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What matters for firms' participation in Global Value Chains in Central and East European countries?

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Abstract

Research background: There has been an extensive body of literature on the growing importance of global value chains (GVCs) in developed and emerging economies. This literature argues that GVCs significantly affect international trade patterns and open new possibilities for participating economies to increase both their exports' quantity and quality, acquire advanced production technologies and improve the overall economic performance. However, the empirical evidence from the Central and East European (CEE) countries, especially at the firm level is still relatively scarce. The majority of existing empirical studies on GVCs in the CEE countries are based on sectoral input-output data.

Purpose of the article: In this article, we study the determinants of firm participation in GVCs using firm-level BEEPS data for 29 CEE countries. We hypothesize that larger, foreign-owned, more productive and innovative firms producing a limited range of products and employing skilled workers are more likely to be involved in GVCs.

Methods: The intensity of participation in GVCs is measured by the usage of imported inputs and the intensity of exports. The empirical study uses the BEEPS firm-level data set for the period 2011–2014 and the probit estimation method.

Findings & Value added: The assembled empirical evidence generally supports these hypotheses. In addition, we find that firms which participate in GVCs produce a smaller range of products, which means that they concentrate on their core competencies. In particular, we find that the EU membership may facilitate participation in GVCs, especially for smaller firms in the CEE countries. This article adds to the existing literature by examining the firm-level determinants of participation in GVCs using the cross-country firm-level survey conducted by the EBRD and the World Bank.

Introduction

The emergence of GVCs significantly affected the landscape of the international organization of production, placing the specialization of countries and individual firms within GVCs at the center of economic analysis. Technological progress, the decrease in trade costs and barriers to entry allowed for the decomposition of production processes into various segments (Johnson & Noguera, 2017). These segments correspond to particular tasks (i.e. design, parts procurement, assembly, distribution) that are relocated, within and across national borders, to the locations where these tasks can be performed more efficiently. The development of GVCs has been driven predominantly by large multinational enterprises (MNEs), which brought about increasing specialization at the task level and also reached smaller firms from the less advanced countries. Therefore, in contrast to classical and neoclassical theories, the modern international economics literature studies not only the movement of final products, but also the cross-border transfer of tasks and the value added associated with them.

The empirical studies identify several factors at the country level that stimulate GVC participation (Kowalski *et al.*, 2015). In particular, the following country level structural characteristics tend to be the most important: market size, the level of economic development, industrial structure, location and government policies. In the last two decades, several new member states (NMS) of the European Union (EU) such as the Czech Republic, Slovakia, Hungary and Poland managed to integrate themselves into European supply chains due to cultural similarity, geographical proximity and labor costs differentials, (IMF, 2013). This allowed the NMS to reindustrialize their economies after a rapid decline in the industrial output in the early period of economic transition (Stollinger, 2016; Cerovic *et al.*, 2014). The accession to the EU and the increased inflow of FDI intensified the fragmentation of cross-border production among the NMS and the creation of various industry clusters (Iossifov, 2014; Stollinger 2016; Head & Mayer, 2017). However, a majority of the existing studies on GVCs for the NMS are based on sectoral input-output data, while the firm level is still relatively scarce. A notable exception is the empirical study by Orlic

(2017), who argues that the probability to engage in two-way trade is higher for foreign-owned and bigger firms, as well as those which obtained internationally recognized certificates.

Therefore, in this article we study the determinants of firms' participation in GVCs for 29 countries of Central and Eastern Europe and Turkey in the period 2011–2014. In particular, we hypothesize that larger, foreign-owned, more productive and innovative firms producing a limited range of products and employing skilled workers are more likely to be involved in GVCs. The intensity of participation in GVCs is proxied by the usage of imported inputs and the intensity of exports. The empirical study is based on the probit models applied to the fifth edition of BEEPS firm level data.

The structure of this article is as follows. In the next section, we provide the literature review in which we discuss three major approaches to GVCs based on managerial and sociological analysis and the formal international trade theory literature. In particular, we focus on the issue how smaller firms located in less developed countries can enter into GVCs. Subsequently, we describe the properties of the dataset and the empirical methodology. Then, we show and discuss our estimation results. The paper ends with conclusions and directions for future studies.

Literature review

The neoclassical perception of foreign trade in which a final good is produced in one country and sold and consumed in another country is no longer a valid description of current trade flows taking place in the globalized world economy. The contemporary analysis of international trade flows is often taking place within the context of GVCs. In this context a full range of activities required to bring a specific product to a final consumer, from product design to a distribution system, is taken into account (Cattaneo *et al.*, 2010).

The present GVCs paradigm relates to a number of different intellectual origins. The term “value chains” was first conceived in the business management literature. Porter's (1985) early concept was concerned mainly with how firm strategies could be enhanced by shifting the focus to the configuration of business activities. This concept was used as a fundamental framework for developing a corporate strategy with the aim of promoting firm competitiveness by focusing attention on the whole system of activities involved in producing and consuming a good or service.

A more recent approach to studying GVCs is rooted in sociology where parallel methodological frameworks were elaborated. Drawing on a variety

of fields, ranging from business management to the theory of industrial organization, the concept “global value chains” was proposed (Gereffi & Korzeniewicz, 1994, Gereffi *et al.*, 2005). In contrast to Porter’s (1985) value chain concept, subsequent studies on GVCs consider the creation and transfer of value as a result of firms’ efforts to optimize production networks. Hence, the sociological analysis of GVCs is not just a simple extension of Porter’s original value chain approach. The main objective of this analysis is rather to explore the interplay between value distribution mechanisms and organization of international production–consumption relationships.

The sociological approach to GVCs focuses on the governance structure of organizing cross-national production networks in which the lead firms are MNEs. They create different cooperation and growth opportunities for indigenous firms depending on how they are integrated into MNEs’ GVC. International production networks coordinated by MNEs can range from simple arm’s-length transactions, in which input suppliers participate in GVCs without any long-lasting relationships, to vertical integration associated with managerial control by headquarters over their overseas subsidiaries (Gereffi *et al.*, 2005; Gereffi & Fernandez-Stark, 2011; Gereffi & Lee, 2012). On the one hand, the vertical integration implies the hierarchical structure that is based on a unidirectional control of the parent company over its overseas subsidiaries. The subsidiaries are monitored and evaluated in line with the management strategies of the parent firm. On the other hand, in contrast to vertical integration, outsourcing generates more leveled relationships between clients (buyers) and subcontractors (service suppliers).¹

According to the sociological view, GVCs are associated with flows of knowledge that stimulate the development and upgrading of a firm’s position along the GVCs (Gereffi *et al.*, 2005; Humphrey & Schmitz, 2002). In this context, the firms that are integrated into GVCs aim at moving up to higher value added activities. Firms’ capabilities play an important role in developing governance types since they shape firms’ abilities to introduce technological upgrading and their market position. At the same time, governance types can affect firms’ capabilities via creation, transfer and diffusion of knowledge (Humphrey & Schmitz, 2002). Therefore, firms’ participation in GVCs, capabilities and governance, are all interrelated. In particular, the governance type is determined by complex inter-firm relations and

¹ Gereffi *et al.* (2005) identified three distinct types of governance: relational, modular and captive. They can be measured by three variables: complexity of information between actors in the chain, how the information for production can be codified, and supplier competence.

capabilities of suppliers (Gereffi *et al.*, 2005). As a result, capabilities of suppliers affect their position within GVCs (Agostino *et al.*, 2014).

Another strand in the literature is linked to the theory of international trade and the role of trade costs. The decreasing transportation costs, the lowering of trade barriers and the development of new information and communication technologies allowed fragmenting production processes into separate production stages located in different firms and countries according to their comparative advantage. Therefore, the modern international trade theory deals with not only the movement of final goods, but more often with the cross-national transfer of tasks, or the value added generated by these tasks.

The early theory of production fragmentation within the neoclassical framework, assuming perfect competition and firms' homogeneity, was proposed by Jones and Kierzkowski (1990). According to this theory, firms are viewed as a part of international networks that embody various goods and services supplied by other firms locate in foreign countries. This approach was followed by empirical studies documenting the increasing role of trade in intermediate inputs (Feenstra & Hanson, 1996; Campa & Goldberg, 1997; Yeats, 1998).

Subsequently, new concepts, such as unbundling (Baldwin, 2006) and trade in tasks (Grossman & Rossi-Hansberg, 2008, Miroudot & Ragoussis, 2009), were elaborated on. This led to the development of a newer strand in the literature on international fragmentation of production that emphasizes specialization in tasks rather than in goods. The recognition of the new features of international trade resulted in the development of trade in value added metrics (Koopman *et al.*, 2014). These metrics reveal information whether and to what extent a particular country participates in GVCs. They also provide insights into the position of a particular country's sectors within the GVCs.

Another strand in the theoretical trade literature on GVCs studies the determinants and the effects of participation in GVCs from an individual firm's perspective. This strand provides theoretical foundations regarding MNEs' decisions on whether to engage in vertical integration or acquire intermediate inputs from independent suppliers. This approach is rooted in the New Trade Theory (NTT) literature that stresses the role of product differentiation, monopolistic competition, economies of scale and firm heterogeneity.

The firm level perspective was initially stressed by Melitz (2003) who relaxed the firm symmetry assumption in the Krugman (1980) model of monopolistic competition and allowed firms to differ with respect to their labour productivity. This approach was later extended by a number of fol-

lowers including Antras and Helpman (2004), Bernard *et al.* (2010), and Antras and Yeaple (2014). Their models stress that the capacity of firms determines their participation in international trade and the position within GVCs. Therefore, firms' abilities to move up the value chain depend on the reallocation of their resources from the least productive activities towards the new and the more connected ones.

According to Antras and Helpman (2004), firms are required to make a relationship-specific investment in incomplete contracts environment when they decide whether and how to fragment their production processes. However, in joining a supply chain, fixed costs of investment might be lower compared to vertical integration with the exception of cases where intrafirm trade would involve a high degree of intangibility and where trust would play an important role (Atalay *et al.*, 2014).

The theoretical model proposed by Antras and Helpman (2004) suggests an order of firms' internationalization with the most productive firms servicing foreign markets via foreign direct investment (FDI) and the least productive confined to serve only national markets. Among the firms serving foreign markets, the most productive ones vertically integrate the procurement of intermediate inputs, while the least productive ones source them from independent suppliers. Their model combines the legacies of both the NTT and the frameworks of contract theory which is closely related to sociologists' approaches to GVCs.

Some of the important properties of the Antras and Helpman (2004) model were carried over to a more recent model, proposed by Antras and Chor (2013). In their model, the existence of a number of suppliers leads to different incentives along the value chain. In particular, they show that an incentive to integrate suppliers varies with a relative position in the value chain at which a particular supplier enters a production line. In addition to firm heterogeneity, which plays a key role in determining the extent of vertical integration, a particular firm's decision is also affected by transaction costs and property rights.

The empirical studies on GVCs are newer. However, until recently these studies have been dominated by country-level sectoral analyses based on input-output tables. The early studies based on firms' business records (Dedrick *et al.*, 2008; Xing & Detert, 2010) are now complemented by input-output analysis, in which various metrics were devised using multi-country input-output databases, such as trade in value added (Johnson & Noguera, 2017) and the of length a supply chain (Dietzenbacher *et al.*, 2005; Fally, 2011).

In the context of the NMS, Hagemeyer (2018) studies the role of GVCs in value added trade and productivity growth of in the period between 1995

and 2009. He links growth of sectoral productivity with FDI and exporting and with the position of a sector/country in the GVCs. He shows that sectors that have imported intermediate inputs have experienced higher productivity growth. In addition, he finds faster productivity growth in sectors that are located further away from the final demand and in sectors exporting intermediate goods.

The recent firm-level evidence shows that firms internationalize via different channels and the frequent one is joining the GVCs organized usually by large MNEs (Baldwin & Lopez-Gonzales, 2015). From this perspective, it is important for the lagging behind countries to attract FDI and internationalize domestic firms. On the one hand, the increased fragmentation of production and specialization in tasks enable MNEs to exploit international differences in the costs of production. On the other hand, MNEs as the main organizers of GVCs bring various direct and indirect benefits to the indigenous firms in the host economy. In particular, host-country firms integrated into GVCs may benefit from new types of production, and other related benefits such as creation of new jobs, technology transfer and integration into MNEs' networks (Damijan & Rojec, 2015). Moreover, participation in GVCs provides opportunities for various spillovers from foreign to indigenous firms in the host country (Blomström & Kokko, 1998).

The recent empirical evidence for the CEE countries has generally confirmed the positive role of MNEs in creation of backward spillovers to indigenous firms (Kolasa, 2008; Damijan *et al.*, 2013; Havranek & Irsova, 2011). Moreover, MNEs often require domestic firms to satisfy foreign quality standards, increase their efficiency, and provide access to their supply, distribution and marketing networks. In addition, linkages with MNEs may generate knowledge and pecuniary spillovers along the value chain (Rodriguez-Clare, 1996; Markusen & Venables, 1999). MNEs may lead to crowding out of local firms by entering into upstream and downstream industries, but at the same time can also create new forward and backward linkages that may contribute to the development of local firms. The magnitude of these effects depends on inputs demand, induced efficiency, product quality requirements and knowledge transfers that increase the efficiency of local firms (Barba-Navaretti & Venables, 2006; Smarzynska-Javorcik & Spatareanu, 2008; Godart & Gorg, 2013).

From the perspective of local firms, the participation in GVCs requires a sufficient scale that imposes certain limits on small and medium-sized enterprises (SMEs) as they might often face problems with satisfying foreign standards, or overcoming barriers to entry related to regulations and customs procedures (OECD, 2015). The costs of productivity improvements, such as investments in innovations, human capital and the adoption

of more efficient production technologies may be fixed and only large enterprises can benefit from the economies of scale. Participation in GVCs enables SMEs to overcome barriers to scale and improve their economic performance by supplying exporting firms (Dhyne & Rubinova, 2016). This allows them to avoid paying fixed costs such as design and marketing costs, lower foreign market entry barriers and benefit from the knowledge spillovers from MNEs (Artopoulos *et al.*, 2013; Cieřlik & Hagemeyer, 2014).

Statistical data and research methodology

Our study is based on the "EBRD-World Bank Business Environment and Enterprise Performance Survey" (BEEPS) firm-level data, collected jointly by the World Bank and the European Bank for Reconstruction and Development (EBRD) mainly in the post-communist countries located in Europe and Central Asia and Turkey. The survey questions were related to the identification of the firm, the sector of activity, the legal and economic status, the characteristics of the managers and the size of the firm, the infrastructure of services in the analysed country, the economic performance and key characteristics of the reviewed firms, as well as the stakeholders.

In all countries, with the exception of Albania, the sample was prepared using the stratified random sampling methodology to ensure the representativeness of the sample.² The BEEPS V surveys covered both the manufacturing and service sectors and are representative of the variety of firms according to sector and location within each country. Moreover, particular industries within each sector can differ with respect to their capital intensity and export performance. Therefore, in order to control for heterogeneity across industries, we used industry-specific effects in addition to individual firm characteristics in our estimating equations.

The total sample of BEEPS V data that was collected for the period 2011–2014 consists of 15,883 observations. In a majority of cases, the data include around 250–350 observations per country. The largest samples of firms in the whole database are available for Russia (4,220), Turkey (1,344) and Ukraine (1,002).³ However, in the BEEPS V sample, almost all data were collected for one year only. In particular, almost 60% of the surveys in all countries were conducted in 2013.⁴ Moreover, some individual char-

² The specific details concerning the sampling methodology are explained in the Sampling Manual available online at: <http://www.enterprisesurveys.org/Methodology/>.

³ The list of countries in our sample is shown in Table 1.

⁴ The numbers of observations (surveys) per year were as follows: 2,884 in 2011, 1,833

acteristics are not available for all sampled firms, which implies that the actual sample used in our empirical study is smaller and equals 11,290 observations. This means that the application of panel data analysis was not possible. Therefore, we used the standard probit procedure on the pooled cross-section dataset without controlling for an individual firm's effects but we controlled for country-specific and industry-specific effects.

In our study, we complement the recent empirical evidence presented by Orlic (2017) and investigate the firm-level determinants of GVC participation for firms based in the CEE countries and Turkey. In particular, following the literature review presented in the previous section, we hypothesized that larger, foreign-owned, using foreign licenses, producing a smaller range of products, more productive and innovative firms employing skilled workers were more likely to be involved in GVCs.

In our study, we selected a number of independent variables that should reflect the important characteristics of firms (see, for example: Mayer & Ottaviano, 2008) and their innovation efforts. Thus, apart from standard independent variables, reflecting the stock of human capital and R&D activities, in our study, we also take into consideration various forms of innovation, i.e., product, process, marketing and management, reported by individual firms. The foreign ownership and the use of foreign licences may be important variables reflecting the supply capabilities of the firm.

The descriptions of all variables used in the empirical study are presented in Table 2. The summary statistics and correlations between independent variables for the whole sample of analysed countries are shown in Tables 3 and 4, respectively. The levels of bilateral correlations between variables are very small, with the exception of innovation variables. In particular, the correlation between product innovations and process innovations is equal to 0.485, which means that they are not highly correlated.

In order to assess firms' participation in GVCs, we use the following firm-level measures. The first measure is the firms' share of direct or indirect exports in their total sales.⁵ The second measure is the firms' share of imported inputs and materials. To identify firms involved in GVCs, we take into account only firms that are simultaneously engaged in two-way trade captured by two-way dummy. Our benchmark dependent variable that proxies for GVC participation is a binary variable that take the value 1, if simultaneously the share of direct and indirect exports in total sales and foreign material inputs and supplies expressed as a percentage of all mate-

in 2012, 13,435 in 2013 and 4,287 in 2014.

⁵ It has been argued that relatively less productive firms which cannot export directly can export indirectly through, inter alia, participation in GVCs (Cieřlik & Michałek, 2017). Therefore, we take into account also indirect exports.

rials and supplies in the production of the firm, exceed 10 percent and zero otherwise. We test the robustness of our results using alternative dependent variables with the lower and higher threshold levels equal to 5 and 20 percent, respectively.

Since participation in GVCs is captured by binary variable that takes value 1 when the firm participates in GVCs and 0 otherwise, the probit model was estimated. The probit model can be interpreted as the latent variable model. Our dependent variable indicating participation in GVCs of firm i is the latent variable denoted by Y_i^* . Moreover, we assume that the variable Y_i^* follows $Y_i^* = \mathbf{X}_i\boldsymbol{\Theta} + \varepsilon_i$, where the error term ε_i is independent of \mathbf{X}_i , which is a vector containing explanatory variables that affect participation in GVCs with the first term equal to unity for all i , $\boldsymbol{\Theta}$ is the vector of parameters on these variables that needs to be estimated and ε_i is assumed to be normally distributed with a zero mean.

Then Y_i can be viewed as an indicator for whether our latent variable is positive:

$$Y_i = \begin{cases} 1 & \text{if } Y_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

We can obtain the distribution of Y_i given \mathbf{X}_i . Hence, the probability that a firm participates in GVCs can be written as:

$$P(Y_i=1 | \mathbf{X}_i) = \Phi(\mathbf{X}_i\boldsymbol{\theta}) \quad (2)$$

where $\Phi(\cdot)$ denotes the standard normal cumulative distribution function (cdf).

To be able to successfully employ the probit model, it is important to know how to interpret estimated parameters on our explanatory variables. Consider a specific explanatory variable x_{ij} , which is an element of vector \mathbf{X}_i . The partial effect of x_{ij} on the probability of participation in GVCs can be written as:

$$\partial P(Y_i=1 | \mathbf{X}_i) / \partial x_{ij} = \partial p(\mathbf{X}_i) / \partial x_{ij} \quad (3)$$

When multiplied by Δx_{ij} , equation (3) yields an approximate change in $P(Y_i=1 | \mathbf{X}_i)$ when x_{ij} increases by Δx_{ij} , holding all other independent variables constant.

Results

In this section, we report our estimation results obtained using the probit model. Our dependent variable measures the degree of firm's involvement in both imports of material inputs and supplies and direct and indirect exports. We define three symmetric imports and exports thresholds: 20, 10 and 5 per cent. First, in columns (1)–(3) of Table 5 we report the estimation results for the respective thresholds for the whole sample of firms. Then, in columns (4)–(5) we show estimation results for the benchmark 10 per cent threshold for large and small firms. Small firms are defined as entities employing up to 20 persons, while the large firms over 21.⁶ Finally, in column (6) we show estimation results for the EU firms only for the benchmark 10 per cent threshold.

In column (1) we show our benchmark results obtained from the specification with the 10 per cent threshold in GVC participation. The estimated parameter on the productivity variable (*lprod*) is positive and statistically significant at the 1 per cent level. This variable is a key variable in the recent models that stress the role of firm heterogeneity in export performance. The positive sign of the estimated parameter result is in line with the prediction of Melitz (2003) model.

Moreover, positive signs and statistically significant parameters are obtained for variables related to the measures of technological capabilities of the firm including R&D spending, the share of university graduates in the total employment, the purchases of foreign licenses and product innovations. However, the product innovations do not seem to be related to GVC participation. The positive signs and statistically significant parameters are reported also for the foreign ownership variable, which suggests that firms with foreign capital participation are more likely to be involved in GVCs, in contrast to the state owned firms (*share_gov*). Finally, the positive and statistically significant parameter on the EU membership dummy variable shows that favorable institutional environment and economic stability encourage GVC participation.

The negative and statistically significant coefficient on the *multi* variable suggests that the firms more intensively involved in GVCs are more specialized in production of a limited number of products. The estimated parameter of a firm's age and the years of experience of the top manager are not significant. However, the estimated parameter on *exper_fem* variable reveals a negative sign, and is significant at the 5 per cent level, which

⁶ We decided to treat all firms employing more than 20 persons as large due to the fact that the number of very large firms employing 250 persons and more was very limited in our sample (less than 5%). This threshold allows to obtain two subsamples of similar size.

may suggest the firms in which the top managers are women are less likely to be involved in GVCs.

The robustness of our benchmark results is studied in columns (2) and (3) where we use the alternative thresholds for GVC participation. These additional results are quite similar to the benchmark results reported in column (1). In particular, the estimation results reported in column (2) for the lower 5 per cent threshold show the same levels of statistical significance of the estimated parameters on the explanatory variables, with the exception of the *exper_fem* variable, which now becomes significant at the 1 per cent level.

The estimation results obtained for the higher 20 per cent threshold are less similar to the benchmark results. In particular, these results reveal that the share of university graduates in total employment loses completely its previous statistical significance while other three variables describing labor productivity, product innovations and the gender of the top manager partly lose their previous statistical significance. Nevertheless, the majority of the estimated coefficients on the independent variables remain fairly stable and reveal the same levels of statistical significance for different levels of GVC participation thresholds.

In columns (4)–(5), we show estimation results for the benchmark 10 per cent threshold for the subsamples of large and small firms. Compared to the benchmark estimation results reported in column (1) it can be observed in column (4) that in the case of large firms a smaller number of independent variables is statistically significant. In particular, the estimated parameter on the productivity variable is not significant. Moreover, product innovations, EU membership and the gender of the manager (*exper_fem*) are not significant. The estimated parameter on the share of the university graduates in the total employment is statistically significant only at the 10 per cent level. Finally, the estimated parameter on the age of the firm becomes positive and statistically significant at the 10 per cent level. These results show that for large firms the measures of technological capabilities matter less for the participation in GVCs. Moreover, the institutional environment related to the EU membership is also not significant. Finally, in the case of large firms, the gender of top managers seems to be not important, while the experience of companies measured by their age is more important for GVC participation in comparison to all firms.

The results reported in column (5) show that in the case of small firms the estimated parameter on the productivity variable is significant only at the 5 per cent level. Moreover, the variable describing product differentiation (*multi*) is not statistically significant, in contrast to the benchmark results. Finally, the estimated parameter on the gender of top manager be-

comes statistically significant at the 1 per cent level. It is interesting to note that for small firms the estimated value of the parameter for the EU membership is visibly higher compared to the sample of all firms.

Finally, in the last column we report the results obtained for all firms from the EU countries only. This reduces the size of the sample for which we were able to make estimations only to less than 25 per cent of the full sample. It can be noted that in the case of the EU firms the estimated parameter on the productivity variable remains positive and highly significant, and its value is almost twice as high as the variable for the benchmark results obtained for the full sample. Moreover, other measures of technological capabilities display positive signs, but reveal lower levels of statistical significance. In particular, the estimated parameter on the product innovation variable is significant only at the 10 per cent level, while the parameter on the use of foreign licenses is significant at the 5 per cent level. Finally, in contrast to the full sample results, the estimated parameter on the government ownership is negative and statistically significant at the 5 per cent level. This means that state-owned firms are less likely to participate in GVCs.

Conclusions

In this paper we studied the determinants of firm participation in GVCs for 29 countries of Central and Eastern Europe and Turkey in the period 2011–2014 using the fifth edition of BEEPS firm level data. The intensity of participation in GVCs was proxied by the simultaneous usage of imported inputs and the intensity of direct and indirect exports. In particular, we hypothesized that larger, foreign-owned, more productive and innovative firms producing a limited range of products and employing skilled workers were more likely to be involved in GVCs.

The assembled empirical evidence generally supported these hypotheses. In particular, we found that firms that participate in GVCs produced a smaller range of products which means that they concentrated on their core competencies. These results were robust with respect to the choice of the threshold level of participation in GVCs. Moreover, it was found that in the case of smaller firms employing up to 20 persons, their participation in GVCs requires a relatively higher level of productivity and the ability to make product innovations. We also found that the EU membership might facilitate the participation in GVCs, especially for the smaller firms in the CEE countries.

Given the importance of small and medium sized enterprises in the CEE economies, future research should be more focused on the determinants of participation in GVCs of these firms. In particular, the role of internationally recognized quality certification should be studied as SMEs might face problems with satisfying foreign quality standards. This would allow for verifying whether a more active public policy aimed at lowering the costs of certification could increase the participation of small and medium firms in GVCs.

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Annex

Table 1. List of countries

Country	Number of observations per country
Albania	360
Armenia	360
Azerbaijan	390
Belarus	360
Bosnia-Herzegovina	360
Bulgaria	293
Croatia	360
Czech_Republic	254
Estonia	273
FYR Macedonia	360
Georgia	360
Hungary	310
Kazakhstan	600
Kosovo	202
Kyrgyzstan	270
Latvia	336
Lithuania	270
Moldova	360
Mongolia	360
Montenegro	150
Poland	542
Romania	540
Russia	4220
Serbia	360
Slovak_Republic	268
Slovenia	270
Tajikistan	359
Turkey	1344
Ukraine	1002
Uzbekistan	390
Total	15883

Source: *BEEPS V*.

Table 2. Variables used in the empirical analysis

Dependent variables used in separate estimations:	Description of variables:
GVC _n	Binary variables that take the value 1 if simultaneously the share of direct and indirect exports in total sales and foreign material inputs & supplies as a percentage of all materials & supplies in the production of the firm, exceed <i>n</i> percent and zero otherwise; where <i>n</i> equals 5, 10 and 20.
Independent variables:	Description of variables:
Lprod	Logarithm of productivity expressed as the total amount of annual sales per full-time employee.
Lage	The logarithm of the number of years since the establishment of the company.
Lexper_manag	Natural logarithm indicating how many years of working experience in this sector the top manager has
Exper_fem	Binary variable indicating whether the top manager is female (1 – female and 0– male))
Share_gov	Percentage of capital owned by government/state.
Multi*	100 minus the share of the main product in total sales. This variable measures whether the firm is producing many (multiple) products (zero means that the main product represents 100% of supply).
Innov_product	Binary variable describing whether new products/services had been introduced over the last three years.
Innov_process	Binary variable describing whether new production/supply methods had been introduced over the last three years.
R_D	Binary variable describing whether there had been a spending on R&D over the last three years.
Uni	Percentage of full-time employees who had completed a university degree.
Lsize	Logarithm of the number of permanent, full-time employees in this firm at the end of the last fiscal year.
Fo	Binary variable indicating whether the percentage owned by private foreign individuals is larger than zero.
Folicences	Binary variable describing whether the firm used technology licensed from a foreign-owned company.
EU	Binary variable indicating the EU membership of the country

Note: *The role of product mix for exporters is analysed in Mayer *et al.* (2014).

Table 3. Summary statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
lprod	11,366	13.196	2.539	3.506	25.798
lage	14,405	2.393	0.722	0	5.159
Share_gov	14,393	0.926	7.907	0	99
Multi	14,026	15.834	22.200	0	100
R_D	14,444	0.101	0.302	0	1
Uni	13,859	36.106	31.607	0	100
lsize	14,45	2.987	1.230	0	9.305
Fo	14,539	0.080	0.271	0	1
Folicenses	14,366	0.130	0.336	0	1
Innov_product	14,478	0.252	0.434	0	1
Innov_process	14,477	0.204	0.403	0	1
lexper_manag	14,102	16.049	9.726	1	64
Exper_fem	14,467	0.205	0.404	0	1

Table 5. Estimation results

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	GVC-10	GVC-5	GVC-20	G-10 big	G-10 small	EU mem
lprod	0.0364*** (0.0119)	0.0528*** (0.0117)	0.0299** (0.0127)	0.0265 (0.0163)	0.0451** (0.0180)	0.0665*** (0.0220)
lage	0.0281 (0.0270)	0.0212 (0.0263)	-0.0146 (0.0290)	0.0730* (0.0373)	-0.00796 (0.0408)	0.0203 (0.0541)
exper_ manag	-9.53e-05 (0.00176)	0.000791 (0.00172)	-0.00110 (0.00189)	-0.000113 (0.00236)	-0.000893 (0.00276)	-0.00382 (0.00318)
exper_ fem	-0.116** (0.0457)	-0.154*** (0.0447)	-0.0859* (0.0490)	-0.0494 (0.0705)	-0.166*** (0.0613)	-0.156** (0.0768)
share_gov	-0.00165 (0.00216)	-0.00180 (0.00210)	-0.00210 (0.00235)	-0.00106 (0.00238)	-0.00570 (0.00650)	-0.0173** (0.00808)
multi	0.00252*** (0.000773)	0.00194*** (0.000746)	0.00335*** (0.000843)	0.00341*** (0.00112)	-0.00133 (0.00109)	-0.00335** (0.00136)
innov_ product	0.146*** (0.0416)	0.180*** (0.0403)	0.0810* (0.0449)	0.0738 (0.0593)	0.236*** (0.0592)	0.138* (0.0707)
innov_ process	0.0387 (0.0449)	0.0678 (0.0435)	0.0571 (0.0482)	0.0399 (0.0623)	0.0461 (0.0660)	0.106 (0.0759)
R_D	0.268*** (0.0484)	0.311*** (0.0471)	0.215*** (0.0519)	0.267*** (0.0644)	0.300*** (0.0751)	0.313*** (0.0840)
uni	0.00193*** (0.000610)	0.00179*** (0.000594)	0.000849 (0.000660)	0.00157* (0.000920)	0.00248*** (0.000851)	0.00106 (0.00110)
lsize	0.190*** (0.0139)	0.206*** (0.0136)	0.174*** (0.0148)	0.165*** (0.0243)	0.160*** (0.0489)	0.169*** (0.0251)
Fo	0.452*** (0.0543)	0.478*** (0.0537)	0.486*** (0.0558)	0.405*** (0.0691)	0.569*** (0.0909)	0.434*** (0.0867)
folicenses	0.252*** (0.0432)	0.248*** (0.0424)	0.276*** (0.0454)	0.233*** (0.0574)	0.263*** (0.0677)	0.199** (0.0792)
EU	0.845*** (0.146)	0.988*** (0.144)	0.640*** (0.151)	0.225 (0.235)	1.270*** (0.202)	
Constant	-2.220*** (0.211)	-2.464*** (0.207)	-2.001*** (0.221)	-1.579*** (0.320)	-2.529*** (0.320)	-1.423*** (0.311)
Observations	11,290	11,290	11,290	4,582	6,615	2,787
Log likelihood	-3725	-3965	-3170	-1886	-1776	-1204
Pseudo R2	0.212	0.226	0.207	0.222	0.166	0.227

Note: significance level: (***) = 1%, (**) = 5%, (*) = 10%, standard errors in parentheses.