

# Role of intangible assets in global value chains: evidence from the Slovak Republic

Júlia Ďurčová

Technical university of Košice, Faculty of economics, Košice, Slovakia,  
<https://orcid.org/0000-0002-9312-914X>

Marek Pekarčík

Technical university of Košice, Faculty of economics, Košice, Slovakia  
<https://orcid.org/0000-0002-1384-4304>

## Abstract

**Background:** Slovak firms are very strongly integrated into globally organized production. However, their position in global value chains (GVCs) concentrates on downstream activities with lower value added generation.

**Purpose:** Intangible assets should be an important driver of the creation and productivity growth of domestic value added and thus of international competitiveness. Key activities supporting the creation and productivity of value added within GVCs can be done through an innovation environment, investments in intangible ICT assets and improving the quality of human capital.

**Approach:** This paper aims to analyse, according to econometric model based on panel data analysis, the role of intangibles in Slovak GVC participation. Moreover, the linkages between investment in selected intangibles and different forms of integration into GVCs – forward and backward, are examined.

**Findings:** Our results show that the accumulation of intangibles is positively associated with Slovak participation and position within GVCs. The same result is confirmed separately for forward and backward participation. When intangibles are divided into three groups, only computerized information and economic competencies are significantly associated with Slovak GVC participation and position. They increase the quality of human capital, organization and management of production and create a favourable competitive environment.

**Limitations:** Further research could be extended to a more detailed examination of the impact of intangibles on specific sectors. The availability of data on the creation of value added and thus involvement in the GVCs is a major limitation at the macroeconomic level. Therefore, it is necessary to verify these findings with an analysis at the firms' level data.

**Keywords:** intangible assets, global value chains, intangible ICT assets, innovative property, economic competencies

## Introduction

Nowadays, it is not a matter of whether to participate in the global economy, but how to do so gainfully (Fernandez-Stark & Gereffi, 2018). Recent empirical research verifies the close relationship between innovation, value creation and economic growth. Intangible investment is expected to shift productivity growth, global competition as well as upgrading in global value

chains (GVCs). The relationship between intangibles and productivity is well documented in many empirical studies, but not the relation between intangible assets and GVCs participation and value added appropriation. Jona-Lasinio & Meliciani (2018) bring the first step to mapping the role of intangibles for globally organized production. They concluded that investment in intangibles fosters participation in GVCs and

higher value added creation along the chain. Therefore, the countries must produce sophisticated products to compete in high value added activities within GVCs. So, if the country wants to increase participation in GVCs in more valuable activities, it is important to support the accumulation of intangibles, which leads to the development of innovative infrastructure and quality human capital. The intangibles should be an important driver of countries integration in the globally organized production. Exporting companies are generally more productive than companies that produce exclusively for their domestic market. The competitive pressure on foreign markets is often fiercer, which leads exporting companies to increase productivity (Jona-Lasinio & Meliciani, 2019). Participation in GVCs and productivity are mutually connected. For example, international trade and GVCs participation support the specialization of countries and firms in the most productive activities and offshoring less productive. Moreover, it facilitates the import and export of technology as well as the interaction of firms from different countries which can lead to knowledge spillover. The increased international competition supports productive firms through growing economies of scale (Jona-Lasinio & Meliciani, 2018). Therefore, this paper aims to analyze the role of intangibles for GVC participation in the case of the Slovak Republic - the small and highly open economy of Central Europe. We will investigate (i) the impact of intangibles on GVCs participation; (ii) the impact of individual forms of intangibles on GVC participation and (iii) the impact of intangibles on different forms of participation (forward and backward). Our study will rely on existing studies and provide a perspective from the point of view of a small and very open economy.

The paper is organized as follows: the introduction, the review of empirical literature (Section 1), GVC participation and intangibles: measurement and data (Section 2), the research methodology (Section 3), presentation and discussion of the results (Section 4) and concluding remarks (Section 5).

## 1. Theoretical background

The recent changes in the world and world trade have strong consequences for the established functioning of the economy. For the CEE region, GVCs have become a determining factor of economic systems, and their integration together with foreign direct investment has contributed to

productivity growth and convergence to the EU (Pellényi, 2020). According to Ge, Fu, Xie, Liu, & Mo (2018), GVCs productivity effect is obvious in capital-intensive, technology-intensive enterprises. However, there has been a slowdown in the development of new technologies in the leading companies of CEE countries, and thus the value added appropriation in these countries is slowing down. Pavlínek and Ženka, (2011, 2016). We can observe a change in the paradigm of globally organized production and the international fragmentation of production. The determinant of this change is ongoing industrial revolution conceptualized as Industry 4.0. Butollo, Gereffi and Krzywdinski (2022) summarize theoretical and empirical contributions on how the determinants of Industry 4.0 (AI, IoT) affect globally organized production within GVC. Delera, Pietrobelli, Calza and Lavopa (2022) confirmed the positive association between companies' participation in GVC and the ability to adopt Industry 4.0 technologies and determinants. Firms are adapting to Industry 4.0 by developing value chains based on technological resources and capabilities (Castelo-Branco, Oliveira, Simoes-Coelho & Portugal, 2022). Industry 4.0 gradually changes the comparative advantages of individual companies and countries through the adoption of new technologies and innovations. These are stimulated and supported by the intangibles. The development of new technologies faces the problem of sufficient intellectual and innovative capital. Therefore, it is necessary to pay attention to those factors that positively affect GVCs' upgrading, and the creation of domestic value added (DVA). For Slovakia, a very open and export-oriented economy, it is the eminent interest to correctly identify determinants supporting the development of an intellectual and innovative environment and the quality of human capital.

The form of the country's participation in GVCs is crucial. The main interest of a country or firms is to participate in globally organized production activities and tasks characterized by a high level of value added. Value added is increasingly concentrated on pre-production and post-production activities. Countries engaged in these types of activities achieve a higher position in the GVCs as well as a competitive advantage in the knowledge economy. These countries are also characterized by higher intangibles. According to Durand and Milberg (2018) and Rikap (2022), these countries created so-called Intellectual monopolies.

Intangible assets can be split into three basic groups: innovative property, computerized information, and economic competencies (Corrado, Haskel & Jona\_Lasinio, 2017). Economic competencies represent a specific type of intangible assets, not reported in traditional statistics or national accounts due to the complexity of quantification. This type of intangibles has an impact on business performance as it increases production efficiency and allows a country to participate in the production of technologically and highly sophisticated products with a high degree of value added.

The empirical literature encounters the problem of availability and reporting of high-quality and accurate data on intangible assets as well as conceptual definitions and uniform methodology (Mojca, Ahmed, Josh, Alberto, Giulio & Tjaša, 2023). However, there exist several studies dealing with this problem. For example, Kano, Tsang and Yeung (2020) map the rapidly growing domain of GVC, De Marchi and Alford (2022) examine the role of state policymaking in a context of GVC and Paoloni, Coluccia, Fontana and Solimene (2020) bring structured literature review based on knowledge management, intellectual capital and entrepreneurship and examine the role of knowledge and information as a strategic component for company. Corrado, Haskel, Jona-Lasinio and Iommi (2013, 2016) bring the methodology for measurement of intangibles. Pekarčík & Ďurčová (2020) examine the role of intangible assets within GVCs. Chen, Los and Timmer (2018) research the role of intangibles in GVCs. Pekarčík, Ďurčová and Glova (2022) examine the role of ICT assets on participation in GVCs. Marcolin, Miroudot and Squicciarini (2016) and Marcolin and Squicciarini (2017) analyse the interaction between global value chains and investments in intangible assets based on knowledge capital. They showed that industry-level investment in organizational capital is significantly positively correlated with the country's backward participation in GVCs and concluded that investment in knowledge capital and integration into GVCs can be mutually emphasized. Buckley, Strange, Timmer and de Vries (2022) confirm the importance of intangible asset accumulation within GVC as a driver of economic development and show that returns captured by intangible assets are greater than from tangible assets. The research on the impact of intangible asset accumulation on economic development is not limited only to global level. On

the regional level, Gumbau-Albert and Maudos (2022) confirm that the intangible assets explain regional GVA growth. Jona-Lasinio et al. (2019) find that, in advanced countries, intangibles have a positive effect on participation in GVCs and they complement tangibles. Moreover, within intangibles it is non-R&D (mainly training) as the main driver of participation. Intangibles influence both forward and backward participation (training and organizational capital forward participation; marketing, advertising, and design backward participation). The study of Vrh (2018) also examines the differences between EU countries (new' (CEE-10) and 'old' (EU-15) countries). The results showed that the group of CEE-10 countries missed the investments in intangibles and can increase GVC participation primarily through foreign direct investment, spillover effect and imported intangibles. Adarov and Stehreh (2020) conclude that intangibles have significantly positive effects on productivity growth, increase participation and position in GVCs, and the level of domestic value-added creation. Jaax and Miroudot (2021) state that the fragmentation of production and, consequently, the catch-up in the value chain, depends on the development of domestic innovation capabilities. This can be influenced by specific government policies that can affect how innovation is shared across countries and the potential for knowledge spillover. Nonnis, Bounfour and Kim (2023) examine the role of knowledge spillover between European countries using principal component analysis to aggregate intangibles. Ito, Ikeuchi, Criscuolo, Timmis, and Bergeaud (2023) confirm, based on OECD ICIO Tables, that the firms in key hubs within GVCs benefit from knowledge spillover. Tsakanikas, Caloghirou and Dimas (2022) support the premise of knowledge spillover through intangibles and find that imported intangibles and patents contribute to manufacturing sectoral specialization in GVCs and domestic intangibles are correlated with innovation. Therefore, our research focuses on the impact of intangible accumulation at Slovak industrial level on participation and position in GVCs. In the next section we provide a deeper definition and measurement of variables.

## 2. Data analysis

Our analysis is based on value added flows data retrieved from OECD – TIVA database (OECD, 2019). Indicators of Backward (BL) and Forward (FL) participation indexes are measured according to the specification of Koopman, Powers, Wang,

and Wei (2010), Hummels, Ishii and Yi (2001) and Johnson (2017). Overall GVCs participation is given by the sum of BL and FL. GVCs position is measured according to Banerjee and Zeman (2020) or Jona-Lasinio, Manzocchi and Meliciani (2019), as the ratio of FL to BL – the relative downstream or upstream country’s position. This variable helps us understand the country’s ability to appropriate the share of value added created within the GVCs.

The data of intangibles are retrieved from EUKLEMS and INTAN-Invest databases for the period 1995 to 2017 (data for a longer period are not currently available) (see Tab.1). The INTAN-Invest and EUKLEMS databases are consistent with National Accounting Principles and expand data on the intangibles associated with economic competencies.

**Table 1** Forms and sources of variables

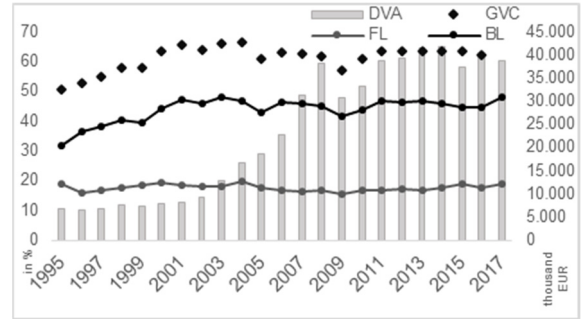
Name of variable	Definition
DVAFEX_TOT_H_In	Domestic value added embodied in foreign exports / Total hours worked (natural logarithm)
FVADEX_TOT_H_In	Foreign value added embodied in domestic exports / Total hours worked (natural logarithm)
Δ Tang_In	Total tangible assets - Tangibles
Δ TotIntg_In	Total intangible assets - Intangibles
Δ SoftDB_In	Intangible ICT assets
Δ InovProp_In	Innovative property
Δ EconComp_In	Economic Competencies
CIT	Corporate income tax rate

Source: the authors, own, according to Corrado et al. 2016; Stehrer, Bykova, Jäger, Reiter & Schwarzhappel, 2019

We divide intangibles into three basic groups, according to Corrado et al. (2016). The first group - Computerized Information, consists of computer software and databases. The second - Innovative Property - includes the innovative activity built on a scientific base of knowledge as well as innovation and new product, process R&D. The third - Economic Competencies - includes spending on strategic planning, worker training, redesigning or reconfiguring existing products in existing markets, investment to retain or gain market share and investment in brand names (Corrado et al. 2016).

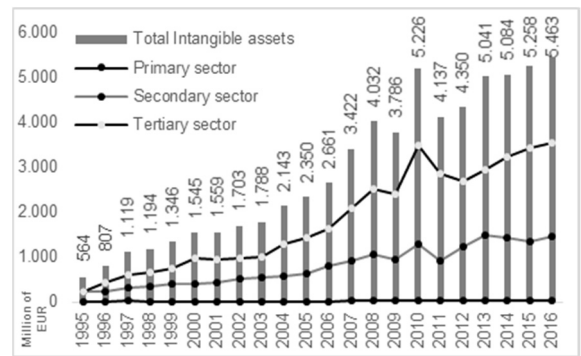
Figure 1 depicts Slovak participation in globally organized production which was increasing over the observed period, but mainly between 1995 and 2005. It is known as the main transformation period of the Slovak economy, by process of privatization as well as foreign direct

investment growth (e.g., green field investment of PSA, Kia, etc.). The average value of Slovak participation in GVCs was rising and now is more than 61%. The data for backward and forward participation reveals that the participation in the global production network is concentrated mainly in downstream production, meaning that Slovak production is involved in activities with low value-added generation. However, the development of the domestic value added in Slovak export (Fig. 1 DVA – right axis) is growing.



**Figure 1** The development of GVCs participation and domestic value added  
Source: the authors, data from OECD (2019)

Figure 2 illustrates the accumulation of intangibles in Slovakia. Intangibles were growing; moreover, the share of total intangibles to total tangibles was increasing, so the intangibles in the Slovak Republic increased. Before the accession to the EU the share of intangibles to tangibles was approximately 16%, while after accession (i.e., after 2004), this share was more than 30%.



**Figure 2** The development of Intangible assets in Slovak Republic  
Source: the authors, data from OECD (2019)

In 2017, this share represented approximately 35%. As expected, intangibles are mainly concentrated in tertiary sectors. Furthermore, there is a significant difference between intangibles and tangibles. For example, in manufacturing,

intangibles increased almost six times while tangibles just three times.

### 3. Econometric approach

In an econometric analysis by implementing the Hausmann panel robustness test (Hausman, 1978), we confirm the panel regression with random effect. This empirical strategy is consistent with the structure of the data and with the econometric strategy of Jona-Lasinio et al. (2019) and Vrh (2018). We confirm that the total panel is robust. We use lagged data for capital inputs due to the intangibles methodology and the potential endogeneity problem. Based on the theoretical background and literature review, we formulate the following hypotheses:

HP1. Intangible assets have a positive impact on the SR participation in the GVCs.

HP2. Intangible assets have a positive impact on the SR position in the GVCs.

HP3. Economic competencies have the highest positive impact on the SR participation in the GVCs.

Our benchmark equation is as follows:

$$\ln Y_{i,t}^{GVC} = \alpha \Delta \ln K_{i,t}^{Tang} + \sum_{q \in Q} \beta_q \Delta \ln K_{i,t}^{TotIntg} + \gamma X_{i,t} + u_{i,t} + \varepsilon_{i,t} \quad (1)$$

where  $i$  = industry;  $t$  = time;  $q$  = specific types of intangibles (SoftDB, InovProp, EconComp);  $Y_{i,t}^{GVC}$  represents different indicators of GVCs participation (total, backward and forward participation and GVCs position);  $K_{i,t}^{Tang}$  is tangible assets;  $K_{i,t}^{TotIntg}$  represents intangible assets (see Tab.1);  $X$  are control variable (corporate income tax rate);  $u_{i,t}$  is the industry and time random effects;  $\varepsilon_{i,t}$  is the random error term. We use lagged (one-year) panel data for the period 1995 – 2017 (575 observations - 25 sectors and 23 years). We use sector data according to the classification of ISIC Rev 4. The industrial sector is divided according to individual categories. Other sectors are in aggregate form. GVCs variables are based on gross export and were standardized by the number of total hours worked from the EU-KLEMS database due to various disparities. Capital input data are indexed (2010=100). We want to investigate the impact of changes in the accumulation of intangibles on the GVCs participation and position. As a control variable, we use the corporate income tax rate. It may have

an impact on multinational corporations and their decision to locate a foreign affiliate. The higher the tax rate, the lower the probability of placing a foreign affiliate in a country. Increasing tax rate will thus cause a reduction in the creation of domestic value added share of gross export.

Intangibles supports participation, and more importantly, supports the appropriation of value added within the GVCs (position). Therefore, we direct our research to identify specific types of intangibles that improve the creation of Slovak DVA e.g., GVC participation and position. We assume that the intangibles will have a positive impact on the appropriation of value added within GVCs. Since Slovak republic uses its comparative advantage in the form of a relatively cheap and well-qualified labour force and is close to final demand markets, its predominant form of participation in GVCs is backward linkages. This means that Slovak production is dependent on the import of intermediate products, i.e., foreign value added. According to Pellényi (2020), CEE countries can fall into the limitation trap of the volume of domestic value added in export. Slovak specialization in manufacturing activities in the GVCs may cause the economy to fall into this trap. Upgrading and modernization of products, processes and skills in the GVCs and manufacturing industry through the accumulation of intangibles can contribute to increasing the creation of DVA and thus a greater value-added appropriation within GVCs. In the case of process upgrading, we observe that Slovak companies accumulate intangibles primarily associated with economic competencies (organizational capital, training etc.). Therefore, we assume that their accumulation can help increase participation. In the case of product upgrading, the country needs to have a robust innovation environment. Intangibles associated with innovation assets (R&D, design etc.) can help to support this environment. However, it is important that investments in innovation are linked to specific companies.

We assume that the coefficients of tangibles and intangibles will be positive, confirming the positive impact on GVCs participation. We expect that tangibles have a stronger positive impact on Slovak participation in the GVCs in different forms of participation.

Regarding the impact of individual forms of intangibles, we assume that in the case of forward and backward participation intangibles have a relatively strong positive impact. Computerized information (SoftDb) and economic competencies

(EconComp) will be important drivers for GVCs participation. Moreover, we assume that intangibles have a stronger positive impact on Slovak position in the GVCs, thus Slovak ability to appropriate the value added within GVCs. We expect the coefficient for economic competencies (EconComp) to be higher than other types of intangibles, as they represent the largest part of intangibles. The economic competencies support the improvement of human capital. Their high accumulation in countries with a predominant BL participation is due to the exigency of multinational corporations to train their manufacturing employees. Innovative property (InovProp) is expected to have a strong impact on domestic value added, the country's participation and position in GVCs, productivity as well as economic growth. Investment in computerized information (SoftDb) is particularly important for exporting countries, trading in international markets with goods and services embodying high levels of foreign value added. This is the case of an export-oriented economy e.g., the Slovak Republic. We present the econometric results of the regression analysis in the next section.

#### 4. Research results

The first regression results for the total tangibles (Tang) and total intangibles (TotIntg) are presented in Table 2; in the following Table 3 we show the regression results for forward and backward participation; in Table 4 we exhibit individual effects of Computerized Information (SoftDb), Innovative Property (InovProp) and Economic Competencies (EconComp).

The coefficient for TotIntg is significant and positive, supporting our first hypothesis, that intangibles have a positive effect on the participation of the Slovak Republic in GVCs. Our findings are consistent with Jona-Lasinio et al. (2019), Durand and Milberg (2018), emphasizing the positive effect of intangibles on participation in GVCs. As expected, all intangibles contribute positively to both forward and backward participation.

We expect that tangibles will be more associated with participation in GVCs. These have a greater impact on total (0.510), FL (0.484) and BL (0.496) participation than intangibles (Tab.2 and 3). However, the difference between the impact of tangibles and intangibles on the involvement of Slovakia in GVCs are very small. We confirm that tangibles are predominantly associated with BL participation, thereby

confirming the described condition, relative comparative advantage and impact of high BL participation. Intangibles are more associated with the position, which means that their accumulation supports Slovakia's appropriation of value added. The value of coefficient is 0.236, indicating that the 10% increase in their accumulation is, assuming ceteris paribus, associated with 2.3% improvement in Slovak ability to appropriate value added within the GVCs.

**Table 2** The effect of tangibles and intangibles on Slovak participation and position in the GVCs

GVCs	GVC Part.	GVC Part.	GVC Position	GVC Position
Tang_In <sub>t-1</sub>	0.510*** (0.048)		0.220*** (0.029)	
TotIntg_In <sub>t-1</sub>		0.507*** (0.053)		0.236*** (0.031)
CIT_In	-1.996*** (0.091)	-1.964*** (0.095)	-0.132** (0.051)	-0.097* (0.057)
Balanced	YES	YES	YES	YES
Random	YES	YES	YES	YES
No. of obs.	550	550	550	550
R2	0.710	0.698	0.198	0.196
F_stat.	***	***	***	***
Hausmann	0.9997	0.06712	0.9811	0.7955

Source: the authors,  
 Note: Standard errors in parentheses  
 \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Moreover, our results show that tangibles are significant for forward and backward participation (Tab. 3). Tangibles are primarily associated with BL participation. The strong positive impact of tangibles on BL participation is also confirmed by Marcolin, Le Mouel and Squicciarini (2017). The Slovak Republic was oriented towards tangibles; therefore, it is normal that we observe a greater impact of tangibles with BL participation. The results imply that intangibles could positively influence BL, FL and Total GVCs participation.

As we expected, we observe a negative coefficient for the control variable, which indicates that increasing the corporate income tax rate (CIT) has a negative impact on the country's involvement in globally organized production – rising obstacles to cross-border trade.

Intangibles tend to take significant part in global value chains in European countries (e.g., Adarov & Stehrer, 2019; 2020). Our findings show that intangibles are positively related to the Slovak GVCs participation. However, not all intangibles are equally relevant. While the effect of Economic Competencies on participation is large and positive, it is small and positive for Computerized

Information (software and databases) and insignificant in the case of Innovative Property. In Table 4, we analyse the impact of different types of intangibles on total participation in GVCs. The results (Tab. 4) show that the economic competencies have the greatest positive impact (0.584) on the integration of Slovakia in the GVCs. Intangible ICT assets (0.045) have the second most important impact. The coefficient of innovative assets is not statistically significant. According to our results, Economic Competencies support the Slovak involvement in GVCs the most.

**Table 3** The effect of tangibles and intangibles on Slovak FL and BL participation in the GVCs

GVCs	FL	FL	BL	BL
Tang_In <sub>t-1</sub>	0.484*** (0.046)		0.496*** (0.055)	
TotIntg_In <sub>t-1</sub>		0.466*** (0.051)		0.493*** (0.060)
CIT_In	-1.943*** (0.081)	-1.930*** (0.094)	-2.042*** (0.104)	-2.011*** (0.111)
Balanced	YES	YES	YES	YES
Rando	YES	YES	YES	YES
No. obs.	550	550	550	550
R2	0.717	0.703	0.659	0.648
F_stat.	***	***	***	***
Hausmann	0.09975	0.0570	0.9984	0.1775

Source: the authors,

Note: Standard errors in parentheses \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Economic Competencies are associated with improving the quality of human capital, organization of production and management. A large part of economic competencies, even in Slovakia, was associated with activities with a lower rate of value added – assembly and production. Therefore, Economic Competencies support Slovak participation in the GVCs very positively.

Intangible ICT assets are associated with the increase in Slovak GVC participation. This type of intangibles is inevitable in organizing global production networks. Ensuring up-to-date fast communication within supply chains and customers is an important area of business organization today. The use of intangible ICT assets, such as software and databases, improve productivity and we confirm that they also improve Slovak involvement in GVCs.

Investment in Innovative Property can become an instrument to increase drawing benefits from GVCs. In the case of Slovak innovation assets, the coefficient is not statistically significant. Further investment in Innovative Property can increase the returns from backward GVCs participation. It can

take the form of generating new knowledge or expertise and enhancing the absorptive capacity of firms and their ability to exploit inputs from globally organized production. According to Montesor and Vezzani (2016) the specific types of Innovative Property, such as Design and R&D, could increase an innovative environment. However, it is striking that this type of intangibles has declined (- 17%) in total intangible assets in Slovakia based on INTAN – Invest data.

**Table 4** The effect of specific types of intangibles on Slovak participation in the GVCs

	GVCs Participation		
Tang_In <sub>t-1</sub>	0.329*** (0.038)	0.336*** (0.038)	0.196*** (0.040)
SoftDB_In <sub>t-1</sub>	0.045** (0.023)		
InovProp_In <sub>t-1</sub>		0.032 (0.022)	
EconComp_In <sub>t-1</sub>			0.584*** (0.073)
CIT_In	-2.121*** (0.091)	-2.191*** (0.086)	-1.669*** (0.103)
Balanced	YES	YES	YES
Random	YES	YES	YES
No. of obs.	550	550	550
R2	0.700	0.699	0.730
F_stat.	***	***	***
Hausmann	0.6136	0.9858	0.4015

Source: the authors,

Note: Standard errors in parentheses \*p<0.1; \*\*p<0.05; \*\*\*p<0.01

Each country has a specific way of participating in the GVCs and so, it is not entirely possible to abstract the overall aggregate results for individual countries. Therefore, it is important to analyse the impact of specific types of intangibles on the individual country's participation and position. The appropriate setting of national public policies to support the creation of a knowledge-based economy on the principle of the accumulation of intangibles is essential. Our results show that in the case of Slovakia, investment in intangibles, primarily in economic competencies i.e. the quality of human capital, is the most important factor for business productivity growth and GVC participation. Currently, more than ever, if firms want to achieve a higher level of participation and increase their position in the GVC, they need to allocate resources not only into innovative property but also to economic competencies such as organizational capital or training. The increasing quality of human capital becomes a key element that managers must focus on in order to maintain their international competitiveness within the

framework of global organized production.

Marrocu, Paci and Pontis (2011) highlight the importance of policies designed to stimulate the accumulation of intangibles at the firm's level. The positive effect of intangible assets, especially intellectual capital on business performance also confirmed Radonic, Milosavljevic and Knezevic (2021) and this positive effect on market value firms was also confirmed by Dancakova, Sopko, Glova and Andrejovská (2022) and Glova, Andrejovska and Vegsoova (2020). Factors with a strong impact on unlocking the potential of intangibles accumulation are presented by Thum-Thysen, Voigt, Bilbao-Osorio, Maier and Ognyanova (2017, 2019). It is important to support and create a pro-competitive regulation framework that aimed at the reduction of barriers to adopt new technologies and thereby contributing to the development of the necessary innovation ecosystem. Thus, an important conclusion for policymakers is to stimulate the accumulation of intangibles which have the potential to improve the productivity of firms as well as domestic value added and improve the appropriation of value added within the GVC.

## Conclusions

The participation of the Slovak Republic in the GVCs increased, mainly due to the backward participation. This brings a lot of positive effects for Slovak economy, however, the gains could be even higher. The question is how to increase the benefits and gains from participation in GVCs. The recent problem is that more than half of Slovak firms' exports are composed of foreign value added - imported intermediates. It indicates that the Slovak position concentrates on downstream activities of GVCs with lower domestic value added creation. A key element, necessary for countries and firms to compete in high value added activities, is the capability to produce sophisticated products within the sophisticated process, which is closely linked to the endowment of intangibles. Therefore, we investigate to what extent the intangibles accumulation is associated with the GVCs participation and position (value added appropriation) in the Slovak Republic.

To our knowledge, the contribution of our research is, to be the first to examine the interaction between intangibles and the participation and position of the Slovak Republic in the GVCs. Our results show that the accumulation of intangibles is positively associated with the participation of Slovak firms in GVCs, and the most important

result is that intangibles improve Slovak value-added appropriation i.e., position. The same result is confirmed separately for forward and backward participation.

Economic competencies and Intangible ICT assets (Computerised information) are positively associated with GVCs participation. We find that economic competencies positively support involvement of Slovak firms in GVCs. It increases the quality of human capital, and organization and management of production and thus creates a favourable competitive environment for firms. Intangible ICT assets have a significant impact on improving the country's participation in the GVCs. Investment in Innovative property can become an instrument to increase drawing benefits from GVCs involvement. However, it is striking that this type of intangibles has declined in total Slovak intangibles.

We confirmed that intangibles support Slovak firm's involvement and value-added appropriation within GVCs. Therefore, it is necessary to create through policy implementation, an attractive and competitive environment that will support the accumulation of innovative intangibles. Further research could be extended to a more detailed examination of the impact of intangibles on specific sectors according to the ISIC rev. 4 classification. It is important to analyse the role of the accumulation of more detailed specific types of intangibles at the sectoral level because we observe large differences in their impact on the creation and productivity of value added. The availability of data on the creation of value added and thus involvement in the GVCs is a major limitation at the macroeconomic level. Therefore, it is necessary to verify these findings with an analysis at the firm's level data.

## Acknowledgement

This article was written within the project of KEGA 040UMB-4/2021 and project VEGA No. 1/0673/21.

## References

- Adarov, A. & Stehrer, R. (2020). Capital dynamics, global value chains, competitiveness and barriers to FDI and capital accumulation in the EU. Research Report Publications Office of the European Union, 446/2020. Retrieved December 5, 2022, from <https://publications.jrc.ec.europa.eu/repository/handle/JRC121096>
- Adarov, A & Stehrer, R. (2019). Tangible and intangible assets in the growth performance of the EU, Japan and the US. Research Report of The Vienna Institute for International Economic Studies, 442/2019. Retrieved



- December 5, 2022, from <https://wiiw.ac.at/tangible-and-intangible-assets-in-the-growth-performance-of-the-eu-japan-and-the-us-dlp-5058.pdf>
- Banerjee, B. & Zeman, J. (2020). Determinants of global value chains participation: a cross-country analysis. NBS Working Paper 1/2020. Retrieved December 5, 2022 from: [https://nbs.sk/\\_img/documents/publik/wp\\_1\\_2020\\_zem\\_an\\_determinants\\_of\\_GVC\\_en.pdf](https://nbs.sk/_img/documents/publik/wp_1_2020_zem_an_determinants_of_GVC_en.pdf)
- Buckley, J.P., Strange, R., Timmer, P. M. & de Vries, G. (2022). Rent appropriation in global value chains: the past, present, and future of intangible assets. *Global Strategy Journal*, 12 (4), 679-696. <https://doi.org/10.1002/gsj.1438>
- Butollo, F., Gereffi, G. & Krzywdinski, M. (2022). Digital transformation and value chains: introduction. *Global Networks: a Journal of Transnational Affairs*, 22(4), 585-594. <https://doi.org/10.1111/glob.12388>
- Castelo-Branco, I., Oliveira, T., Simoes-Coelho, P. & Portugal, J. (2022). Measuring the fourth industrial revolution through the Industry 4.0 lens: the relevance of resources, capabilities and the value chain. *Computer in Industry*, 138, 103639. <https://doi.org/10.1016/j.compind.2022.103639>
- Chen, W., Los, B. & Timmer, M.,P. (2018). Factor incomes in global value chains: the role of intangibles. National Bureau of Economic Research, Working Papers 25242. <https://doi.org/10.3386/w25242>
- Corrado, C., Haskel, J., Jona-Lasinio, C. & Iommi, M. (2013). Innovation and intangible investment in Europe, Japan, and the United States. *Oxford Review of Economic Policy*, 29(3), 261-286. <https://doi.org/10.1093/oxrep/qrt017>
- Corrado, C., Haskel, J., Jona-Lasinio, C. & Iommi, M. (2016). Intangible investment in the EU and US before and since Great Recession and its contribution to productivity growth. EIB Working Papers 2016/08. Retrieved December 5, 2022, from <https://www.econstor.eu/bitstream/10419/149979/1/877829535.pdf>
- Corrado, C., Haskel, J. & Jona\_Lasinio, J. (2017). Knowledge Spillovers, ICT and Productivity Growth. *Oxford Bulletin of Economics and Statistics*, 79(4), 592-618. <https://doi.org/10.1111/obes.12171>
- Dancakova, D., Sopko, J., Glova, J. & Andrejovská, A. (2022). The impact of intangible assets on the market value of companies: cross-sector evidence. *Mathematics*, 10(20), 3819. <https://doi.org/10.3390/math10203819>
- Delera, M., Pietrobelli, C., Calza, E. & Lavopa, A.(2022). Does value chain participation facilitate the adoption of Industry 4.0 technologies in developing countries? *World Development*, 152. <https://doi.org/10.1016/j.worlddev.2021.105788>
- De Marchi, V. & Alford, M. (2022). State policies and upgrading in global value chains: a systematic literature review. *Journal of International Business Policy*, 5, 88-111. <https://doi.org/10.1057/s42214-021-00107-8>
- Durand, C. & Milberg, W. (2018). Intellectual monopoly in global value chains. Working Papers 1807, 07/2018, 404-429. <https://doi.org/10.1080/09692290.2019.1660703>
- Fernandez-Stark, K., & Gereffi, G. (2018). Global value chain analysis: a primer (second edition). In *Global Value Chains and Development: Redefining the Contours of 21 Century Capitalism*. 305-342. Cambridge University Press. <https://doi.org/10.1017/9781108559423.012>
- Ge, J., Fu, Y., Xie, R., Liu, Y., & Mo, W. (2018). The effect of GVC embeddedness on productivity improvement: From the perspective of R&D and government subsidy. *Technological Forecasting and Social Change*, 135, 22-31. <https://doi.org/10.1016/j.techfore.2018.07.057>
- Gumbau-Albert, M. & Maudos, J. (2022). The importance of intangible assets in regional economic growth: a growth accounting approach, *The Annals of Regional Science*, 69, 361-390. <https://doi.org/10.1007/s00168-022-01138-6>
- Glova, J., Andrejovska, A. & Vegsoova, O. (2020). Intangibles in manufacturing industry: an empirical analysis. EAI/Springer Innovation in Communication and Computing, 5th EAI Interational Conference on Management of Manufacturing Systems, MMS 2020, 469-477. [https://doi.org/10.1007/978-3-030-67241-6\\_37](https://doi.org/10.1007/978-3-030-67241-6_37)
- Hausman, J., A. (1978). Specification test in econometrics. *Econometrica* 46 (6), 1251-1271. <https://doi.org/10.2307/1913827>
- Hummels, D., Ishii, J. & Yi, K.-M. (2001). The nature and growth of vertical specialization in world trade. *Journal of International Economics*, 54 (1), 75-96. [https://doi.org/10.1016/S0022-1996\(00\)00093-3](https://doi.org/10.1016/S0022-1996(00)00093-3)
- Ito, K., Ikeuchi, K., Criscuolo, Ch., Timmis, J. & Bergeaud, A. (2023). Global value chains and domestic innovation. *Research Policy*, 52(3), 104699. <https://doi.org/10.1016/j.respol.2022.104699>
- Jaax, A. & Miroudot, S. (2021). Capturing value in GVCs through intangible assets: the role of the trade-investment-intellectual property nexus. *Journal of International Business Policy* 4/2021, 433-452. <https://doi.org/10.1057/s42214-020-00086-2>
- Johnson, C.,R., (2017). Measuring global value chains. National bureau of economic research working papers, 24027. <https://doi.org/10.3386/w24027>
- Jona-Lasinio, C. & Meliciani, V. (2018). Productivity growth and international competitiveness: Does intangible capital matter? *Intereconomics Review of European Economic Policy* 53(2), 58-62. <https://doi.org/10.1007/s10272-018-0722-y>
- Jona-Lasinio, C. & Meliciani, V. (2019). Global value chains and productivity growth: Does intangible capital matter? *International Productivity Monitor*, Center for the Study of Living Standards, 36, 53-78. <https://doi.org/10.1007/s10272-018-0722-y>
- Jona-Lasinio, C., Manzocchi, S. & Meliciani, V. (2019). Knowledge-based capital and value creation in global supply chains. *Technological Forecasting & Social Change*, 148. <https://doi.org/10.1016/j.techfore.2019.07.015>
- Kano, L., Tsang, E. W.K. & Yeung, H. W. (2020). Global value chains: a review of the multi-disciplinary literature. *Journal of International Business Studies*, 51, 577-622. <https://doi.org/10.1057/s41267-020-00304-2>

- Koopman, R., Powers, W., Wang, Z. & Wei, S.-J. (2010). Give credit where credit is due: tracing value added in global production chains. National Bureau of Economic Research Working Papers 16426. <https://doi.org/10.3386/w16426>
- Marcolin, L., Miroudot, S. & Squicciarini, M. (2016). GVCs, jobs and routine content of occupations. OECD Trade Policy Papers, 187. <https://doi.org/10.1787/5jm0mq7kr6s8-en>
- Marcolin, L. & Squicciarini, M. (2017). Investing in innovation and skills: thriving in global value chains. OECD Science, Technology and Innovation Policy Papers, 44/2017. Retrieved December 5, 2022 from <https://www.oecd-ilibrary.org/docserver/9e296b43-en.pdf?expires=1635249180&id=id&accname=guest&checksum=2409BED8B8232A37E718F7203451E143>
- Marcolin, L., Le Mouel, M. & Squicciarini, M. (2017). Investment in knowledge based capital and backward linkages in global value chains. Working Party on Industry Analysis. 1/2016. Retrieved December 5, 2022, from [https://one.oecd.org/document/DSTI/EAS/IND/WPIA\(2016\)1/en/pdf](https://one.oecd.org/document/DSTI/EAS/IND/WPIA(2016)1/en/pdf)
- Marrocu, E., Paci, R. & Pontis, M. (2011). Intangible capital and firms' productivity. *Industrial and Corporate Change*, 21 (2), 377-402. <https://doi.org/10.1093/icc/dtr042>
- Mojca, B., Ahmed, B., Josh, M., Alberto, N., Giulio, P., & Tjaša, R. (2023). Measuring Investment in Intangible Assets. *Advances in Business Statistics, Methods and Data Collection*, 79-103. <https://doi.org/10.1002/9781119672333.ch5>
- Montresor, S. & Vezzani, A. (2016). Intangible investment and innovation propensity: evidence from the innobarometer 2013. *IPTS. Industry and Innovation*, 23 (4), 331-352. <https://doi.org/10.1080/13662716.2016.1151770>
- Nonnis, A., Bounfour, A. & Kim, K. (2023). Knowledge spillovers and intangible complementarities: empirical case of European countries. *Research Policy*, 52 (1), 104611. <https://doi.org/10.1016/j.respol.2022.104611>
- OECD. (2019). Guide to OECD's Trade in value added (TIVA) indicators, 2018 edition. OECD Indicators Guide. Retrieved December 5, 2022 from <https://stats.oecd.org>
- Paoloni, M., Coluccia, D., Fontana, S. & Solimene, S. (2020). Knowledge management, intellectual capital and entrepreneurship: a structures literature review. *Journal of Knowledge Management*, 24(8), 1797-1818. <https://doi.org/10.1108/JKM-01-2020-0052>
- Pavlínek, P. & Ženka, J. (2011). Upgrading in the automotive industry: firm-level evidence from Central Europe. *Journal of Economic Geography*, 11 (3), 559-586. <https://doi.org/10.1093/jeg/lbq023>
- Pavlínek, P. & Ženka, J. (2016). Value creation and value capture in the automotive industry: empirical evidence from Czechia. *Environment and Planning*, 48 (5), 937-959. <https://doi.org/10.1177/0308518X15619934>
- Pekarčík, M. & Ďurčová, J. (2020). Capital accumulation – intangible and tangible assets in global value chains. *International Academic Journal*, 1 (1), 4-12.
- Pekarčík, M., Ďurčová, J. & Glova, J. (2022). Intangible ICT and their importance within global value chains: an empirical analysis based on longitudinal data regression. *Mathematics*, 10 (7). <https://doi.org/10.3390/math10071198>
- Pellényi, G.M. (2020). The role of Central & Eastern Europe in global value chains: evidence from occupation-level employment data. *Economic Brief 062*. Retrieved December 5, 2022 from: <https://econpapers.repec.org/RePEc:euf:ecobri:062>
- Radonic, M., Milosavljevic, M. & Knezevic, S. (2021). Intangible assets as financial performance drivers of IT industry: evidence from an emerging market. *E&M Economics and Management*, 24 (2), 119-135. <https://doi.org/10.15240/tul/001/2021-2-008>
- Rikap, C. (2022). From global value chains to corporate production and innovation systems: exploring the rise of intellectual monopoly capitalism. *Area Development Policy*, 7 (2), 147-161. <https://doi.org/10.1080/23792949.2021.2025118>
- Thum-Thysen, A., Voigt, P., Bilbao-Osorio, B., Maier, Ch., & Ognyanova, D. (2017). Unlocking investment in intangible assets. Quarterly Report on the Euro Area, European Commission (DG ECFIN), 16(1), 23-35.
- Thum-Thysen, A., Voigt, P., Bilbao-Osorio, B., Maier, Ch. & Ognyanova, D. (2019). Investment dynamics in Europe: distinct drivers and barriers for investing in intangible versus tangible assets? *Structural Change and Economic Dynamics*, 51, 77-88. <https://doi.org/10.1016/j.strueco.2019.06.010>
- Tsakanikas, A., Caloghirou, Y. & Dimas, P. (2022). Intangibles, innovation, and sector specialization in global value chains: a case study on the EU's and the UK's manufacturing industries. *Technological Forecasting and Social Change*, 177, 121491. <https://doi.org/10.1016/j.techfore.2022.121488>
- Vrh, N., (2018). What drivers the differences in domestic value added in exports between old and new E.U. member states? *Economic Research-Ekonomska Istraživanja*, 31 (1), 645-663. <https://doi.org/10.1080/1331677X.2018.1438910>
- Stehrer, R., Bykova, A., Jäger, K., Reiter, O. & Schwarzhappel, M. (2019). Industry Level Growth and Productivity Data with Special Focus on Intangible Assets. *Wiiw Statistical Report No.8*. Retrieved December 5, 2022, from <https://euklems.eu/wp-content/uploads/2019/10/Methodology.pdf>

#### ✉ Correspondence

Júlia Ďurčová

Technical university of Košice, Faculty of economics,  
Košice, Némcovej 32, 04001 Košice, Slovakia

E-mail: [julia.durcova@tuke.sk](mailto:julia.durcova@tuke.sk)