 2018 for country (11 CEE countries) – industry (6 advanced manufacturing industries) groups are consistent with the underlying economic theory. The lagged dependent variable has shown to be highly positively associated with dependent variables in all three models, especially in the case of GVC_FL variable. The change in the lagged dependent variable by 1% is associated with 0.66% change of dependent variable GVC_TOT, while it is associated with 0.65% change of dependent variable GVC_BL. As GVC_FL was not included in the model in the natural logarithm form (given its small changes and small values), the intercept for GVC_FL shows that the change of the lagged dependent variable by a percentage point is associated with the change of GVC_FL by 1%. These results confirm the dynamic nature of the data and the choice of the dynamic panel estimator.

The results of the analysis show that independent variable FDI stock in manufacturing industry has shown to be statistically significant at the 1% level in the specifications with GVC_BL and GVC_TOT as dependent variables. A 1% change in FDI stock in the manufacturing industry is associated with 0.12% change in GVC_TOT and GVC_BL in advanced manufacturing industries. Similar results in these two specifications can be associated with very low levels of the GVC_FL, making the GVC_BL variable prevailing in the calculation of GVC_TOT in this set of countries. The same independent variable has not shown to be statistically significant in the case of GVC_FL. So, inward FDI stock in manufacturing industry has shown to be more important for facilitating the GVC backward integration of advanced

manufacturing industries in this set of countries, making it one of the determinants of their downstream position in international production networks.

Given the importance of the GVC_BL for calculating GVC_TOT, i.e., due to small values of GVC_FL, most of the results of both model estimations are highly similar. The share of research and development in GDP has shown to be statistically significant at the level of 5%, but with a relatively low coefficient. Increase in the share of R&D in GDP by 1% is associated with the change of GVC_TOT by 0.08% and with the change of GVC_BL by 0.09% in advanced manufacturing industries, which potentially indicates that an increase in innovativeness might somewhat lead to seeking efficiency through increasing backward GVC integration within these industries. The share of manufacturing industry in GDP has shown to be negatively associated with both GVC_TOT and GVC_BL at the level of significance of 5%. The 1% increase of manufacturing industry share in GDP is associated with a decrease of GVC_BL by 0.18% and a decrease of GVC_TOT by 0.16% in advanced manufacturing industries. This shows that the change in industrialization levels is related to a reverse change of the GVC_BL (and GVC_TOT). Also, GDP has shown to be negatively associated with the GVC_TOT and GVC_BL at the level of significance of 1%. The increase of GDP by 1% is associated with the decrease of GVC_BL by 0.12% and GVC_TOT by 0.11%. GDP per capita, used as a measure of development, has not shown to be significant in any of the models, as well as the real exchange rate which was used as a measure of cost competitiveness. Besides the lagged value of GVC_FL, none of the independent variables have shown to be significant in the model with the GVC_FL as the dependent variable. As noted in the beginning, in these advanced manufacturing industries, this can be due to very low levels and persistence of this indicator across time.

3.2 Discussion

The results of the analysis in GVC_TOT and GVC_BL models are largely in line with previous research exploring the FDI inflow/inward stock as a driver of GVC participation using different sets of countries, levels of analysis, time periods and data (Adarov & Stehrer, 2021; Efogo et al., 2021; Kersan-Skabic, 2019). As previously noted, Kersan-Skabic (2019) has shown FDI inflows to be a statistically significant predictor of GVC integration on the country level in EU CEE countries. Importance of FDI for the increase in GVC participation is pointed out in recent paper by Adarov and Stehrer (2021), which also show that FDI stock as a share of GDP is statistically significant and positive in the case of GVC backward and GVC total participation at the aggregate country-level, using the WIOD in the sample of European countries in the period from 2000 to 2014. Also, the results of the presented model are in line with Efogo et al. (2021) who explored the FDI inflow effects on GVCs in the sample of developing countries in the period from 2010 to 2019 using the UNCTAD-Eora database. Regardless of the sector (primary, secondary or tertiary), Efogo et al. (2021) show the importance of FDI inflow for backward GVC participation. Thus, the estimation results presented in this paper further expand prior research stressing the importance of FDI inflows/inward stock in shaping the GVCs.

This analysis provides some valuable insights for policymakers. To bolster the integration of advanced manufacturing industries in global value chains, they should actively promote FDI in the manufacturing sector and allocate resources to support research and development. In this context it is important to highlight the findings of Vavra et al. (2021). Their research shows that firms in CEE countries face challenges in achieving innovative outputs due to various factors such as innovation policies (at both national and company level), managerial attitudes towards risk and mistrust between various stakeholders. Yet, impact of internal R&D on firm product innovations is often positive even for these countries. Additionally, Dobrzanski (2018) shows that increasing spending on innovation sometimes fails to yield proportional effects in the CEE region, whereas the old EU member states more effectively allocate the R&D resources. Thus, innovation policies should be carefully designed in this set of countries in order to achieve the desired goals. This is especially important as fostering globally competitive advanced manufacturing industries can yield technological advancements followed by economic growth and an increased demand for higher-skilled jobs with correspondingly higher wages. In this context the quality of human capital is particularly important and

the potential inefficiencies in education within CEE countries (compared to the old EU member states) call for a re-evaluation and restructuring of education systems, as suggested by Kottaridi et al. (2019).

Furthermore, these findings highlight that a country's degree of industrialization, measured as the share of manufacturing industry in GDP may not necessarily result in a strong integration of these advanced industries within GVCs. Thus, attracting FDI, particularly in these industries is important to drive the desired paths of integration within these GVCs. Moreover, for firms, this paper stresses the potential of spillover effects within these industries driven by FDI. It highlights the facilitating role of the R&D investments in fostering the integration of firms within advanced manufacturing industries in GVCs. Thus, it emphasizes the importance of knowledge and technology transfer, whether through international mergers and acquisitions or learning from new industry peers, in the process of integration into global production networks within advanced manufacturing industries. To provide more precise policy recommendations further analysis which would broaden the knowledge in this field is recommended.

This research has encompassed advanced industries, but it would also be beneficial to analyze the determinants of knowledge intensive services integration in GVCs. This is especially important, given the significant connection of computer programming and telecommunications with manufacturing of computer, electronic and optical products. As noted by Ciriaci and Palma (2016) these services serve as carriers and sources of knowledge, exerting important influence on the performance of sectors, value chains and clusters within and across industries and countries.

Conclusions

The primary aim of this paper was to explore the importance of FDI inward stock in the manufacturing industry for GVC participation in the advanced industries in manufacturing in the post-transition countries in the CEE region. Dynamic panel models using the system GMM estimator were used to empirically explore this relationship in the case of forward, backward and total GVC integration. The presented results of the analysis are in line with the economic theory and prior empirical research, which included diverse sets of countries and industries across different periods. Positive and statistically significant variables for GVC participation were the lagged dependent variable in all three models and investments in research and development for GVC total and GVC backward participation. While the high coefficients pertaining to the lagged variables point out to a high association of these indicators to their past values, the research and development share in GDP estimated effects are less strong and might indicate that an increase in economy innovativeness is somewhat associated to seeking efficiency through increasing backward GVC integration within these advanced industries. The share of manufacturing in GDP and GDP level showed a negative association with GVC total and GVC backward participation, thus also stressing some important negative trends behind the rising backward GVC integration in some of the developing countries. The variable of our main interest, FDI stock in the manufacturing sector has shown to be positively associated with GVC backward and GVC total variables in the first two models, while it has not shown to be statistically significant for forward participation in these industries. This can be explained by the fact that CEE countries are often positioned in the downstream of GVCs. Also, the prevailing importance of the GVC_BL for calculating GVC_TOT (and small values of GVC_FL) leads to a high similarity of estimation results for GVC_TOT and GVC_BL model. The findings which show the importance of FDI inward stock in the manufacturing industry indicate the necessity to promote the attractiveness of FDI in the manufacturing industry, specifically in the advanced industries that are more integrated in GVCs in general. Such targeting of FDI can be a vehicle for the development of knowledge-based industries and it can be an expected and preferred path to increase innovativeness and reach higher levels of competitiveness in the new EU member states.

The main contribution of this research is in exploring the connection between FDI inward stock and GVC integration in the most propulsive industries in CEE. As in some of the countries included in the analysis the majority of FDI went to services sectors which often were market-seeking ones (financial industry and retail) which do not usually show significant spillover effects, this research, instead of exploring the effects of the total amounts of attracted FDI,

focused on the FDI inflows in the manufacturing sector. Also, this research estimated separate models for total GVC participation, backward and forward participation, pointing to important differences across sets of countries and industries, given their position along the GVCs.

The main limitation for conducting in-depth sectoral-level studies is the limited overall sectoral-data availability, which is yet to be provided. This analysis is limited to data on FDI inflows in the manufacturing industry as the main independent variable, while exploring more detailed FDI inflow/inward stock in relation to GVC participation data, especially at company level, would provide additional valuable information on the direct and indirect effects of FDI inflows and FDI inward stock across industries. Additionally including the knowledge intensive services integration in GVCs might provide some additional valuable insights. Also, exploring separately the effects of greenfield and brownfield FDI flows might provide valuable information on the nature of the FDI-GVC participation relationships.

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