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THE EFFECTS OF GLOBAL VALUE CHAINS PARTICIPATION ON DOMESTIC PRODUCTIVITY: IN THE CASE OF CENTRAL AND EASTERN EUROPEAN COUNTRIES

Master's Thesis

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TABLE OF CONTENTS

1. Introduction **6**

2. Literature Review **9**

2.1. A Brief History of Global Value Chains 9

2.2. Definitions of Global Value Chains 11

2.3. Measuring of Global Value Chains Participation 12

2.3.1 The Development Status of Global Value Chains Participation Measures 12

2.3.2 The Forward and Backward Global Value Chains Participation 14

2.4. The Relationship between Global Value Chains Participation and Domestic Productivity 17

3. Research Methods and Regression Models **19**

4. Data Description **21**

4.1 Explanations of Data Source and Variables 21

4.2 Descriptive Statistics 23

5. Empirical Process and Results Interpretations **27**

5.1 Provisional Analysis 27

5.2 Comparisons of Pooled OLS, Fixed Effects and Random Effects Models 30

5.3 Diagnostic Tests and the Feasible Generalized Least Squares models 31

6. Conclusions and Limitations **34**

Reference **36**

Appendix **40**

LIST OF TABLES

Table 2.1 The differences of Broad / Traditional View and Narrow / Relational View

Table 2.2 The Three Main Value-added Based Databases

Table 2.3 OECD TiVA Database's Indicators for Forward and Backward Participation in GVCs (TiVA 2021 version)

Table 2.4 Top 5 Import and Export Products in Czech Republic's Machinery Sector

Table 4.1 Explanations of Variables and Data Sources

Table 4.2 Descriptive Statistics of the Variables

Table 4.3 Grouping *tfp* and GVC indicators by years

Table 4.4 Grouping *tfp* and GVC indicators by years by countries

Table 5.1 Outputs of the Within Estimator Approach for Entity Fixed Effects

Table 5.2 Outputs of FGLS Models

LIST OF FIGURES

Figure 1.1 A Sample of Global Value Chains (Nutella®)

Figure 2.1 The Development of Information and Communication Technologies Shown by World Development Indicators

Figure 2.2 Gross exports are broken down into value-added exports

Figure 2.3 The Comparison of Russian Federation's Forward and Backward GVC Participation

Figure 2.4 The Export Structure of Russian Federation in 2018

Figure 2.5 The uneven distribution of value-added in Global Value Chains

Figure 4.1 Countries' Proportion of the Forward and the Backward GVCs Participation (Average value of 1998 to 2018)

Figure 4.2 Sample Countries' Average Forward GVC Participation Comparing to Rest of the World

Figure 4.3 Sample Countries' Average Backward GVC Participation Comparing to Rest of the World

Figure 5.1 The Dependent Variable's Time Properties (separately)

Figure 5.2 The Dependent Variable's Time Properties (overall)

Figure 5.3 Heterogeneity of Total Factor Productivity across Entities

Figure 5.4 Heterogeneity of Total Factor Productivity across Years

The Effects of Global Value Chains Participation on Domestic Productivity: in the Case of Central and Eastern European Countries

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ABSTRACT
This dissertation focuses on the effects of global value chains (GVCs) participation on domestic productivity. The definition and brief history of GVCs and measures of GVCs participation are introduced first, and then we review the previous studies that are relevant to the relationship between GVCs participation and domestic productivity. Regarding empirical analyses, the Feasible Generalized Least Squares (FGLS) model is selected, and the primary variables include total factor productivity (TFP), human capital, inflation, foreign direct investment, innovation levels, and GVC participation indicators, and the statistics are based on 12 CEE countries from 1995 to 2018. The outcomes indicate a positive relationship between the integration of GVC participation and TFP development, while there is no significant evidence to conclude that countries' position in GVCs can influence the domestic productivity.

KEY WORDS Global value chain; Global economic integration; Productivity; Central and East European countries; Panel fixed-effects

JEL CLASSIFICATIONS F02; F14; F43

1. Introduction

Over the past few decades, the world has seen a significant increase in the globalization of industrial processes between nations, which has been made possible by various advancements in technology, institutions, and politics. Following trading capital (typically in the form of foreign direct investment) and merchandise in the first two stages of globalization, the third phase focuses on the segmentations of production, in which a growing number of companies are opting for offshore parts, components, or services to suppliers in other, frequently remote countries in order to organize manufacturing on a global scale (Amador & Cabral, 2016; Ignatenko, Raei & Mircheva, 2019; Mallick & Zhang, 2022). The third stage of the

international trade patterns is also known as global value chains (GVCs). Despite some features involved in the current wave of globalization are not especially fire-new, such as the continuous increases of trade-to-GDP ratio, it is widely believed that the changes to the global economy since the 1980s have some unique characteristics, and that viewing the rise of GVCs as simply an intensification of cross-national trade integration misses a number of important aspects of this phenomenon (Barjamovic et al., 2019; World Bank, 2020; Antràs, 2020). GVCs are considered to divide the production procedure among various economies, therefore, businesses merely concentrate on a single task and do not create the entire product, which is a significant driver of improved productivity and higher business competitiveness (OECD, 2013; World Bank, 2020). GVCs can also be characterized as a series of added value procedures across international borders that take place from the moment the item or service is created until it is utilized, involving services after the sale and recycling (Sturgeon, 2001; Kawakami, 2011). As the Figure 1.1 exhibits, the frequently observed "Made in" labels on produced goods have become antiquated reminders of the past while the majority of products are “Made in the World” today (Antràs, 2020).

The emergence of GVCs is regarded as a critical driving force behind changes in worldwide economic activities, by stimulating trade, boosting productivity and wages on a global scale, generating employment opportunities, and bringing about transformations in the economic structure (Aghion & Howitt, 2009; Baldwin, 2011; Timmer et al., 2013; Gunnella, Fidora & Schmit, 2017; Mallick & Fukumi, 2021). Based on available literature, participating in GVCs allows businesses to access new international markets, specialize in core operations, gain access to more sophisticated and high-quality inputs, and learn from new ideas, technology transfer and spillover to increase export scale (Collier & Venables, 2007; Criscuolo & Timmis, 2017; Pahl & Timmer, 2020).

It follows that the impact of global value chains on productivity has become a hot topic. According to (Wiryawan et al., 2022), the research on this subject is affluent for two main reasons. Firstly, the highly availability of statistics can produce a lot of literature that directly investigates the connection between GVCs and productivity. Furthermore, the findings of such a study tend to be more likely to lead to direct policy consequences which will boost a nation's productivity. However, comparing to a significant number of studies on the impact of trade on welfare and productivity, the effects of participation in GVCs have not been as thoroughly examined (Ignatenko, Raei & Mircheva, 2019) and the empirical outcomes of this theme based on diverse datasets tend to be mixed. Taking country-specific studies on

offshoring as an example, Amiti and Wei (2009) argues that service offshoring can contribute to total factor productivity (TFP) significantly, while the influence of material offshoring may be not prominent. Conversely, some scholars believe that it is material offshoring exerting positive effects on TFP (Egger, Pfaffermayr & Wolfmayr-Schnitzer, 2001; Daveri & Jona-Lasinio, 2008). What's more, the existing literature does not provide sufficient evidence and policy implications specific to Central and Eastern European (CEE) countries, which is an essential part of GVCs (Cieślik et al., 2019), however, due to various divisions of production in GVCs, the results of studies may alter significantly depending on national differences (Mallick & Zhang, 2022). Therefore, this thesis aims to analyse the effects of GVCs participation on domestic productivity in the case of CEE countries. According to Antràs (2020) and World Bank (2020), research on GVCs participation at the national dimension and industrial dimension is much more extensive, for which the statistics are more accessible than firm-level data. Although the significance of corporate-level research is increasingly emphasised and the studies on this field have been deepening in recent years (Montalbano et al., 2018; Antràs, 2020), there are some obstacles to conducting corporate-level research in this thesis due to limitations in access to firm-level data. Therefore, this thesis decides to build a country-level dataset of twelve CEE countries, including Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Russian Federation[1], Slovak Republic and Slovenia, from 1995 to 2018 to do panel data analysis. The selection of the sample countries mainly depends on the intersection of OECD TiVA Database, World Bank Open Data and Penn World Table version 10.01, in which these twelve CEE countries all have relatively complete and continuous annual data.

The remain parts are structured as follows. In the second section, the paper reviews some existing literature connecting with the development process and definitions of GVC, and then explains the Forward GVC participation and Backward GVC participation. In the third section, the research methodology will be introduced in detail. In the fourth section, we will describe statistics, including data sources, meanings of primary variables and summarizing statistics by countries and years. In the fifth section, we will do some provisional analyses, comparing three diverse models and interpret the critical outcomes of Feasible Generalized

[1] Some readers may wonder why the Russian Federation was chosen while Belarus and Ukraine were not, because the indicators used to measure GVCs participation in this thesis are mainly from the OECD TiVA Database, in which the relevant statistics of Belarus and Ukraine are not involved.

Least Squares (FGLS) model. Finally, conclusions and limitations of this thesis are provided in the last section.

Figure 1.1 A Sample of Global Value Chains (Nutella®)

Note: Owned by Ferrero S.p.A., Nutella® is a registered trademark for Spread Containing Cocoa and Other Ingredients.

Source: OECD (2013)

2. Literature Review

In this part, the thesis will introduce the existing literature in this field, including the history, definitions and drivers of GVCs, measures of productivity and GVCs' participation, GVCs' mapping, and the research on the relationship of GVCs' participation and productivity growth.

2.1. A Brief History of Global Value Chains

As stated in Banga (2014), GVCs first appeared through supply chains in East Asia, in which Japanese investors captured a leading position and started a flying geese pattern of trade and investment. To take advantage of geographic advantages and create export platforms for diverse elements, Japanese investors established manufacturing facilities in some East Asian nations, and later in Southeast Asia. These developing countries, with their lower labour

costs, have become Japan's production hubs and were responsible for various segments of production. Final assembly was completed in a third nation, after which the final products were sent to international market. The completed goods have become more dispersed, which improved cost competitiveness. The world of trading in goods is being transformed into trading in tasks (Mehta, 2018). GVCs, involving the production process spreading worldwide to become internationally competitive, are originated from this occurrence.

As countries become increasingly enthusiastic about GVCs' research, there seems to be an increasing requirement for relating theoretical ideas with a specific research strategy, hence, GVCs studies have progressed from a theoretical framework to an applied research methodology over the past 20 years (Frederick, 2019). Case analysis and qualitative firm-based research served as the foundation for the GVCs approaches' development, however, in contemporary data-driven environment, assessments as well as proposals have to include at least estimated quantitative indicators on significant concerns, such as improvements in exports, output, employment, wages, or skill levels, in order to be worthwhile to policymakers and government agencies (Frederick, 2019). In addition, more standardized data sources were also applied to facilitate comparison and repeatability through time (Frederick, 2014)

The previous two decades have seen remarkable development of GVCs. Though it is challenging to distinguish the factors that contribute to an expansion in global trade from those that have particular effects on the production's dispersion, lowering transport, information, and communication expenses, the rapid acceleration of technology advancement, and reduced political and economic barriers to trade and capital flows are considered as the primary driving forces of GVCs (Hillberry, 2011; Amador & Cabral, 2016). Hillberry (2011) argues that the expansion of flight options as well as the integration of the Eastern Europe and East Asia' emerging economies into the global market can be significant drivers of production fragmentation. In addition, WTO (2008) emphasizes the significance of the reduction in international trade expenditures, which include tariffs, the cost of communication and transportation, and the time spending on transferring goods, as well as the decrease in managerial costs associated with offshoring, which is largely caused by advancements of information and communications technologies (expressed in Figure 2.1). What's more, Nordas (2008) discovers that facilities, particularly ports, have a significant effect on the production's fragmentation in the apparel industry, while the excellent governance and policies of openness affect distribution networks in the electronics industry.

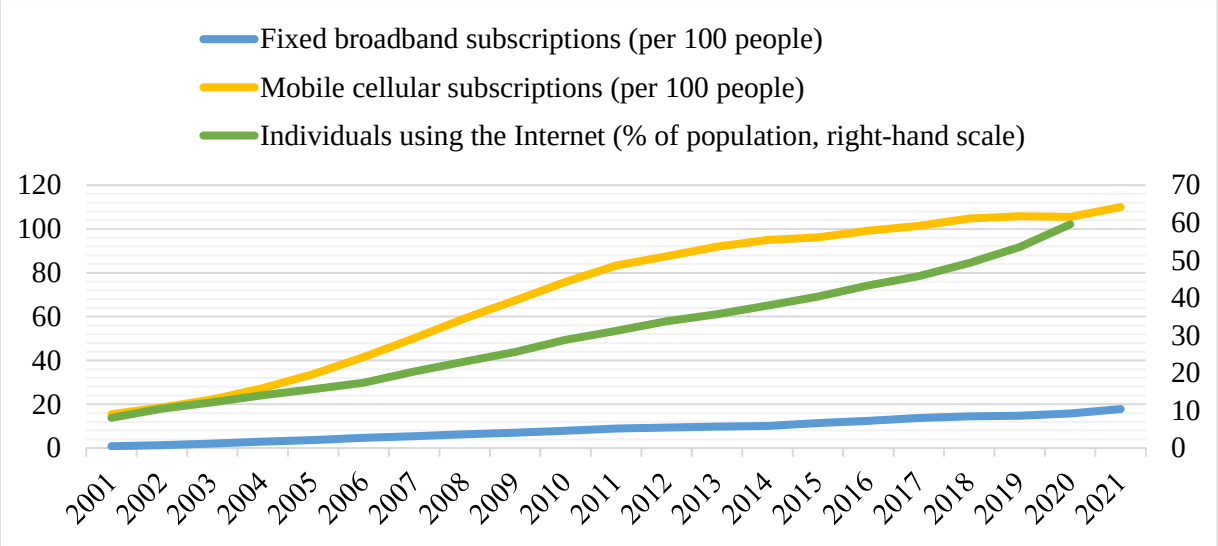


Figure 2.1 The Development of Information and Communication Technologies Shown by World Development Indicators

Source: World Bank Open Data, summarized by the Author

2.2. Definitions of Global Value Chains

A value chain describes all the tasks that a business performs to take a product or service from creation to its ultimate use by the consumer (Backer & Miroudot, 2013). As introduced by World Bank Group (2020), GVCs break down national production processes, so that the domestic firms can specialise in a particular task and do not require to produce the whole product.

Lots of literature provides a somewhat similar definition of GVCs, while the author suggests that the related concepts of GVCs are described relatively clearly and comprehensively by Antràs (2020). He argues that there are two distinct concepts of GVCs, one with a broad scope and another with a narrower focus. In the broad or traditional point of view, a GVC is made up of several stages that go into creating a good or service that is sold to consumers, each of which adds value and at least two of which are produced in different nations. On the other hand, though studies applying the broad perspective of GVCs have obtained insightful outcomes, it is concerned that the definition of GVCs now in use may be too wide to accurately reflect the innovative economic landscape that has arisen over the past thirty years. Therefore, the narrow or relational conceptualization of GVCs removing emphasis from the straightforward distribution of value added among nations just as a result of anonymous, spot

transfers of commodities and services is proposed, in which it is critical to know which individual agents are taking part in a GVC.

The primary differences of these two types of definitions based on Antràs (2020) are summarized in Table 2.1. It can be concluded that the broad concept of GVCs focuses more on macro-level research, using national and industry databases, while the narrow one is based mostly on analysis of company-level data. Considering the availability of data, this thesis selects country-level statistics for the empirical analysis and belongs to the scope of GVCs in the broad sense. Therefore, in the following section, this discussion of the measures of GVCs participation will be mainly at the macro perspective.

Table 2.1

The differences of Broad / Traditional View and Narrow / Relational View

	Broad / Traditional	Narrow / Relational
Basis of Definition	A greater utilization of foreign value added in production, particularly in export-oriented industry.	A greater utilization of foreign value added in production, particularly in export-oriented industry, but concentrating on intrafirm and cross-firm transactions incorporating relationship agreements and customized inputs (as opposed to anonymous, spot trades in homogeneous items).
Empirical Research	Metrics of foreign value added in production and exports at the national and sectoral levels (connected to backward and forward GVC participation indices). Comparable metrics at the company-level.	Case studies. Evaluations of global ownership structures or intrafirm trade movements. Empirical research on the endurance of firm-level trading interactions. Assessments based on HS products (anonymous vs relational).

Source: Antràs (2020), Summarized by the Author

2.3. Measuring of Global Value Chains Participation

2.3.1 The Development Status of Global Value Chains Participation Measures

To comprehend the global generation and distribution of value, along with a country's potential for thriving in an increasingly interdependent environment, it is crucial to evaluate GVCs participation in through appropriate methods (Montalbano et al., 2018; Antràs, 2020; Frederick, 2019). Despite a comprehensive framework has not been developed at the theoretical level, due to the complexity of GVCs' analysis, there are still a large number of

worthwhile approaches proposed in the existing economic literature (Amador & Cabral, 2016; Antràs, 2020).

The research on GVCs participation was initially more theoretical, and empirical studies in this area were very limited due to the availability of data (Ignatenko, Raei & Mircheva, 2019). The fundamental studies of Wang et al. (2013) and Koopman et al. (2014), which suggested approaches to decompose the gross trade flows into origins of value-added, were a significant milestone in the analysis of GVCs, and then statistics and methodologies based on trade in value-added approach have become more and more comprehensive. To discover the track of value-added trade flows, substantial efforts have been dedicated to combining information from customs offices with the national Input-Output tables to compile the global Input-Output tables (Banga, 2014; Antràs, 2020; World Bank Group, 2020). As stated in OECD (2021b), the national Input-Output Tables are used to display the connections between domestic industries and the final demand categories such as households, government, investment, exports, and inventory changes. On the other hand, the consumption of finished goods imports and the use of imported intermediate items to produce goods and services can also been illustrated by the national Input-Output tables. There are a number of world Input-Output tables used in research, and the more extensively applied can be the Organisation for Economic Cooperation and Development (OECD) TiVA database, the Eora Supply Chain (the Eora MRIO) database and World Input-Output Database (WIOD) (shown in Table 2.2). As these statistics are currently accessible, researchers' attention is turning to measuring how GVCs participation affects countries' economic performances (Ignatenko, Raei & Mircheva, 2019).

Table 2.2

The Three Main Value-added Based Databases

Database	Content
OECD TiVA	The 2021 edition of the OECD TiVA database includes data on 66 economies from 1995 to 2018. TiVA indicators are figured out using OECD Inter-Country Input-Output (ICIO) table (OECD, 2021a).
Eora MRIO	The data of 190 nations and 15,909 sectors from 1990 to 2021 is represented in a balanced global multi-region input-output (MRIO) table (Eora, 2023).
WIOD	43 countries and a model for rest of the world are included the World Input-Output Tables for the reference period from 2000 to 2014 (University of Groningen, 2016).

Source: Summarized by the Author

According to World Bank Group (2020), the global Input-Output tables can be contributed to derive alternative metrics for evaluating the integration of GVCs for diverse economies and industries. It also argues that the natural approach for the degree of GVCs participation is the proportion of GVC trade of the gross trade flows that cross a minimum of two borders, and proposes two components to measure the GVC participation, which are the Forward GVCs participation and the Backward GVCs participation (the further explanations of them are provided in the section 2.3.2). On the other hand, the method of global Input-Output tables based on aggregated input-output statistics also involves certain noticeable deficiencies, due to the rough divisions of sectors and the large number of assumptions imposed by the researchers when constructing the tables (Antràs, 2020; World Bank Group, 2020). However, despite not perfect, the global Input-Output tables are still considered to be one of the most effective research techniques in existence and are widely utilized in the measurement of GVCs participation (Banga, 2014; Mehta, 2018; Montalbano et al., 2018; Ignatenko, Raei & Mircheva, 2019; World Bank Group, 2020; Mallick & Zhang, 2022). Therefore, this dissertation also decides to use the global Input-Output method for analysing, and selects the statistics from OECD TiVA database that has been extensively adopted in terms of policy-oriented studies (Amador & Cabral, 2016). Further discussions about the detailed measure approach will be provided in the following part.

2.3.2 The Forward and Backward Global Value Chains Participation

In this part, the thesis will introduce the conceptions and implications of the Forward GVC participation and the Backward GVC participation.

As argued in Ignatenko, Raei and Mircheva (2019), the export process can be decomposed into various segments by the trade in value added theory, and the thesis summarises this view more clearly in Figure 2.2, in which the Forward GVC linkage and the Backward linkage are labelled. What's more, Table 2.3 shows that definitions of Forward GVC participation and Backward GVC participation from OECD TiVA Database. Regarding essential indicators of measuring the value added in the method of global input-output tables, both the Forward GVC participation and the Backward GVC participation are frequently selected to analyse the integration of GVC (Banga, 2014; Montalbano et al., 2018; Ignatenko, Raei & Mircheva, 2019; Mallick & Zhang, 2022).

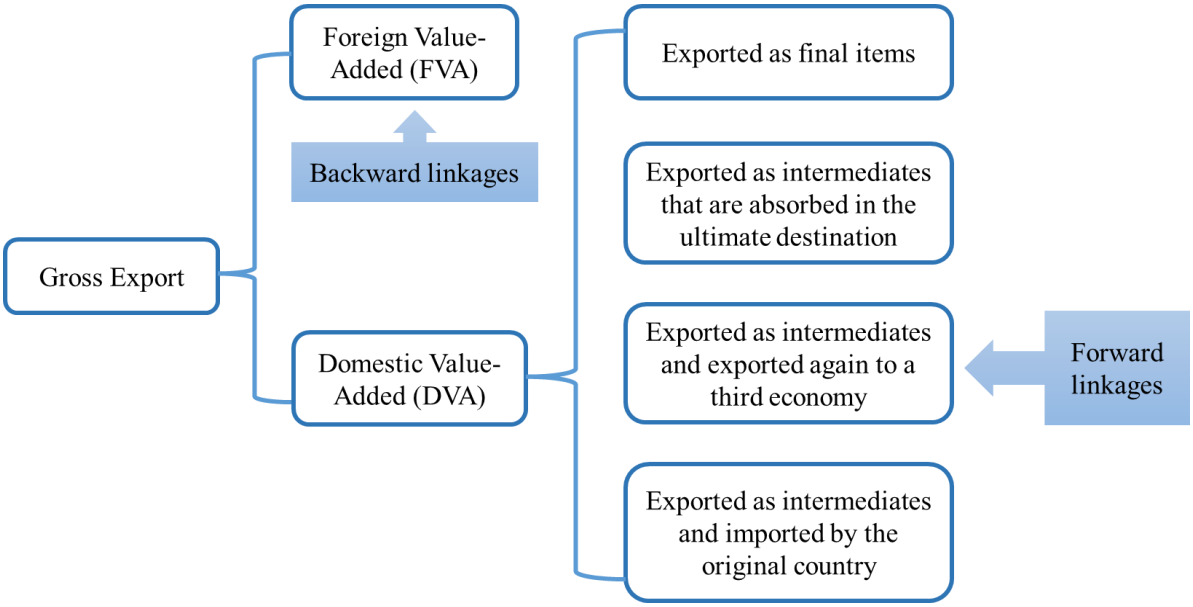


Figure 2.2 Gross exports are broken down into value-added exports

Source: Based on Ignatenko, Raei and Mircheva (2019), summarized by the Author

Table 2.3

OECD TiVA Database's Indicators for Forward and Backward Participation in GVCs (TiVA 2021 version)

Indicator code	Indicator label
FEXDVApSH	Forward participation in GVCs: Domestic Value-Added embodied in intermediate exports, which will be re-exported to third countries later, as % of total gross exports of the source country
DEXFVApSH	Backward participation in GVCs: Foreign Value-Added embodied in exports, as % of total gross exports of the exporting country

Source: OECD TiVA Database

The Forward GVC participation and the Backward GVC participation can also be regarded as signals for an economy's industries statement to some extent. According to Banga (2014) and OECD (2021b), the country with a high level of Forward participation may occupy a relatively upstream position in the global value chain, as its exports can be integrated as inputs into other countries' exports, which are in turn exported to their final destination. For instance, as shown in Figure 2.3 and Figure 2.4, Russia Federation has a relatively high ratio of the Forward GVC participation to the Backward GVC participation (the average value of 1995-2018 is 1.40), and raw materials such as minerals constitute more than 50% of its exports in 2018. On the other hand, the Backward GVC participation may indicate a downstream location, in which the country's exports are closer to the final products and

contain plenty of intermediate items imported from other economies. The Czech Republic with a lower ratio of the Forward GVC participation to the Backward GVC participation (the mean of 1995-2018 is 0.53) can be used as an example of a country situated in the downstream of GVC, and machinery and electronics sectors account for a large proportion of its international trade. Table 2.4 exhibits the top five products of import and export in Czech's machinery industry, in which we can observe that the intermediate items account for a larger proportion of its imports, while its export sector involves a higher share of final goods.

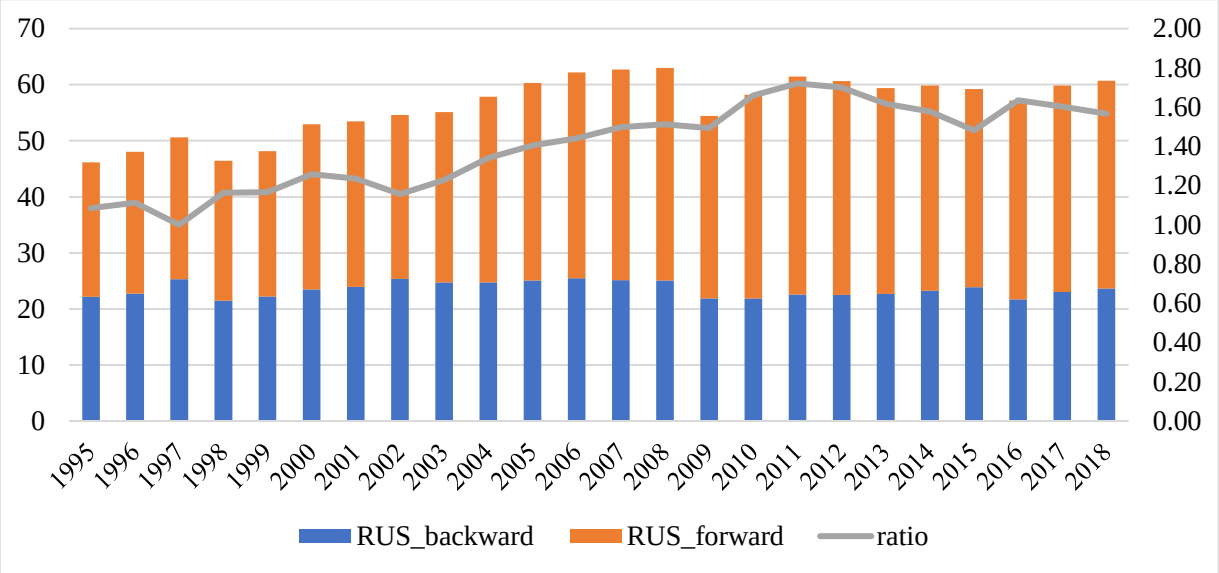


Figure 2.3 Comparison of Russian Federation's Forward and Backward GVC Participation

Source: OECD TiVA Database, summarized by the Author

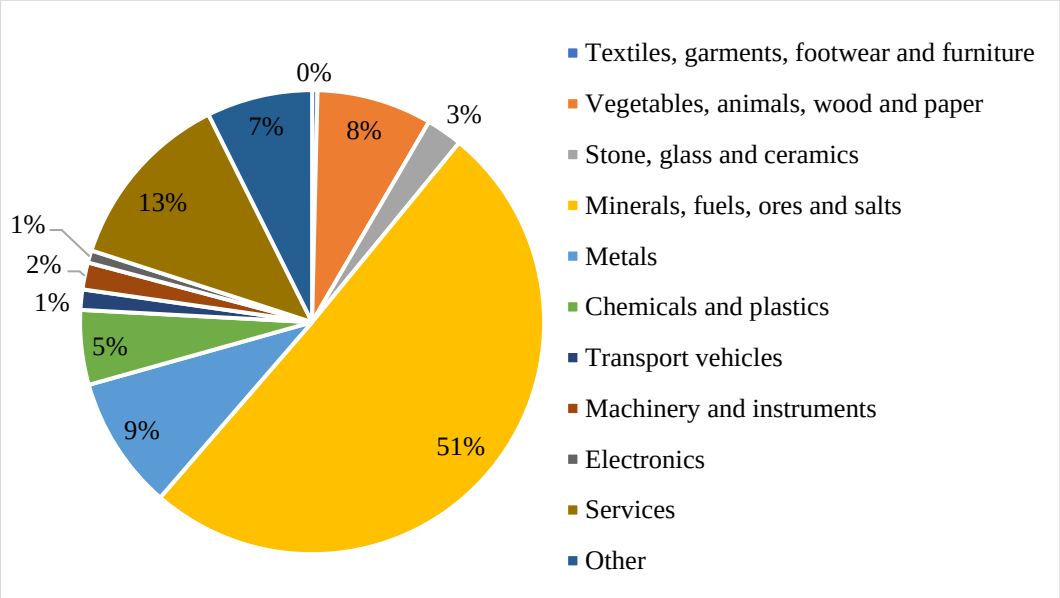


Figure 2.4 The Export Structure of Russian Federation in 2018

Source: Atlas of Economic Complexity (ATLAS), summarized by the Author

Table 2.4

Top 5 Import and Export Products in Czech Republic's Machinery Sector

Import	Proportion	Export	Proportion
Parts and accessories for office machines	17.15%	Computers	20.92%
Computers	9.31%	Parts and accessories for office machines	8.55%
Spark-ignition reciprocating internal combustion piston engines	3.69%	Toys	5.26%
Compression-ignition internal combustion piston engines	3.60%	Pumps for liquids	4.97%
Pumps for liquids	3.48%	Centrifuges	4.01%

Source: Atlas of Economic Complexity (ATLAS), summarized by the Author

2.4. The Relationship between Global Value Chains Participation and Domestic Productivity

At the end of the literature review, the thesis will briefly introduce the relevant studies on the relationship between GVCs participation and domestic productivity.

There are numerous studies that have concluded that the increasing of GVCs participation can exert positive effects on domestic productivity. From a theoretical perspective, Aghion and Howitt (2009) argue that the competition effects of GVCs participation can filter out the outstanding domestic businesses and eliminate the laggards to some extent, which can be contributed to enhancing the efficiency of production. This view is supported by Criscuolo and Timmis (2017). They also confirm the positive impacts of foreign competition to some extent, and also suggest that through participating in GVCs, firms can become more proficient in their core tasks that can contribute to facilitating the productivity growth. In addition, according to Ignatenko, Raei and Mircheva (2019), by participating in GVCs, local businesses can improve their access to information, explore new markets, and gain opportunities for rapid technology learning and skill development, which are vital factors for productivity improvements. For the studies of the specific economies or industries, Gunnella, Fidora and Schmitz (2017) conduct the research on euro area and indicate that GVCs participants can gain from absorbing parent companies' more advanced technologies or management experiences, which may ultimately promote the upgrading of capital and improve their domestic productivity. What's more, the research of Constantinescu, Matto and Ruta (2017), involving the statistics of thirteen sectors in forty countries from 1995 to 2009, performs panel analysis methods and argues that there is a positive relationship between GVC participation and the growth of labour productivity. More recent studies include

Wiryawan et al. (2022), which explores the statistics of thirty-seven developing countries and concludes that GVCs participation can contribute to the upgrading of manufacturing in these countries and thus increase productivity. Furthermore, some scholars have also carried out studies depended on firm-level data. Ge et.al (2018) select the entropy balance method to analyse whether GVCs participation can promote the productivity of local enterprises with China's firm-level statistics from 2000 to 2007, and then argue that integration of GVCs can significantly improve China's manufacturing companies' productivity. Similarly, Benkovskis et.al (2019) utilize the firm-level data of Estonia and Latvia to analyse the export and productivity in GVCs, which reveals that firms in GVCs can increase productivity through the knowledge spillovers.

However, this theme has not been researched throughout and the results of GVCs' effects on domestic productivity are mixed due to distinct methodologies and sample statistics. This point is already mentioned in the Introduction section (see Page 9), and the studies that have been shown are not repeated in this part. In addition, some academics are also concerned that the unequally distributions of GVCs' diverse segments (shown in Figure 2.5)may hinder the productivity growth in developing nations, for example, countries in various segments of GVCs have differential value added in the production and distribution process, while developing economies are most often in the lower value added segment (Banga, 2014; Grimes & Sun, 2016; World Bank Report, 2020). Such an uneven distribution may further aggravate the gap between developing countries and developed countries, as a result the emerging economies may fall in the "middle income trap[2]" after a rapid but brief economy growth (Banga, 2014; Grimes & Sun, 2016; Doner & Schneiders, 2016).

In summary, as the methodology for measuring GVCs participation and revenue distribution is not well established yet, and selections of samples are variously, it still requires to explore that whether the participants can gain benefits through GVCs, such as increased competitiveness and technological upgrading, and ultimately boost the domestic productivity. On the other hand, despite the situations of countries or industries are diverse to some extent, majority of existing studies indicate a positive relationship between GVCs participation and productivity growth, and most of them are considered as relatively influential academic

[2] Referring to a condition, in which a country has reached a certain income level due to certain factors, such as lower labour costs, but stays at that economic level. A country in the middle-income trap loses the competitiveness of its exports due to rising wages and is unable to compete with other countries that produce at low cost, and cannot enter the high value added markets as well as the developed economies (Doner & Schneiders, 2016).

articles. Therefore, the thesis tends to suppose that the integration of GVCs can contribute to the development of productivity.

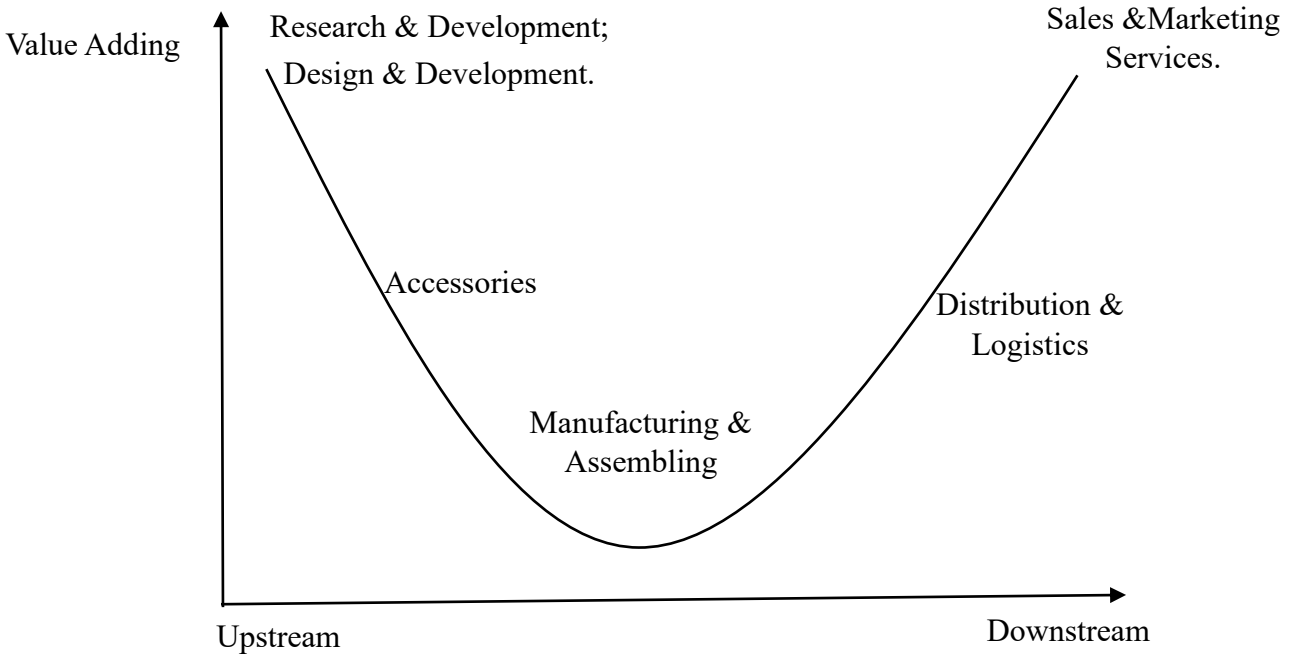


Figure 2.5 The uneven distribution of value-added in Global Value Chains
Source: based on Banga (2014) and Grimes and Sun (2016), summarized by the Author

3. Research Methods and Regression Models

After a brief introduction to the dissertation's theme and some principal contemporary studies, this section will provide a description of the research methodology and regression model of this thesis. For performing the empirical analysis on the relationship between GVC participation and domestic productivity, the thesis primarily refers to the research of Montalbano et.al. (2018), Wiryawan et al. (2022) and Mallick and Zhang (2022).

As this thesis adopts data for twelve CEE countries from 1995 to 2018, it was decided to use the panel Fixed-Effect method for assessment (Wiryawan et al., 2022), which implies that the data for *n* different entities is applied, and each entity is observed at *T* distinct times, in accordance with the accepted methodologies in this area (Stock & Watson, 2020, p. 52). To some extent, panel data can help solve the problem of omitted variable bias, which often occurs due to subtle individual differences or heterogeneity. Additionally, it provides more insight into the dynamic behaviors of individuals.

Initially, to determine if the panel data is stationary or not, the Levin-Lin-Chu (LLC) test will first be performed (Joo & Shawl, 2021). Secondly, using the Chow F-test, Breusch-Pagan Lagrange Multiplier (LM) test, and Hausman test, we discuss the fixed-effects (FE), pooled ordinary least squares (OLS), and random-effects (RE) models. Based on our analysis, we have determined that the FE model is the most appropriate approach. And then, for the FE model, the heteroscedasticity, autocorrelation and cross-sectional dependence will be examinate in the section of diagnostic testing. Finally, the Feasible Generalized Least Squares (FGLS) model is ultimately determined to be the most suitable one for this dissertation, and interpretations for the outputs of the regression are subsequently expressed. For every test, we adopt a 5% significance level that indicate to tolerate a 5% possibility of incorrectly rejecting the true null hypothesis and utilize Stata17.0 as the statistical analysis software.

There is a snapshot of the regression variables. Firstly, according to Montalbano et.al. (2018) and Mallick and Zhang (2022), the thesis selects the Total Factor Productivity (TFP) as the dependent variable to express the variation of domestic productivity. Secondly, the indicators of Forward GVC participation and Backward GVC participation are used to measure the integration of GVC participation, and then the ratio of Forward to Backward GVC linkages written as rgvcfb can indicate the country's position in GVCs[3] (Montalbano et.al., 2018; Ignatenko, Raei & Mircheva, 2019; Wiryawan et al., 2022; Mallick & Zhang, 2022). Finally, the control variables should at least include the human capital, innovation, foreign direct investment (FDI) and inflation that can influence the TFP significantly (Antràs, 2020; Joo & Shawl, 2021; Mallick & Zhang, 2022).

As Stock and Watson (2020, p.371) proposed, the population regression models for this thesis are constructed as follows. The thesis investigates the effects of Forward GVC participation, Backward GVC participation and the country's position in GVCs (locating upstream or downstream) on TFP separately.

$$tfp_{it} = \beta_0 + \beta_1 fdi_{it} + \beta_2 humancapital_{it} + \beta_3 difinnovation_{it} + \beta_4 inflation_{it} + \beta_5 gvcforward_{it} + \beta_8 Z_i + \beta_9 S_t + \mu_{it} \quad (1)$$

$$tfp_{it} = \beta_0 + \beta_1 fdi_{it} + \beta_2 humancapital_{it} + \beta_3 difinnovation_{it} + \beta_4 inflation_{it} + \beta_5 gvcbackward_{it} + \beta_6 Z_i + \beta_7 S_t + \mu_{it} \quad (2)$$

[3] According to Montalbano et.al. (2018), the ratio of Forward GVC participation to Backward GVC participation being greater than one can indicate that the economy locates at upstream in the GVC, while a ratio being smaller than one means a downstream position.

$$tfp_{it} = \beta_0 + \beta_1 fdi_{it} + \beta_2 humancapital_{it} + \beta_3 difinnovation_{it} + \beta_4 inflation_{it} + \beta_5 rgvcfb_{it} + \beta_6 Z_i + \beta_7 S_t + \mu_{it} \quad (3)$$

Slopes are from β_1 to β_7, and the intercept is symbolized by β_0. Considering the subscripts, *i* is applied to distinguish the countries, and *t* stands for different years. The unobserved effects presented by Z_i include factors that may be not influenced by time variations but can affect the *tfp* in the i^{th} country. Similarly, the S_t expresses the unobserved effects that can vary over time but be constant across entities. What's more, μ_{it} is the error term. In the following section, more comprehensive explanations for the observed variables will be indicated.

4. Data Description

4.1 Explanations of Data Source and Variables

The dissertation applies annual statistics from the Penn World Table version 10.01 (PWT 10.01), Organisation for Economic Co-operation and Development (OECD) TiVA database and World Bank Open Data for twelve CEE countries, involving Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Russian Federation, Slovak Republic and Slovenia. In addition, the reference period is from 1995 to 2018, because the value-added data in OECD TiVA database is currently updated to 2018. The time range allows for a benefit of the thesis, in which the empirical analysis is not affected by the Covid-2019 epidemic of recent years.

There are three types of variables in our dataset (exhibited in Table 4.1). Firstly, *Countrycode, countryid* and *countryname* are identifier variables using to identify the twelve different countries, while *year* stands for the time series from 1995 to 2018. Therefore, in this panel dataset, twelve entities (n) and twenty-four time periods (T). Secondly, according to Solow (1957), Burda and Severgnini (2009) and Silaghi and Alexa (2015), TFP, a significant indicator of countries' productivity level, can be explained as an upgrade in technology or factor efficiency, and its steady enhancement is essential to economic growth. What's more, the thesis also refers to Mallick and Zhang (2022) that analyses the effects of GVC participation on Asian countries' productivity growth expressed by the TFP. Therefore, the indicator "Total Factor Productivity at constant national prices (2017=1)" from Penn World Table 10.01 (Gouma, Inklaar & Marapin, 2023) is selected as the dependent variable to imply the development of domestic productivity and it is symbolized as *tfp* in this thesis. Finally,

there are also eight independent variables in the regression analysis. For the variables of GVCs participation, we choose Forward participation indicator and Backward participation indicator from OECD TiVA database to measure each country's degree of GVCs participation, which are donated as *gvcforward* and *gvcbackward* respectively (Mallick & Zhang, 2022; Montalbano et al., 2018). In addition, the *rgvcfb* variable, formed by the ratio of *gvcforward* to *gvcbackward*, is the indicator of GVC position, in which a greater than one value means the country's upstream position in GVCs (Banga, 2014; Montalbano et al., 2018).

In following analysis, we will perform regressions with *gvcforward*, *gvcbackward* and *rgvcfb* respectively, which can contribute to obtain more detailed conclusions. What's more, for control variables, the thesis primarily involves indicators of human capital (*humancapital*), innovation (*innovation* and *difinnovation*), foreign direct investment (*fdi*) and macro stability (*inflation*), which are considered to be significant to TFP's development (Antràs, 2020; Joo & Shawl, 2021; Mallick & Zhang, 2022)

Table 4.1

Explanations of Variables and Data Sources

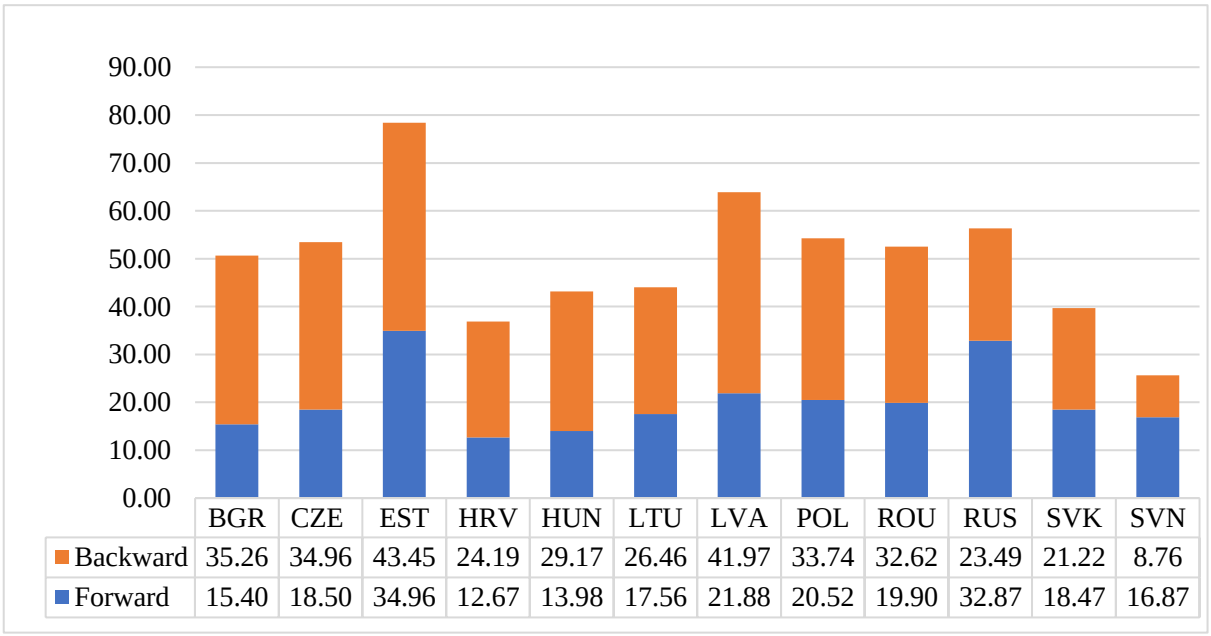
Variable name	Variable definition	Variable data source
Identifier variables		
countrycode	3-letter ISO country code.	
countryname	Country name.	
currencyid	Numbering of countries.	
year	Year.	
Dependent variable		
tfp	Total Factor Productivity at constant national prices (2017=1).	Penn World Table version 10.01
Independent variables		
humancapital	Human capital index, based on years of schooling and returns to education.	Penn World Table version 10.01
fdi	Foreign direct investment, net inflows (% of GDP).	World Bank Open data
innovation	Patent applications, residents, per 100,000 people.	Calculated by World Bank Open data
difinnovation	First-order differential of innovation variable.	Calculated by World Bank Open data
inflation	Annual change rate of Consumer Price Index (CPI)	World Bank Open data

gvcforward	Forward participation in GVCs: Domestic value-added included in foreign exports as a percentage of gross exports, by foreign exporting country.	OECD TiVA database
gvcbackward	Backward participation in GVCs: Foreign value-added embodied in exports, as a percentage of total gross exports of the exporting country.	OECD TiVA database
rgvcfb	The ratio of forward participation to backward participation.	Calculated by OECD TiVA database

Source: Summarized by the Author

4.2 Descriptive Statistics

Before using the econometric software to analysis, let us view the integration of GVC participation of these sample countries through graphs. As exhibited in Figure 4.1, it can be seen that almost all of these countries have a Backward GVC participation greater than the Forward GVC participation, while only the Russian Federation and Slovenia have a larger Forward GVC participation. Additionally, Figure 4.2 compare the average Forward GVC participation of these countries and the rest of world, and in a similar way, Figure 4.3 shows the disparity of Backward GVC participation between the mean of sample countries and other economies in the worldwide. Based on these figures, roughly speaking, CEE countries are more likely to participate in GVC through backward linkages.



	BGR	CZE	EST	HRV	HUN	LTU	LVA	POL	ROU	RUS	SVK	SVN
Backward	35.26	34.96	43.45	24.19	29.17	26.46	41.97	33.74	32.62	23.49	21.22	8.76
Forward	15.40	18.50	34.96	12.67	13.98	17.56	21.88	20.52	19.90	32.87	18.47	16.87

Figure 4.1 Countries' Proportion of the Forward and the Backward GVCs Participation (Average value of 1998 to 2018)

Source: OECD TiVA Database, summarized by the Author

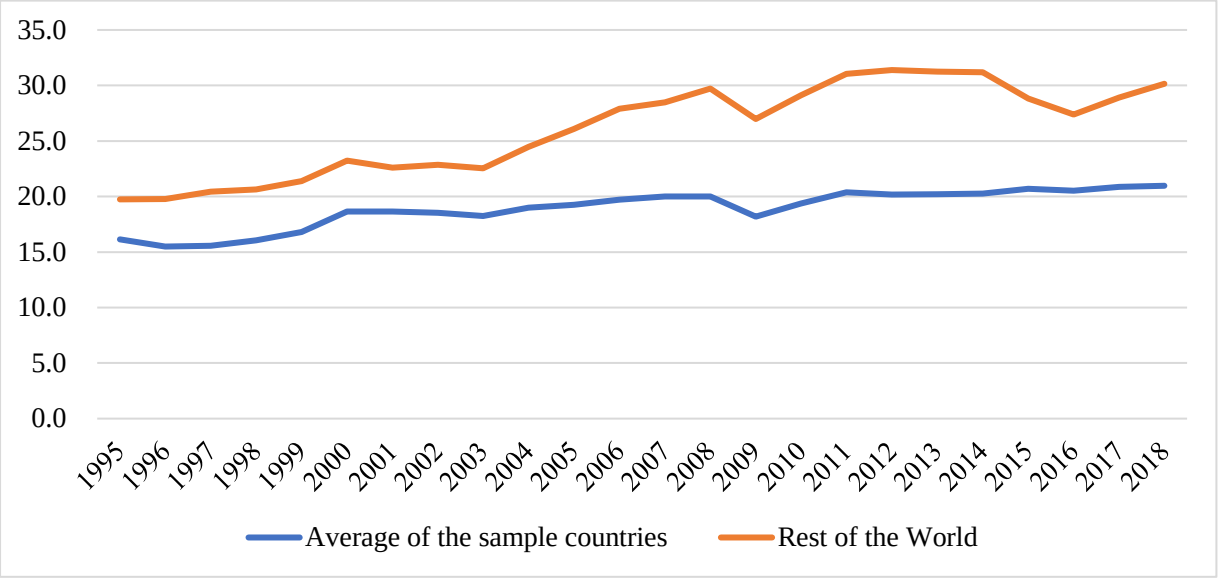


Figure 4.2 Sample Countries' Average Forward GVC Participation Comparing to Rest of the World

Source: OECD TiVA Database, summarized by the Author

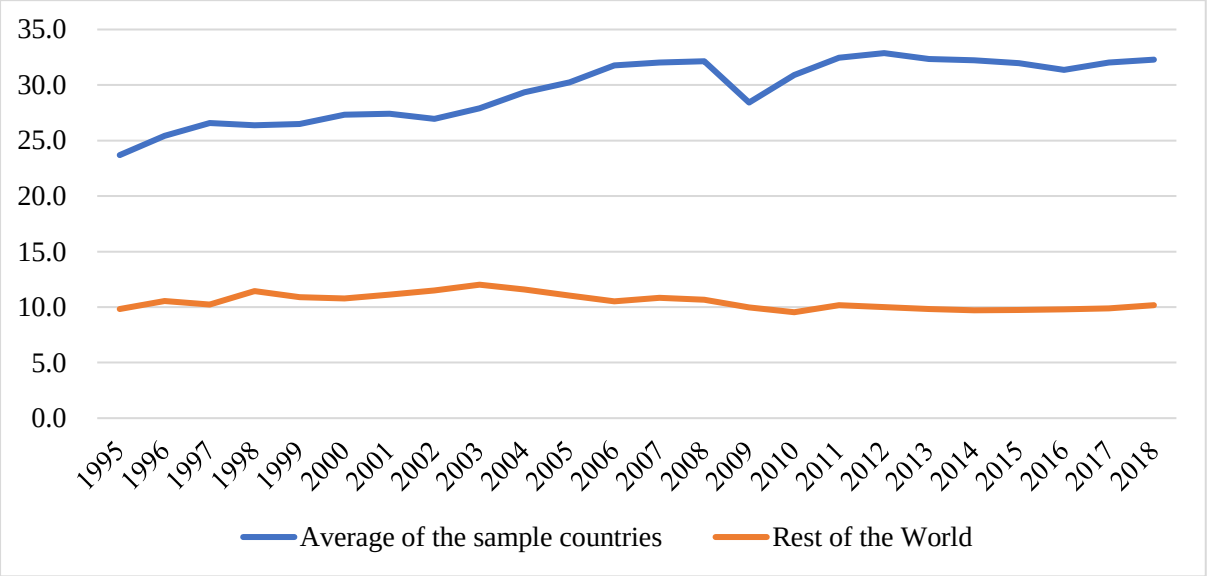


Figure 4.3 Sample Countries' Average Backward GVC Participation Comparing to Rest of the World

Source: OECD TiVA Database, summarized by the Author

When doing analysis in Stata, Table 4.2 shows the observations classified by variables and presents the means, standard deviations, maximum and minimum of the variables incorporated in the analysis. The large extreme and standard deviations of certain variables may imply that there is considerable heterogeneity in the observations, i.e. that some economies may perform more abnormally or remarkably in particular years due to specific

causes. In addition, the mean of *gvcforward* is smaller than *gvcbackward*'s, and the ratio of forward GVC participation to backward GVC participation is about 0.75, which indicate that considering CEE countries may relatively locate in the downstream of GVCs. The values of GVC participation indicators are also consistent with Figure 4.1 to Figure 4.3.

Table 4.3 and Table 4.4 group the dependent and GVC participation variables by years and entities separately, along with their means and medians. In Table 4.3, the means and medians of *gvcforward* and *gvcbackward* reveal that the integration of GVC participation in these twelve CEE countries has increased over time, regardless of whether it is forward or backward participation. In addition, *rgvcfb* also shows a fluctuating upward trend, implying that forward GVC participation has grown faster than backward GVC participation in these economies during the reference period. In addition, the *tfp* also shows an increasing trend that is similar to GVC participation indicators. Therefore, we add *gvcforward* and *gvcbackward* as *totalgvc* to do a simple regression with *tfp*, which may be contributed to obtain provisional conjecture of the relationship between GVC participation and productivity. Furthermore, in Table 4.4, we can observe that these indicators distinctly differ between countries, for example, the mean value of backward participation in Slovenia is only 8.76, while in Estonia it is at a high level of 43.45.

From the preliminary description of the statistics, we can infer that there may be certain temporal and national heterogeneity in these statistics. Therefore, panel data analysis is applied for further empirical research, in which the existing of heterogeneity or outlier may not cause severe problems.

Table 4.2

Descriptive Statistics of the Variables

Variable	Obs	Mean	Std. dev.	Min	Max
countryid	288	6.5	3.458061	1	12
year	288	2006.5	6.934236	1995	2018
tfp	288	0.910965	0.12228	0.588291	1.382275
innovation	288	208.892	387.6354	13.14545	1483.758
humancapital	288	3.214404	0.247717	2.720516	3.821207
inflation	288	12.14038	64.62896	-1.5448	1058.374
gvcforward	288	18.91009	5.403913	10.175	38.844
gvcbackward	288	29.60747	10.01155	7.285	48.895
rgvcfb	288	0.754196	0.454203	0.367131	2.329012

Source: Calculated by the Author, with Stata

Table 4.3

Grouping tfp and GVC Indicators by Years

year	N	Mean (*tfp*)	Median (*tfp*)	Mean (*gvcforward*)	Median (*gvcforward*)	Mean (*gvcbackward*)	Median (*gvcbackward*)	Mean (*rgvcfb*)	Median (*rgvcfb*)
1995	12	0.7776	0.7533	16.1432	15.4415	23.6898	23.3950	0.7493	0.6588
1996	12	0.8000	0.7709	15.4937	14.8700	25.4370	26.4185	0.6973	0.5523
1997	12	0.7997	0.7670	15.5741	15.1780	26.5653	26.0445	0.6675	0.5415
1998	12	0.8066	0.7642	16.0642	16.1880	26.3683	25.5380	0.6876	0.5726
1999	12	0.7980	0.7631	16.8038	16.5970	26.4996	25.7425	0.6960	0.5784
2000	12	0.8215	0.7947	18.6485	19.2265	27.3246	26.6935	0.7698	0.6304
2001	12	0.8413	0.8217	18.6502	19.3155	27.4118	27.1020	0.7724	0.6257
2002	12	0.8660	0.8353	18.5463	18.9465	26.9495	25.3785	0.7724	0.6231
2003	12	0.8921	0.8628	18.2589	18.5015	27.8959	26.9560	0.7371	0.6225
2004	12	0.9177	0.8848	19.0086	19.2970	29.3418	29.1705	0.7569	0.6080
2005	12	0.9444	0.9073	19.2514	18.8915	30.2522	31.3355	0.7554	0.5745
2006	12	0.9721	0.9430	19.7294	18.7945	31.7753	32.9845	0.7483	0.5631
2007	12	0.9940	0.9846	20.0177	19.4015	32.0389	31.9180	0.7547	0.5358
2008	12	0.9802	0.9642	19.9953	19.1635	32.1422	33.6570	0.7447	0.5631
2009	12	0.9249	0.9200	18.1739	17.5765	28.4376	28.6195	0.7455	0.5842
2010	12	0.9370	0.9540	19.3684	18.1605	30.9081	31.7830	0.7640	0.5724
2011	12	0.9536	0.9595	20.3917	19.0115	32.4703	33.3815	0.7825	0.5656
2012	12	0.9546	0.9668	20.1763	18.9220	32.8761	33.9890	0.7717	0.5458
2013	12	0.9555	0.9634	20.2122	19.3695	32.3345	32.9485	0.7838	0.5698
2014	12	0.9592	0.9644	20.2610	19.2335	32.2245	32.5255	0.7723	0.5768
2015	12	0.9694	0.9688	20.6968	20.0575	31.9603	32.6700	0.7852	0.6016
2016	12	0.9782	0.9766	20.5313	19.9505	31.3745	32.1840	0.7941	0.6257
2017	12	1.0000	1.0000	20.8774	19.9710	32.0183	32.9530	0.7949	0.5999
2018	12	1.0196	1.0177	20.9678	19.7965	32.2829	33.1930	0.7972	0.5906
Total	288	0.9110	0.9413	18.9101	18.5885	29.6075	29.7175	0.7542	0.5801

Source: Calculated by the Author, with Stata

Table 4.4

Grouping tfp and GVC Indicators by Years by Countries

Country code	N	Mean (*tfp*)	Median (*tfp*)	Mean (*gvcforward*)	Median (*gvcforward*)	Mean (*gvcbackward*)	Median (*gvcbackward*)	Mean (*rgvcfb*)	Median (*rgvcfb*)
BGR	24	1.0718	1.0603	15.3958	15.3770	35.2583	37.6640	0.4492	0.4189
CZE	24	0.8814	0.9133	18.5006	18.8265	34.9633	34.6980	0.5317	0.5447
EST	24	0.9024	0.9580	18.3140	18.6460	43.4516	46.1840	0.4274	0.4233
HRV	24	1.0163	1.0051	12.6715	12.7405	24.1909	24.2420	0.5258	0.5494
HUN	24	0.9632	0.9830	13.9810	14.0325	29.1658	29.6725	0.4797	0.4822
LTU	24	0.8554	0.8835	17.5550	18.0445	26.4625	27.9500	0.6663	0.6649
LVA	24	0.8340	0.8687	21.8834	21.9415	41.9722	43.3315	0.5302	0.5239
POL	24	0.9093	0.9280	20.5178	21.0490	33.7423	34.6965	0.6075	0.6125
ROU	24	0.8478	0.8759	19.8958	20.3860	32.6219	33.1360	0.6197	0.6184
RUS	24	0.8674	0.9471	32.8654	35.2745	23.4856	23.3375	1.4021	1.4608

SVK	24	0.8663	0.9032	18.4718	18.6200	21.2158	21.5945	0.8777	0.8485
SVN	24	0.9164	0.9321	16.8689	16.3600	8.7594	8.7220	1.9332	1.9998

Source: Calculated by the Author, with Stata

5. Empirical Process and Results Interpretations

5.1 Provisional Analysis

Let us move on to the preliminary analysis after outlining the research procedures and the characteristics of the data. When conducting econometric research, it is essential to begin by checking the stationarity of the variables. Failure to do so could lead to a spurious regression problem, particularly when a nonstationary process involving the time trend (Wooldridge, 2020, pp. 351-354).

As exhibited in Figure 5.1 and Figure 5.2, it is observed that in most of the countries, the TFP is fluctuating with years and gradually get closer to each other (2017=1), which may indicate a time trend in values of dependent variable. As our dataset has a smaller number of entities (n) than time periods (T), we applied the Levin-Lin-Chu (LLC) test is to detect the existence of a unit root and the results express that the *tfp*, *fdi*, *humancapital*, *gvcforward*, *gvcbackward*, *rgvcfb* and *inflation* are all have a p-value lower than 0.05, so we can conclude that at the 5% significant level, the null hypothesis that the data involves unit roots should be rejected and all these variables are stationary. For innovation with the p-value of 0.87, we calculate its first-order differential and it is named as *difinnovation*. The LLC test is performed for *difinnovation* again, and we obtain a significant result. Therefore, the thesis utilizes *difinnovation* to stand for innovation level to do further studies.

Figure 5.3 illustrates the average TFP in each country from 1995 to 2018, and Figure 5.4 exhibits the mean of TFP in single year (2017=1) calculated by the twelve selected entities. The heterogeneity of dependent variable in the entity and time dimensions are observed in these two graphs separately, in which the development of TFP is obvious along with years, while the fluctuations among countries are relatively smaller. What's more, the TFP suddenly declines around 2008 that can be attributed to the Great Recession, which can also be an example for the effects of macro stability on productivity improvement. The independent variables can also be subjected to the analyses of visual heterogeneity, but their inclusion in this report is not required.

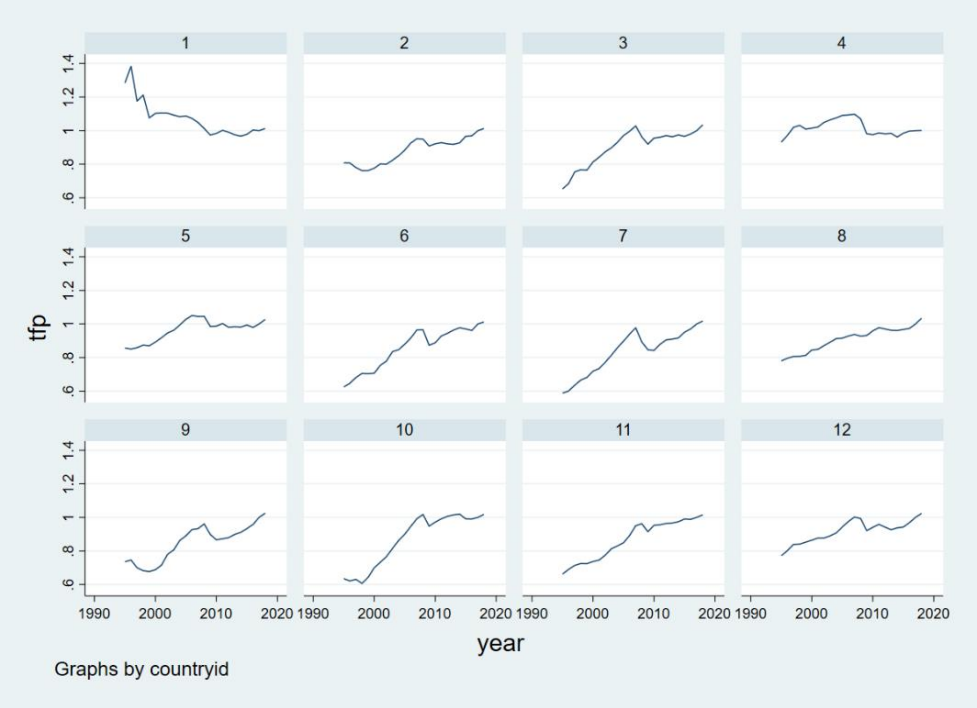


Figure 5.1 The Dependent Variable's Time Properties (separately)

Source: Calculated by the Author, with Stata

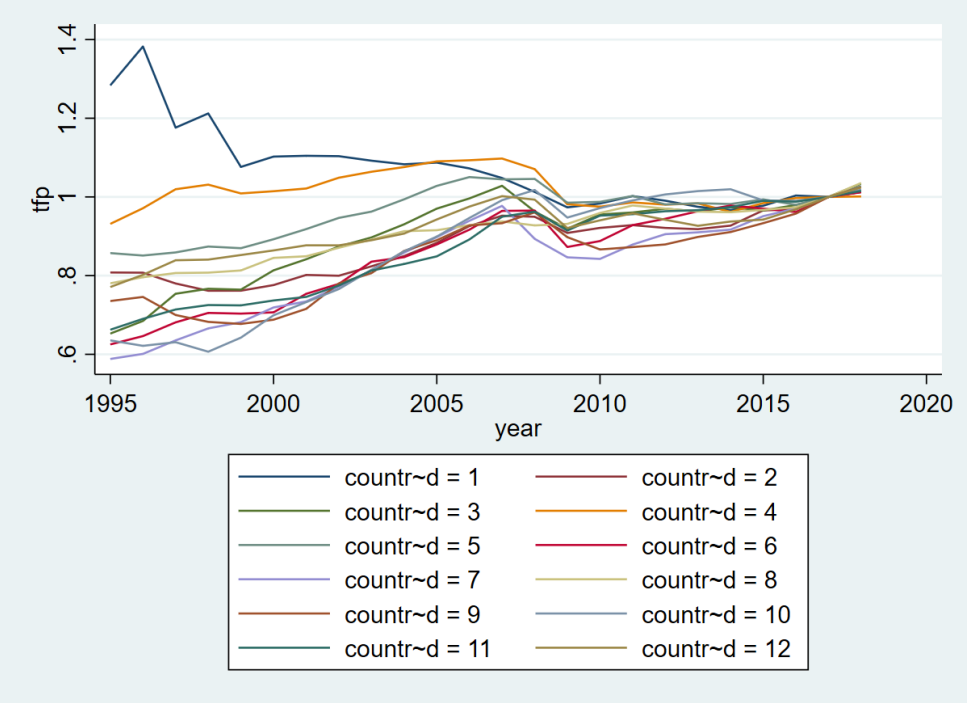


Figure 5.2 The Dependent Variable's Time Properties (overall)

Source: Calculated by the Author, with Stata

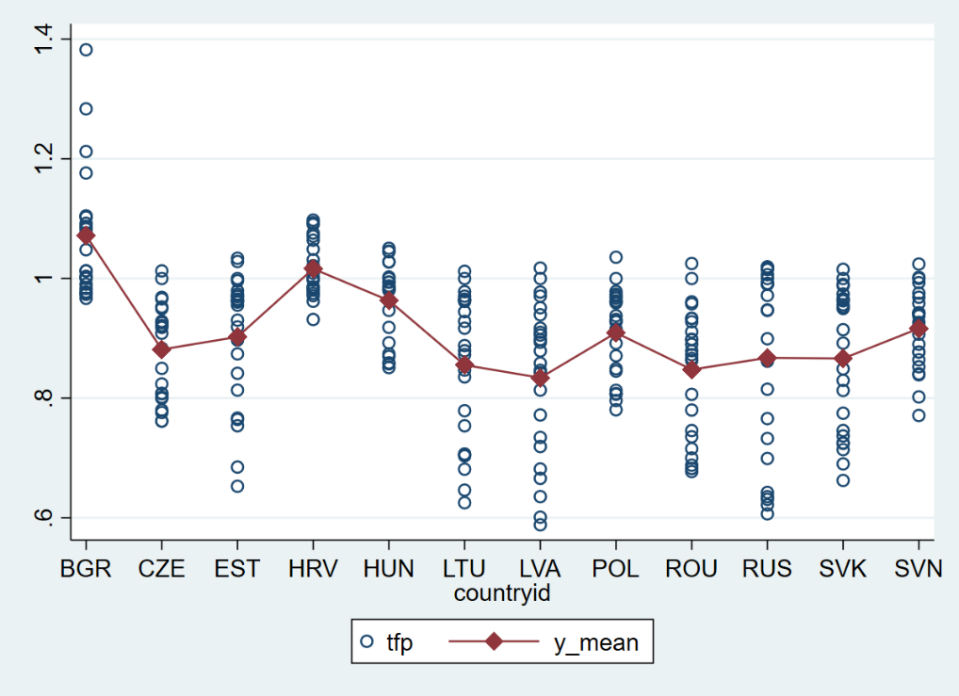


Figure 5.3 Heterogeneity of Total Factor Productivity across Entities

Source: Calculated by the Author, with Stata

Figure 5.4 Heterogeneity of Total Factor Productivity across Years

Source: Calculated by the Author, with Stata

5.2 Comparisons of Pooled OLS, Fixed Effects and Random Effects Models

In this part, the dissertation will compare the FE model, pooled OLS model and RE model and decide the most appropriate one to apply for further steps.

The FE model can be estimated by two equivalent methods, the first one is within estimator method and the other one is the least squares dummy variable (LSDV) approach. The results of within estimator method for entity effects are exhibited in Table 5.1 in which the regression outputs of the three models are reported together. In the last line, the outcomes of the F-test in all the three regressions (Prob > F = 0.0000) indicate that the null hypothesis that the pooled OLS model is more efficient than the FE model can be rejected at the 5% significant level and fixed effects across economies may be present. On the other hand, the above regression results have also been re-tested using the LSDV method. Due to the space limitations, the outputs of LSDV regression are merely presented in the Appendix, in which almost all dummy variables of countries are significant, supporting the existence of entity fixed effects. Furthermore, the command “testparm _Icountryi*” processed after LSDV approach to examine if all the dummy variables stand for countries are equal to zero, also confirms that the FE model is more suitable. For testing time fixed effects, the thesis performs some similar analyses and null hypotheses are also rejected (the full regression results for within estimator method and LSDV approach can be found in Appendix).

In summary, the above analyses indicate the presence of entity and time fixed effects, therefore, the FE model is superior to the pooled OLS model.

In order to compare the pooled model and the RE model, the thesis conducts the LM test and all the three models’ p-value are equal to zero, which means the rejection of the null hypothesis (see the Appendix). Therefore, we can conclude that the RE model is also more suitable than the pooled OLS model. Furthermore, we require to select the optimal one between the FE model and RE model. The Hausman test, which is an appropriate method to compare the FE model and the RE model, is adopted and its outcomes demonstrate that the FE model is the more preferable one (see the Appendix). As a result, the FE model can be utilized for following research and the thesis requires to apply the Two-way FE model, including both country fixed effects and time fixed effects. What’s more, by contrasting the results of these two methods, we cannot discover any substantial diversities between these two methods, therefore, we decided to select the Within estimator method FE model, which can contribute to avoiding generating too many dummy variables. For reasons of space, the

thesis does not show the outcomes of the Two-way FE model in the content and locates the result table in Appendix.

Table 5.1

Outputs of the Within Estimator Approach for Entity Fixed Effects

Variables	(1)	(2)	(3)
	tfp	tfp	tfp
fdi	.001	.001	.001
	(.001)	(.001)	(.001)
humancapital	.259***	.355***	.398***
	(.037)	(.037)	(.032)
inflation	.0002***	0***	.0002***
	(0)	(0)	(0)
gvcforward	.017***		
	(.003)		
difinnovation	.009**	.017***	.013***
	(.004)	(.004)	(.004)
gvcbackward		.004**	
		(.002)	
rgvcfb			.082
			(.043)
_cons	-.242**	-.344***	-.432***
	(.098)	(.103)	(.102)
Observations	276	276	276
R-squared	.52	.455	.450
Standard errors are in parentheses			
****** p<.01, ** p<.05***			
Prob > F = 0.0000 for all the three regressions			

Source: Calculated by the Author, with Stata

5.3 Diagnostic Tests and the Feasible Generalized Least Squares models

After selecting the optimal model, it still requires performing some diagnostic tests for the model's validity and reliability, and then do certain modifications if necessary.

Firstly, the thesis conducts the Wooldridge test to examinate the autocorrelation problem and the p-value of the test is less than 0.05 in every model (see the Appendix), which implies that

the null hypothesis for no first-order autocorrelation can be rejected. Secondly, to measure the groupwise heteroskedasticity, the modified Wald test can be applied, and the outcomes indicate the heteroscedasticity's existence (see the Appendix). Finally, considering the correlation of the residuals across countries, the Pesaran's test is conducted and the p-values for models of Forward GVC participation, Backward GVC participation and their ratio are 0.0366, 0.0138 and 0.0299 separately (see the Appendix), which can contribute to rejecting the null hypothesis for no cross-sectional dependence of all the three models.

Through above tests, it can be confirmed that the FE model is suffering the troubles of autocorrelation, heteroskedasticity and cross-sectional correlation, which may cause vague and pointless estimation outcomes. To analyse based on the panel data that involves all the three mentioned problems, Reed and Ye (2011) argue that the Feasible Generalized Least Squares (Parks) estimator can be an appropriate model, and it is only adopted in the panel that the T is larger than n. The thesis's panel data is organized by twelve sample countries and twenty-four years, therefore, the FGLS method can be adopted for eventual estimation. The outcomes of the FGLS model for all the three equations are expressed in Table 5.2.

The endogeneity problem, which refers to the potential impact of an unobserved variable on the study's results, should be considered before describing the regression outcomes, and we hold the opinion that endogeneity cannot have significant repercussions in this thesis. The reasons are as follows. Firstly, certain omit variable issues can be resolved by the panel data analysis approach. Secondly, each explanatory variable utilized in the model is chosen after the thorough evaluation of the outstanding research conducted in relevant area. Finally, the issue of endogeneity is not considered as a serious problem that requires essential treatment by many scholars who involve similar independent variables in their research, such as Montalbano et al. (2018) and Mallick and Zhang (2022). Therefore, the thesis believes that the outcomes of the current estimation model can be trustworthy and effective, and there is no requirement to worry about the issue of endogeneity.

Following the econometric process, let us turn to interpretation of the three FGLS models according to Table 5.2. For all the three models, it shows that the effects of FDI and innovation are not significant at the selected significant level. The inflation may cause slight negative influence on TFP development, while human capital can be more contributed to TFP growth relatively. These results are similar to (Mallick & Zhang, 2022)'s study to some extent, while the difference just exists in backward GVC participation, in which they argue

that the FDI can exert a positive effect on TFP but human capital may be not significant in the long run. What's more, the negative effects of inflation also support the guess of TFP's sudden decline in 2008 (shown in Figure 5.4) and confirm the important role of macro stability in productivity improvement.

When it comes to the GVC participation indicators, it reveals that the whatever forward GVC participation or backward GVC participation can influence the TFP positively, while the effects of forward GVC participation (with a 0.003 coefficient) is slightly larger than the backward GVC participation (with a 0.002 coefficient). In other words, when forward GVC participation increases one unit, the TFP is expected to increase 0.003, while for backward GVC participation, this number is merely 0.002. This conclusion is consistent with many current studies in some points, though they use various sample countries and industries statistics (Montalbano et al., 2018; Ignatenko, Raei & Mircheva, 2019; Pahl & Timmer, 2020; Mallick & Zhang, 2022). By contrast, Mallick and Zhang (2022) suggest that only forward GVC participation can promote the TFP in long run (in short run, both of them are insignificant), while the thesis argues that both forward and backward GVC participation have the positive influence. Furthermore, we find that the ratio of Forward to Backward GVC participation is not significant that is different from Montalbano et al. (2018)'s conclusion, in which the empirical outcomes indicate that locating at the upstream position in GVCs can be more beneficial to increase TFP than a downstream position.

To summarize, the dissertation possesses certain similarities with existing literature, which to some extent supports some of the research points and also indirectly demonstrates the validity of the thesis. As for the differences, it may be due to the differential selection of sample data and methodologies, for example, this thesis is based on macro data from CEE countries, while Montalbano et al. (2018) apply the firm-level statistics in case of Latin America.

Table 5.2

Outputs of FGLS Models

Variables	(1)	(2)	(3)
	tfp	tfp	tfp
fdi	0	0	0
	(0)	(0)	(0)
humancapital	.134***	.161***	.164***
	(.022)	(.022)	(.025)
inflation	-.00013***	-.00015***	-.00014***
	(0)	(0)	(0)
gvcforward	.003***		

	(.001)		
difinnovation	0	0	0
	(.001)	(.001)	(.001)
gvcbackward		.002***	
		(0)	
rgvcfb			-.012
			(.007)
_cons	.444***	.345***	.403***
	(.08)	(.074)	(.081)
Observations	276	276	276
Pseudo R^2	.z	.z	.z
Standard errors are in parentheses			
****** p<.01, ** p<.05***			

Source: Calculated by the Author, with Stata

6. Conclusions and Limitations

There has been growing interest in the effects of GVC participation on domestic productivity, however, existing research results are inconsistent, leaving uncertainty about whether there is a positive or negative correlation. Additionally, relevant studies in the case of CEE countries, which are also the primary partners in GVCs, are still scarce relatively. Therefore, the dissertation selects panel data analysis to research the connections between the degree of GVC participation and total factor productivity growth, using the dataset established by twelve CEE countries, including Bulgaria, Czech Republic, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Russian Federation, Slovak Republic and Slovenia, from 1995 to 2018. Through a series of empirical analyses, the valid estimations are figure out by the FGLS model. These outcomes indicate the positive effects of GVC participation and human capital on TFP development and the negative impacts of inflation, but cannot reveal the influence of foreign direct investment and GVC position. Through comparing with the previous research in this field, the thesis suggests that the relationship between TFP and GVC participation can vary significantly due to differences in research methodologies and selected statistics.

There are some policy implications can be concluded from the empirical outputs of the thesis. Firstly, the increasing of GVC participation, whatever forward or backward, can promote TFP, so economies should try to improve their integration of GVC participation. Secondly, the coefficient of humancapital is much higher than GVC participation indicators, which may imply that upgrading the domestic human capital is a more effective contributor to

productivity growth. Finally, the economies should control the inflation at an appropriate level to gain a more stable macro environment, which is also essential to enhance TFP.

Admittedly, this thesis is not perfect and there are still certain limitations in it. Such macro-level studies tend to be primarily a measure of the theory and may cause the invisibility of national and industrial specificities, for example, according to Ignatenko, Raei and Mircheva (2019), they argue that the effects of GVC participation can be significantly different in manufacturing sector and service sector, which indicates that the impact of GVC participation on domestic productivity can be differentiated for distinct industry sectors, and thus requires specific policies. Using merely the country-level data, the findings may be not conducive to guiding sound policy development, therefore we are planning to conduct a more detailed industry or firm-level study in the future, with more diverse research approaches, and put forward more practicable policy suggestions.

Résumé

Käesolevas magistritöös keskendutakse ülemaailmsetes väärtusahelates osalemise mõjule kodumaisele tootlikkusele. Töös tutvustatakse esmalt globaalsete väärtusahelate mõistet ja ajalugu ning seejärel arutletakse üksikasjalikumalt globaalsetes väärtusahelates osalemise mõõtmise üle. Lisaks sellele antakse ülevaade varasematest uuringutest, mis on olulised globaalsetes väärtusahelates osalemise ja kodumaise tootlikkuse vahelise seose analüüsi seisukohast. Magistritöö peamised andmeallikad on OECD TiVA andmebaas, Atlas of Economic Complexity (ATLAS), Penn World Table versioon 10.01 ja Maailmapanga avaandmed. Peamised empiirilises analüüsis kasutatavad muutujad on koguteguritootlikkus (TFP), inimkapital, inflatsioon, välismaised otseinvesteeringud, innovatsiooni tase ja globaalsetes väärtusahelates osalemise näitajad. Analüüsis kasutatud statistika põhineb kaheteistkümnel Kesk- ja Ida-Euroopa riigil aastatel 1995-2018. Töös kasutatakse levinud andmeanalüüsi meetodeid, eelkõige fikseeritud efektidega(FE) regressioonimudeleid. Tulemused näitavad positiivset seost globaalsetes väärtusahelates osalemise ulatuse ja TFP kasvu vahel, samas ei leitud olulisi tõendeid selle kohta, et riikide positsioon globaalsetes väärtusahelates (mõõdetuna allavoolu väärtusahelas ja ülesvoolu väärtusahelas osalemise suhtena) võib mõjutada kodumaist tootlikkust. Käesolevas analüüsis kasutatud andmetega ja

uurimismeetoditega seotud piirangute tõttu oleks soovitav viia tulevikus läbi spetsiifilisem uuring mikrotasandi andmeid kasutades, kaasates seejuures enam tootlikkuse ja väärtusahelates osalemise vahelist seost mõjutavaid tegureid, näiteks kaubanduspoliitikaga seotud näitajad.

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Appendix

Annex 1. Geographical coverage of Trade in Value Added (TiVA 2021 version)

N	Code	Country	N	Code	Country
1	AUS	Australia	35	CHE	Switzerland
2	AUT	Austria	36	TUR	Turkey
3	BEL	Belgium	37	GBR	United Kingdom
4	CAN	Canada	38	USA	United States
5	CHL	Chile	39	ARG	Argentina
6	COL	Colombia	40	BRA	Brazil
7	CRI	Costa Rica	41	BRN	Brunei Darussalam
8	CZE	Czech Republic	42	BGR	Bulgaria
9	DNK	Denmark	43	KHM	Cambodia
10	EST	Estonia	44	CHN	China (People's Republic of)
11	FIN	Finland	45	HRV	Croatia
12	FRA	France	46	CYP	Cyprus
13	DEU	Germany	47	IND	India
14	GRC	Greece	48	IDN	Indonesia
15	HUN	Hungary	49	HKG	Hong Kong, China
16	ISL	Iceland	50	KAZ	Kazakhstan
17	IRL	Ireland	51	LAO	Lao People's Democratic Rep.
18	ISR	Israel	52	MYS	Malaysia
19	ITA	Italy	53	MLT	Malta
20	JPN	Japan	54	MAR	Morocco
21	KOR	Korea	55	MMR	Myanmar
22	LVA	Latvia	56	PER	Peru
23	LTU	Lithuania	57	PHL	Philippines
24	LUX	Luxembourg	58	ROU	Romania
25	MEX	Mexico	59	RUS	Russian Federation
26	NLD	Netherlands	60	SAU	Saudi Arabia
27	NZL	New Zealand	61	SGP	Singapore
28	NOR	Norway	62	ZAF	South Africa
29	POL	Poland	63	TWN	Chinese Taipei
30	PRT	Portugal	64	THA	Thailand
31	SVK	Slovak Republic	65	TUN	Tunisia
32	SVN	Slovenia	66	VNM	Viet Nam
33	ESP	Spain	67	ROW	Rest of the World
34	SWE	Sweden			

Source: OECD TiVA Database

Annex 2. Average of Forward GVC Participation, Backward GVC Participation and Forward to Backward Ratio for the Sample Countries from 1995 to 2018

Country code	gvcforward	gvcbackward	rgvcfb
BGR	15.40	35.26	0.44
CZE	18.50	34.96	0.53
EST	34.96	43.45	0.80
HRV	12.67	24.19	0.52
HUN	13.98	29.17	0.48

LTU	17.56	26.46	0.66
LVA	21.88	41.97	0.52
POL	20.52	33.74	0.61
ROU	19.90	32.62	0.61
RUS	32.87	23.49	1.40
SVK	18.47	21.22	0.87
SVN	16.87	8.76	1.93

Source: OECD TiVA Database, calculated by the Author

Annex 3. Within Estimator Method for Entity Fixed Effects with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.48	.14	0	.002	
humancapital	.259	.037	7.02	0	.187	.332	***
inflation	0	0	3.03	.003	0	0	***
gvcforward	.017	.003	6.49	0	.012	.022	***
difinnovation	.009	.004	2.27	.024	.001	.017	**
Constant	-.242	.098	-2.48	.014	-.434	-.05	**

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.520	Number of obs	276
F-test	56.070	Prob > F	0.000
Akaike crit. (AIC)	-705.206	Bayesian crit. (BIC)	-683.483

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 4. Within Estimator Method for Entity Fixed Effects with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.76	.08	0	.002	*
humancapital	.355	.037	9.52	0	.282	.429	***
inflation	0	0	2.87	.004	0	0	***
gvcbackward	.004	.002	2.51	.013	.001	.007	**
difinnovation	.017	.004	4.07	0	.009	.025	***
Constant	-.344	.103	-3.33	.001	-.547	-.141	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.455	Number of obs	276
F-test	43.237	Prob > F	0.000
Akaike crit. (AIC)	-670.247	Bayesian crit. (BIC)	-648.525

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 5. Within Estimator Method for Entity Fixed Effects with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.95	.052	0	.003	*
humancapital	.398	.031	12.65	0	.336	.46	***
inflation	0	0	2.30	.022	0	0	**
rgvcfb	.082	.043	1.92	.055	-.002	.166	*
difinnovation	.013	.004	2.90	.004	.004	.021	***
Constant	-.432	.102	-4.22	0	-.634	-.23	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.450	Number of obs	276

F-test	42.304	Prob > F	0.000
Akaike crit. (AIC)	-667.524	Bayesian crit. (BIC)	-645.802

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 6. LSDV Method for Entity Fixed Effects with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.95	.052	0	.003	*
humancapital	.398	.031	12.65	0	.336	.46	***
inflation	0	0	2.30	.022	0	0	**
rgvcfb	.082	.043	1.92	.055	-.002	.166	*
difinnovation	.013	.004	2.90	.004	.004	.021	***
countryid : base 1	0	.	.	.	.	.	
2	-.415	.028	-14.92	0	-.47	-.36	***
3	-.301	.025	-12.13	0	-.35	-.252	***
4	-.091	.022	-4.08	0	-.136	-.047	***
5	-.153	.022	-6.90	0	-.197	-.109	***
6	-.224	.024	-9.42	0	-.271	-.177	***
7	-.195	.022	-8.68	0	-.239	-.151	***
8	-.212	.023	-9.13	0	-.257	-.166	***
9	-.216	.024	-9.15	0	-.262	-.169	***
10	-.326	.048	-6.75	0	-.421	-.231	***
11	-.415	.03	-13.63	0	-.475	-.355	***
12	-.391	.067	-5.84	0	-.523	-.259	***
Constant	-.187	.097	-1.93	.055	-.378	.004	*

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.625	Number of obs	276
F-test	26.952	Prob > F	0.000
Akaike crit. (AIC)	-645.524	Bayesian crit. (BIC)	-583.978

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 7. LSDV Method for Entity Fixed Effects with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.76	.08	0	.002	*
humancapital	.355	.037	9.52	0	.282	.429	***
inflation	0	0	2.87	.004	0	0	***
gvcbackward	.004	.002	2.51	.013	.001	.007	**
difinnovation	.017	.004	4.07	0	.009	.025	***
countryid : base 1	0	.	.	.	.	.	
2	-.381	.031	-12.37	0	-.441	-.32	***
3	-.319	.025	-12.82	0	-.367	-.27	***
4	-.036	.03	-1.19	.235	-.095	.023	
5	-.118	.026	-4.56	0	-.169	-.067	***
6	-.17	.026	-6.44	0	-.222	-.118	***
7	-.216	.025	-8.75	0	-.264	-.167	***
8	-.184	.023	-8.00	0	-.23	-.139	***
9	-.187	.023	-8.28	0	-.231	-.142	***
10	-.185	.034	-5.50	0	-.251	-.119	***
11	-.304	.041	-7.34	0	-.386	-.223	***
12	-.151	.054	-2.81	.005	-.256	-.045	***

Constant	-.156	.097	-1.61	.108	-.347	.034	

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.628	Number of obs	276
F-test	27.379	Prob > F	0.000
Akaike crit. (AIC)	-648.247	Bayesian crit. (BIC)	-586.700

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 8. LSDV Method for Entity Fixed Effects with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.48	.14	0	.002	
humancapital	.259	.037	7.02	0	.187	.332	***
inflation	0	0	3.03	.003	0	0	***
gvcforward	.017	.003	6.49	0	.012	.022	***
difinnovation	.009	.004	2.27	.024	.001	.017	**
countryid : base 1	0	.	.	.	.	.	
2	-.376	.027	-14.14	0	-.429	-.324	***
3	-.296	.023	-12.85	0	-.341	-.251	***
4	-.02	.023	-0.85	.396	-.065	.026	
5	-.104	.022	-4.73	0	-.147	-.061	***
6	-.237	.021	-11.23	0	-.279	-.195	***
7	-.302	.027	-11.13	0	-.355	-.248	***
8	-.265	.023	-11.44	0	-.31	-.219	***
9	-.279	.024	-11.64	0	-.327	-.232	***
10	-.519	.048	-10.90	0	-.613	-.425	***
11	-.36	.025	-14.51	0	-.409	-.311	***
12	-.245	.023	-10.74	0	-.29	-.2	***
Constant	.009	.095	0.09	.927	-.178	.196	

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.673	Number of obs	276
F-test	33.262	Prob > F	0.000
Akaike crit. (AIC)	-683.206	Bayesian crit. (BIC)	-621.659

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 9. LSDV Method for Time Fixed Effects with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	0	.001	-0.30	.761	-.001	.001	
humancapital	-.058	.081	-0.72	.473	-.218	.102	
inflation	0	0	4.10	0	0	0	***
gvcforward	.01	.003	3.43	.001	.004	.016	***
difinnovation	.01	.004	2.43	.016	.002	.018	**
1996b	0	.	.	.	.	.	
1997	-.021	.026	-0.79	.43	-.072	.031	
1998	.008	.026	0.30	.762	-.044	.059	
1999	-.005	.027	-0.18	.857	-.058	.048	
2000	.008	.029	0.27	.785	-.049	.065	
2001	.031	.03	1.04	.3	-.028	.089	
2002	.059	.03	1.93	.055	-.001	.118	*
2003	.086	.031	2.80	.006	.025	.146	***
2004	.104	.032	3.24	.001	.041	.168	***
2005	.13	.034	3.89	0	.064	.197	***
2006	.154	.035	4.40	0	.085	.223	***
2007	.174	.037	4.75	0	.102	.246	***
2008	.158	.037	4.27	0	.085	.231	***

2009	.12	.036	3.30	.001	.048	.191	***
2010	.123	.038	3.20	.002	.047	.198	***
2011	.129	.04	3.19	.002	.049	.208	***
2012	.132	.041	3.20	.002	.051	.213	***
2013	.133	.042	3.14	.002	.049	.216	***
2014	.138	.044	3.16	.002	.052	.224	***
2015	.145	.045	3.20	.002	.056	.234	***
2016	.158	.046	3.41	.001	.067	.25	***
2017	.177	.048	3.70	0	.083	.271	***
2018	.197	.049	4.00	0	.1	.294	***
Constant	.817	.248	3.29	.001	.328	1.306	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.627	Number of obs	276
F-test	14.744	Prob > F	0.000
Akaike crit. (AIC)	-730.803	Bayesian crit. (BIC)	-629.432

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 10. LSDV Method for Time Fixed Effects with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	0	.001	-0.31	.758	-.002	.001	
humancapital	-.081	.084	-0.96	.336	-.246	.084	
inflation	0	0	3.92	0	0	0	***
gvcbackward	-.001	.002	-0.88	.382	-.005	.002	
difinnovation	.013	.004	3.15	.002	.005	.021	***
1996b	0	.	.	.	.	.	
1997	-.018	.027	-0.66	.513	-.071	.035	
1998	.016	.027	0.60	.551	-.037	.069	
1999	.012	.027	0.44	.663	-.042	.065	
2000	.046	.028	1.65	.1	-.009	.101	*
2001	.07	.029	2.46	.015	.014	.126	**
2002	.097	.029	3.30	.001	.039	.154	***
2003	.122	.03	4.02	0	.062	.181	***
2004	.15	.032	4.72	0	.087	.213	***
2005	.18	.033	5.40	0	.114	.246	***
2006	.21	.035	6.00	0	.141	.28	***
2007	.234	.037	6.38	0	.162	.306	***
2008	.218	.038	5.81	0	.144	.292	***
2009	.156	.037	4.23	0	.084	.229	***
2010	.175	.039	4.49	0	.098	.252	***
2011	.193	.041	4.71	0	.112	.274	***
2012	.195	.043	4.58	0	.111	.279	***
2013	.196	.044	4.50	0	.11	.282	***
2014	.202	.045	4.51	0	.114	.29	***
2015	.213	.046	4.65	0	.123	.303	***
2016	.225	.047	4.80	0	.133	.317	***
2017	.248	.048	5.14	0	.153	.344	***
2018	.27	.05	5.43	0	.172	.369	***
Constant	1.073	.258	4.16	0	.565	1.582	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.610	Number of obs	276
F-test	13.707	Prob > F	0.000
Akaike crit. (AIC)	-718.359	Bayesian crit. (BIC)	-616.987

*** p<.01, ** p<.05, * p<.1

Source: Calculated by the Author, with Stata

Annex 11. LSDV Method for Time Fixed Effects with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	0	.001	-0.34	.733	-.002	.001	
humancapital	-.065	.084	-0.78	.436	-.23	.099	
inflation	0	0	4.06	0	0	0	***
rgvcfb	.021	.04	0.53	.594	-.057	.1	
difinnovation	.013	.004	3.17	.002	.005	.021	***
1996b	0	.	.	.	.	.	
1997	-.02	.027	-0.73	.468	-.073	.033	
1998	.014	.027	0.53	.595	-.038	.067	
1999	.009	.027	0.35	.73	-.044	.063	
2000	.041	.028	1.44	.15	-.015	.096	
2001	.064	.029	2.22	.027	.007	.121	**
2002	.091	.03	3.07	.002	.033	.149	***
2003	.115	.03	3.82	0	.056	.175	***
2004	.141	.031	4.50	0	.079	.202	***
2005	.169	.032	5.22	0	.105	.233	***
2006	.197	.033	5.92	0	.132	.263	***
2007	.22	.035	6.32	0	.151	.288	***
2008	.204	.035	5.75	0	.134	.274	***
2009	.147	.036	4.03	0	.075	.218	***
2010	.161	.038	4.29	0	.087	.236	***
2011	.177	.039	4.55	0	.1	.254	***
2012	.178	.04	4.44	0	.099	.257	***
2013	.179	.041	4.33	0	.098	.26	***
2014	.185	.043	4.34	0	.101	.268	***
2015	.196	.044	4.47	0	.11	.282	***
2016	.208	.045	4.59	0	.119	.297	***
2017	.23	.047	4.95	0	.139	.322	***
2018	.252	.048	5.25	0	.157	.346	***
Constant	.977	.254	3.85	0	.477	1.478	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.609	Number of obs	276
F-test	13.661	Prob > F	0.000
Akaike crit. (AIC)	-717.799	Bayesian crit. (BIC)	-616.427

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 12. Within Estimator Method for Time Fixed Effects with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	0.93	.356	-.001	.002	
humancapital	-.064	.026	-2.48	.014	-.116	-.013	**
inflation	0	0	4.64	0	0	.001	***
gvcforward	-.005	.001	-4.98	0	-.007	-.003	***
difinnovation	.012	.005	2.68	.008	.003	.022	***
Constant	1.219	.086	14.25	0	1.05	1.387	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.220	Number of obs	276
F-test	14.015	Prob > F	0.000
Akaike crit. (AIC)	-597.167	Bayesian crit. (BIC)	-575.444

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 13. Within Estimator Method for Time Fixed Effects with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.93	.055	0	.003	*
humancapital	-.084	.028	-3.03	.003	-.138	-.029	***
inflation	0	0	4.38	0	0	.001	***
gvcbackward	-.001	.001	-1.96	.052	-.002	0	*
difinnovation	.017	.005	3.64	0	.008	.027	***
Constant	1.215	.095	12.82	0	1.029	1.402	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.155	Number of obs	276
F-test	9.124	Prob > F	0.000
Akaike crit. (AIC)	-575.088	Bayesian crit. (BIC)	-553.366

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 14. Within Estimator Method for Time Fixed Effects with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.34	.183	-.001	.003	
humancapital	-.065	.028	-2.34	.02	-.12	-.01	**
inflation	0	0	4.42	0	0	.001	***
rgvcfb	-.012	.012	-0.97	.333	-.036	.012	
difinnovation	.018	.005	3.70	0	.008	.027	***
Constant	1.134	.089	12.75	0	.959	1.309	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.146	Number of obs	276
F-test	8.451	Prob > F	0.000
Akaike crit. (AIC)	-571.910	Bayesian crit. (BIC)	-550.187

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 15. The Results of Random Effects Model with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.90	.057	0	.004	*
humancapital	.104	.029	3.60	0	.048	.161	***
inflation	0	0	2.08	.037	0	0	**
gvcforward	-.001	.001	-1.14	.254	-.004	.001	
difinnovation	.017	.006	2.90	.004	.005	.028	***
Constant	.603	.093	6.48	0	.421	.786	***

Mean dependent var	0.917	SD dependent var	0.116
Overall r-squared	0.119	Number of obs	276
Chi-square	36.405	Prob > chi2	0.000
R-squared within	0.047	R-squared between	0.652

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 16. The Results of Random Effects Model with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.77	.077	0	.004	*
humancapital	.1	.028	3.52	0	.044	.156	***

inflation	0	0	2.21	.027	0	0	**
gvcbackward	.001	.001	1.56	.118	0	.002	
difinnovation	.018	.006	3.26	.001	.007	.029	***
Constant	.56	.096	5.84	0	.372	.748	***

Mean dependent var	0.917	SD dependent var	0.116
Overall r-squared	0.123	Number of obs	276
Chi-square	37.698	Prob > chi2	0.000
R-squared within	0.022	R-squared between	0.741

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 17. The Results of Random Effects Model with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.77	.077	0	.004	*
humancapital	.107	.029	3.67	0	.05	.164	***
inflation	0	0	2.14	.033	0	0	**
rgvcfb	-.021	.015	-1.39	.163	-.05	.008	
difinnovation	.018	.006	3.17	.002	.007	.029	***
Constant	.585	.093	6.27	0	.402	.768	***

Mean dependent var	0.917	SD dependent var	0.116
Overall r-squared	0.121	Number of obs	276
Chi-square	37.130	Prob > chi2	0.000
R-squared within	0.034	R-squared between	0.697

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 18. LM Test for Random Effects

H_0: variances across entities are zero (pooled model is better
tfp[countryid,t] = Xb + u[countryid] + e[countryid,t] Estimated results:
(gvcforward) Var SD = sqrt (Var)
tfp 0.0133519 0.1155503 e 0.0046408 0.0681231 u 0.003244 0.0569558
Test: Var(u) = 0 chibar2(01) = 354.79 Prob > chibar2 = 0.0000
(gvcbackward) Var SD = sqrt (Var) *tfp* 0.0133519 0.1155503 e 0.0052674 0.072577 u 0.0028709 0.0535811
Test: Var(u) = 0 chibar2(01) = 447.98 Prob > chibar2 = 0.0000
(rgvcfb) Var SD = sqrt (Var) *tfp* 0.0133519 0.1155503 e 0.0053196 0.0729359 u 0.0039066 0.0625032

Test: Var(u) = 0 chibar2(01) = 403.98 Prob > chibar2 = 0.0000

Source: Calculated by the Author, with Stata

Annex 19. Outcomes of Hausman Test

H_0: Difference in coefficients not systematic	
gvcforward	chi2(4) = 42.3 Prob > chi2 = 0.0000
gvcbackward	chi2(4) = 29.14 Prob > chi2 = 0.0000
rgvcfb	chi2(4) = 26.75 Prob > chi2 = 0.0001

Source: Calculated by the Author, with Stata

Annex 20. Two-way FE Model by Within Estimator Method with *gvcforward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	0.93	.356	-.001	.002	
humancapital	-.064	.026	-2.48	.014	-.116	-.013	**
inflation	0	0	4.64	0	0	.001	***
gvcforward	-.005	.001	-4.98	0	-.007	-.003	***
difinnovation	.012	.005	2.68	.008	.003	.022	***
1996b	0	.	.	.	.	.	
1997	-.031	.035	-0.87	.385	-.1	.039	
1998	.016	.035	0.47	.639	-.052	.085	
1999	.015	.035	0.44	.658	-.053	.084	
2000	.058	.035	1.64	.102	-.011	.127	
2001	.082	.035	2.32	.021	.012	.151	**
2002	.108	.035	3.05	.003	.038	.177	***
2003	.131	.035	3.73	0	.062	.2	***
2004	.159	.035	4.50	0	.09	.229	***
2005	.186	.036	5.20	0	.116	.256	***
2006	.216	.036	6.03	0	.146	.287	***
2007	.237	.037	6.45	0	.164	.309	***
2008	.223	.036	6.17	0	.152	.294	***
2009	.164	.035	4.63	0	.094	.234	***
2010	.186	.036	5.21	0	.116	.256	***
2011	.205	.036	5.71	0	.134	.276	***
2012	.205	.036	5.70	0	.134	.276	***
2013	.209	.036	5.77	0	.137	.28	***
2014	.213	.036	5.86	0	.141	.285	***
2015	.229	.036	6.27	0	.157	.301	***
2016	.234	.037	6.34	0	.161	.307	***
2017	.263	.037	7.15	0	.19	.335	***
2018	.288	.037	7.79	0	.215	.361	***
Constant	1.063	.082	12.92	0	.901	1.225	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.516	Number of obs	276
F-test	9.785	Prob > F	0.000
Akaike crit. (AIC)	-553.167	Bayesian crit. (BIC)	-451.796

*** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 21. Two-way FE Model by Within Estimator Method with *gvcbackward*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.002	.001	1.93	.055	0	.003	*
humancapital	-.084	.028	-3.03	.003	-.138	-.029	***
inflation	0	0	4.38	0	0	.001	***
gvcbackward	-.001	.001	-1.96	.052	-.002	0	*
difinnovation	.017	.005	3.64	0	.008	.027	***
1996b	0	.	.	.	.	.	
1997	-.03	.037	-0.81	.416	-.102	.042	
1998	.013	.036	0.37	.715	-.058	.084	
1999	.01	.036	0.28	.779	-.061	.081	
2000	.046	.036	1.28	.203	-.025	.118	
2001	.072	.037	1.96	.051	0	.144	*
2002	.098	.037	2.67	.008	.026	.17	***
2003	.124	.037	3.38	.001	.052	.195	***
2004	.148	.037	4.03	0	.076	.22	***
2005	.172	.037	4.64	0	.099	.245	***
2006	.202	.037	5.41	0	.128	.275	***
2007	.217	.038	5.73	0	.143	.292	***
2008	.206	.038	5.50	0	.133	.28	***
2009	.158	.037	4.27	0	.085	.231	***
2010	.178	.037	4.77	0	.104	.251	***
2011	.192	.038	5.11	0	.118	.266	***
2012	.194	.038	5.14	0	.12	.268	***
2013	.198	.038	5.22	0	.123	.272	***
2014	.201	.038	5.29	0	.126	.275	***
2015	.216	.038	5.67	0	.141	.291	***
2016	.217	.038	5.65	0	.141	.292	***
2017	.25	.038	6.50	0	.174	.326	***
2018	.279	.039	7.17	0	.202	.355	***
Constant	1.069	.091	11.79	0	.891	1.248	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.475	Number of obs	276
F-test	8.327	Prob > F	0.000
Akaike crit. (AIC)	-531.088	Bayesian crit. (BIC)	-429.717

**** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 22. Two-way FE Model by Within Estimator Method with *rgvcfb*

tfp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
fdi	.001	.001	1.34	.183	-.001	.003	
humancapital	-.065	.028	-2.34	.02	-.12	-.01	**
inflation	0	0	4.42	0	0	.001	***
rgvcfb	-.012	.012	-0.97	.333	-.036	.012	
difinnovation	.018	.005	3.70	0	.008	.027	***
1996b	0	.	.	.	.	.	
1997	-.032	.037	-0.86	.389	-.105	.041	
1998	.012	.036	0.34	.735	-.059	.084	
1999	.009	.036	0.24	.812	-.063	.08	
2000	.045	.037	1.22	.222	-.027	.117	
2001	.07	.037	1.90	.059	-.003	.142	*
2002	.096	.037	2.60	.01	.023	.168	***
2003	.119	.037	3.25	.001	.047	.191	***

2004	.143	.037	3.87	0	.07	.215	***
2005	.167	.037	4.48	0	.094	.24	***
2006	.194	.037	5.21	0	.121	.268	***
2007	.211	.038	5.56	0	.136	.286	***
2008	.198	.037	5.29	0	.124	.272	***
2009	.15	.037	4.05	0	.077	.223	***
2010	.167	.037	4.48	0	.093	.24	***
2011	.18	.037	4.82	0	.106	.253	***
2012	.18	.037	4.82	0	.107	.254	***
2013	.184	.038	4.89	0	.11	.258	***
2014	.187	.038	4.97	0	.113	.262	***
2015	.202	.038	5.33	0	.127	.277	***
2016	.206	.038	5.39	0	.131	.281	***
2017	.236	.038	6.17	0	.16	.311	***
2018	.262	.038	6.81	0	.186	.338	***
Constant	.996	.086	11.58	0	.826	1.165	***

Mean dependent var	0.917	SD dependent var	0.116
R-squared	0.469	Number of obs	276
F-test	8.126	Prob > F	0.000
Akaike crit. (AIC)	-527.910	Bayesian crit. (BIC)	-426.538

**** p<.01, ** p<.05, * p<.1*

Source: Calculated by the Author, with Stata

Annex 23. Wooldridge Test for Autocorrelation

H_0: no first-order autocorrelation	
gvcforward	F (1, 11) = 219.355 Prob > chi2 = 0.0000
gvcbackward	F (1, 11) = 262.810 Prob > chi2 = 0.0000
rgvcfb	F (1, 11) = 296.426 Prob > chi2 = 0.000

Source: Calculated by the Author, with Stata

Annex 24. Modified Wald Test for Groupwise Heteroskedasticity

H_0: sigma(i)^2 = sigma^2 for all i	
gvcforward	chi2(12) = 838.26 Prob > chi2 = 0.0000
gvcbackward	chi2(12) = 896.50 Prob > chi2 = 0.0000
rgvcfb	chi2(12) = 1053.61 Prob > chi2 = 0.0000

Source: Calculated by the Author, with Stata

Annex 25. Pesaran's Test of Cross-sectional Dependence

H_0: no cross-sectional dependence	
gvcforward	Pesaran's Test Statistics = -2.090 Pr = 0.0366
gvcbackward	Pesaran's Test Statistics = -2.461 Pr = 0.0138
rgvcfb	Pesaran's Test Statistics = -2.274 Pr = 0.0229

Source: Calculated by the Author, with Stata

Annex 26. Data used for the Figure 2.1

Year	Individuals using the Internet (% of population, right-hand scale)	Fixed broadband subscriptions (per 100 people)	Mobile cellular subscriptions (per 100 people)
2001	8.05355597	0.84105187	15.4753875
2002	10.5185284	1.34571766	18.5066798
2003	12.1958546	1.97939045	22.2029049
2004	14.0818186	2.95254303	27.2640354
2005	15.6746615	3.65875637	33.724681
2006	17.4227825	4.65116604	41.5041215
2007	20.3508538	5.36406812	50.1778929
2008	23.0022915	6.24846314	59.2568143
2009	25.5528192	7.07302744	67.3362462
2010	28.7948897	7.81686001	75.847611
2011	31.2150097	8.95020372	83.3382079
2012	33.7174057	9.31151301	87.4903463
2013	35.6596568	9.72484554	91.9533578
2014	37.8926275	10.137672	95.0329153
2015	40.2923628	11.4504187	96.1304611
2016	43.285371	12.352245	99.2900667
2017	45.7661677	13.6626535	101.380307
2018	49.2336353	14.4746419	104.747102
2019	53.5706604	14.7684245	105.847062
2020	59.5774005	15.8106993	105.484016
2021		17.7879725	110.008901

Source: World Bank Open Data

Annex 27. All the Stata Codes Used in the Thesis

```
**********Descriptive statistics
xtset countryid year
asdoc sum countryid year tfp humancapital inflation gvcforward gvcbackward rgvcfb
innovation
*****different years
```

```
tabstat tfp,by(year) s(n mean median sd)
tabstat gvcforward,by(year) s(n mean median sd)
tabstat gvcbackward,by(year) s(n mean median sd)
tabstat rgvcfb,by(year) s(n mean median sd)
*****different countries
bysort countryid: tabstat tfp, s(n mean median sd)
bysort countryid: tabstat gvcforward, s(n mean median sd)
bysort countryid: tabstat gvcbackward, s(n mean median sd)
bysort countryid: tabstat rgvcfb, s(n mean median sd)
**********Provisional analysis
*****Stationary
xtline tfp
xtline tfp, overlay
asdoc xtunitroot llc tfp, trend demean lags(0)
asdoc xtunitroot llc rgvcfb, trend demean lags(0)
asdoc xtunitroot llc gvcforward, trend demean lags(0)
asdoc xtunitroot llc gvcbackward, trend demean lags(0)
asdoc xtunitroot llc fdi, trend demean lags(0)
asdoc xtunitroot llc humancapital, trend demean lags(0)
asdoc xtunitroot llc difinnovation, trend lags(0)
asdoc xtunitroot llc inflation, trend demean lags(0)
**All variable reject that null hypothesis at 5% significant level
*****Heterogeneity check
*****graphically check the cross-sectional heterogeneity in dependent variable
bysort countryid: egen y_mean=mean(tfp)
twoway scatter tfp countryid,msymbol(circle_hollow)
>||connected y_mean countryid, msymbol(diamond) xlabel(11"SVK" 8 "POL" 3"EST"
4"HRV" 1 "BGR"  2"CZE" 5"HUN" 6"LTU" 7"LVA" 9"ROU" 10"RUS" 12"SVN")
***graphically check the cross-period heterogeneity in dependent variable
drop y_mean
bysort year: egen y_mean=mean(tfp)
twoway scatter tfp year,msymbol(circle_hollow)||connected y_mean year, msymbol(diamond)
xlabel(1995(5)2018)
***Graphs do not show obvious heterogeneity in cross-sectional,
and the tfp increases significantly from 1995 to 2018***
**********Model's formulation and estimation
*****Fixed effects model: within estimator & LSDV (entity fixed effects)
asdoc xtreg tfp fdi humancapital inflation gvcforward difinnovation, fe
asdoc xtreg tfp fdi humancapital inflation gvcbackward difinnovation, fe
asdoc xtreg tfp fdi humancapital inflation rgvcfb difinnovation, fe
xi: regress tfp fdi humancapital inflation rgvcfb difinnovation i.countryid
xi: regress tfp fdi humancapital inflation gvcbackward difinnovation i.countryid
xi: regress tfp fdi humancapital inflation gvcforward difinnovation i.countryid
testparm _Icountryi*
***Fixed Effects Model is better than pooled model.
*****Fixed effects model: within estimator & LSDV (time fixed effects)
asdoc xtreg tfp fdi humancapital inflation gvcforward difinnovation, fe i(year)
xi: regress tfp fdi humancapital inflation gvcforward difinnovation i.year
testparm _Iyear*
```

asdoc xtreg tfp fdi humancapital inflation gvcbackward difinnovation, fe i(year)
xi: regress tfp fdi humancapital inflation gvcbackward difinnovation i.year
testparm _Iyear*
asdoc xtreg tfp fdi humancapital inflation rgvcfb difinnovation, fe i(year)
xi: regress tfp fdi humancapital inflation rgvcfb difinnovation i.year
testparm _Iyear*
***Fixed Effects Model is better than pooled model.
***Entity and time effects are both present.

**********RE Model

*****Breusch-Pagan Test: Pooled vs RE
asdoc xtreg tfp fdi humancapital inflation gvcforward difinnovation,re
xttest0
asdoc xtreg tfp fdi humancapital inflation gvcbackward difinnovation,re
xttest0
asdoc xtreg tfp fdi humancapital inflation rgvcfb difinnovation,re
xttest0

*****Hausman Testing: H0: RE is better

xtreg tfp fdi humancapital inflation gvcforward difinnovation, fe
estimates store fixed
xtreg tfp fdi humancapital inflation gvcforward difinnovation, re
estimates store random
asdoc hausman fixed random, constant sigmamore
xtreg tfp fdi humancapital inflation gvcbackward difinnovation, fe
estimates store fixed
xtreg tfp fdi humancapital inflation gvcbackward difinnovation, re
estimates store random
hausman fixed random, constant sigmamore
xtreg tfp fdi humancapital inflation rgvcfb difinnovation, fe
estimates store fixed
xtreg tfp fdi humancapital inflation rgvcfb difinnovation, re
estimates store random
hausman fixed random, constant sigmamore
***Reject the null hypothesis, selecting FE Model

*****Model with entry FE and Time FE (selecting within estimator approach)

xi: xtreg tfp fdi humancapital inflation gvcforward difinnovation i.year,fe
xi: xtreg tfp fdi humancapital inflation gvcbackward difinnovation i.year,fe
xi: xtreg tfp fdi humancapital inflation rgvcfb difinnovation i.year,fe

**********Testing autocorrelation, heteroscedasticity and cross-sectional dependence

*****Autocorrelation
net from http://www.stata-journal.com/software/sj3-2/
net describe st0039
net install st0039
asdoc xtserial tfp fdi humancapital inflation gvcforward difinnovation
xtserial tfp fdi humancapital inflation gvcbackward difinnovation
xtserial tfp fdi humancapital inflation rgvcfb difinnovation
***Reject the absence of autocorrelation
*****Heteroscedasticty

xi: xtreg tfp fdi humancapital inflation gvcforward difinnovation i.year, fe xi: xtreg tfp fdi humancapital inflation gvcbackward difinnovation i.year, fe xi: xtreg tfp fdi humancapital inflation rgvcfb difinnovation i.year, fe ssc install xttest3 xttest3 ***Presence of heteroscedasticity *****Testing for corss-sectional dependence/contemporaneous correlation ssc install xtcsd xi: xtreg tfp fdi humancapital inflation gvcbackward difinnovation i.year, fe xi: xtreg tfp fdi humancapital inflation gvcforward difinnovation i.year, fe xi: xtreg tfp fdi humancapital inflation rgvcfb difinnovation i.year, fe xtcsd, pesaran abs ***Presence of cross-sectional dependence
**********Final regression command: FGLS **********
xtgls tfp fdi humancapital inflation gvcforward difinnovation,corr(ar1) panels(correlated) xtgls tfp fdi humancapital inflation gvcbackward difinnovation,corr(ar1) panels(correlated) xtgls tfp fdi humancapital inflation rgvcfb difinnovation,corr(ar1) panels(correlated)

Source: Prepared by the author

Annex 28. Dataset Used for the Thesis' Empirical Analysis

countryid	tfp	fdi	innovation	difinnovation	humancapital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
1	1.2835	0.4762	84.0607		2.8226	62.0548	0.6280	24.661	15.488	1995	BGR	Bulgaria
1	1.3823	0.8866	83.6283	-0.4324	2.8383	121.6075	0.5477	24.122	13.211	1996	BGR	Bulgaria
1	1.1762	4.4609	83.1207	-0.5076	2.8540	1058.3736	0.5372	25.695	13.804	1997	BGR	Bulgaria
1	1.2122	3.5748	82.5679	-0.5528	2.8699	18.6722	0.5753	25.566	14.709	1998	BGR	Bulgaria
1	1.0763	6.0084	82.1062	-0.4616	2.8858	2.5730	0.5003	25.943	12.979	1999	BGR	Bulgaria
1	1.1025	7.5609	81.7017	-0.4045	2.9018	10.3163	0.5103	29.369	14.986	2000	BGR	Bulgaria
1	1.1046	5.7316	80.0914	-1.6103	2.9195	7.3609	0.5120	29.715	15.213	2001	BGR	Bulgaria
1	1.1036	5.5153	78.3716	-1.7198	2.9372	5.8101	0.5261	29.267	15.397	2002	BGR	Bulgaria
1	1.0922	9.9162	77.7533	-0.6183	2.9550	2.3486	0.4615	31.78	14.666	2003	BGR	Bulgaria
1	1.0830	11.7462	77.1686	-0.5847	2.9729	6.1471	0.4304	35.391	15.233	2004	BGR	Bulgaria
1	1.0873	13.7202	76.5897	-0.5789	2.9910	5.0388	0.4060	36.975	15.011	2005	BGR	Bulgaria

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
1	1.0725	22.9044	76.0102	-0.5795	3.0091	7.2616	0.4442	38.358	17.037	2006	BGR	Bulgaria
1	1.0481	31.2275	75.4534	-0.5568	3.0274	8.4025	0.3874	39.643	15.357	2007	BGR	Bulgaria
1	1.0128	18.8995	74.9256	-0.5278	3.0458	12.3487	0.3806	38.353	14.596	2008	BGR	Bulgaria
1	0.9735	7.4902	74.4444	-0.4812	3.0643	2.7532	0.3867	35.891	13.879	2009	BGR	Bulgaria
1	0.9833	3.6362	73.9560	-0.4884	3.0829	2.4390	0.3900	40.008	15.605	2010	BGR	Bulgaria
1	1.0021	3.6475	73.4833	-0.4727	3.0942	4.2199	0.3899	41.665	16.244	2011	BGR	Bulgaria
1	0.9905	3.2930	73.0589	-0.4244	3.1055	2.9546	0.3671	42.745	15.693	2012	BGR	Bulgaria
1	0.9749	3.5639	72.6512	-0.4077	3.1169	0.8901	0.3763	41.688	15.688	2013	BGR	Bulgaria
1	0.9668	1.9158	72.2394	-0.4118	3.1283	-1.418	0.3769	42.307	15.947	2014	BGR	Bulgaria
1	0.9776	4.3744	71.7799	-0.4595	3.1397	-0.105	0.3991	41.961	16.745	2015	BGR	Bulgaria
1	1.0036	2.7587	71.2782	-0.5017	3.1513	-0.799	0.4142	41.225	17.076	2016	BGR	Bulgaria
1	1.0000	3.3907	70.7595	-0.5188	3.1628	2.0616	0.4237	41.711	17.671	2017	BGR	Bulgaria
1	1.0127	2.7272	70.2504	-0.5091	3.1744	2.8145	0.4095	42.159	17.263	2018	BGR	Bulgaria
2	0.8080	4.2688	103.2725		3.3758	8.9905	0.4563	35.85	16.36	1995	CZE	Czech Republic
2	0.8075	2.1299	103.1524	-0.1201	3.4145	8.7588	0.4814	34.231	16.479	1996	CZE	Czech Republic
2	0.7801	2.0690	103.0413	-0.1111	3.4536	8.5962	0.4531	36.298	16.447	1997	CZE	Czech Republic
2	0.7616	5.5386	102.9437	-0.0976	3.4932	10.6984	0.4613	36.617	16.891	1998	CZE	Czech Republic
2	0.7618	9.6859	102.8386	-0.1051	3.5332	2.1354	0.5046	34.202	17.258	1999	CZE	Czech Republic
2	0.7760	8.0660	102.5506	-0.2880	3.5737	3.7754	0.5801	32.437	18.818	2000	CZE	Czech Republic
2	0.8017	8.3186	102.1661	-0.3846	3.5821	4.6627	0.5943	32.391	19.249	2001	CZE	Czech Republic
2	0.7997	10.3370	101.9692	-0.1969	3.5904	1.9030	0.5939	32.672	19.404	2002	CZE	Czech Republic

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
2	0.8237	2.0194	101.9400	-0.0292	3.5988	0.1187	0.6127	31.277	19.164	2003	CZE	Czech Republic
2	0.8498	5.3612	101.9710	0.0310	3.6073	2.7601	0.5967	32.195	19.212	2004	CZE	Czech Republic
2	0.8832	10.0115	102.1122	0.1411	3.6157	1.8571	0.5438	34.151	18.57	2005	CZE	Czech Republic
2	0.9260	4.5641	102.3891	0.2769	3.6198	2.5340	0.5461	34.261	18.709	2006	CZE	Czech Republic
2	0.9523	7.2644	102.9883	0.5992	3.6240	2.8531	0.5543	33.982	18.835	2007	CZE	Czech Republic
2	0.9496	3.7225	103.8460	0.8577	3.6281	6.3587	0.5676	33.799	19.186	2008	CZE	Czech Republic
2	0.9085	2.5413	104.4394	0.5933	3.6323	1.0194	0.5642	29.991	16.922	2009	CZE	Czech Republic
2	0.9213	4.8634	104.7441	0.3047	3.6364	1.4727	0.5133	35.135	18.035	2010	CZE	Czech Republic
2	0.9284	1.8247	104.9609	0.2168	3.6406	1.9172	0.4783	39.301	18.796	2011	CZE	Czech Republic
2	0.9212	4.5166	105.1079	0.1470	3.6448	3.2876	0.4680	39.424	18.451	2012	CZE	Czech Republic
2	0.9181	3.4757	105.1427	0.0349	3.6489	1.4383	0.4890	39.217	19.176	2013	CZE	Czech Republic
2	0.9271	3.8635	105.2535	0.1107	3.6531	0.3440	0.5008	38.215	19.137	2014	CZE	Czech Republic
2	0.9659	0.9041	105.4606	0.2071	3.6574	0.3094	0.5425	36.619	19.864	2015	CZE	Czech Republic
2	0.9684	5.5284	105.6633	0.2027	3.6616	0.6835	0.5456	36.075	19.683	2016	CZE	Czech Republic
2	1.0000	5.1387	105.9444	0.2811	3.6658	2.4505	0.5566	35.427	19.717	2017	CZE	Czech Republic
2	1.0127	3.3432	106.2993	0.3549	3.6701	2.1495	0.5559	35.353	19.652	2018	CZE	Czech Republic
3	0.6527	4.5927	14.3663		3.0316	28.7766	0.5738	26.828	15.395	1995	EST	Estonia
3	0.6848	3.4653	14.1559	-0.2104	3.0839	23.0503	0.5307	28.138	14.932	1996	EST	Estonia
3	0.7539	5.3168	13.9954	-0.1606	3.1371	10.5819	0.4818	32.529	15.671	1997	EST	Estonia
3	0.7667	10.4966	13.8616	-0.1338	3.1913	8.2083	0.4426	36.674	16.233	1998	EST	Estonia
3	0.7644	5.6609	13.9024	0.0409	3.2463	3.2961	0.4408	39.959	17.614	1999	EST	Estonia

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
3	0.8134	7.3192	13.9699	0.0674	3.3024	4.0185	0.4223	46.496	19.635	2000	EST	Estonia
3	0.8416	9.4792	13.8812	-0.0887	3.3172	5.7483	0.4433	44.498	19.724	2001	EST	Estonia
3	0.8739	4.5906	13.7935	-0.0877	3.3322	3.5719	0.4494	42.657	19.172	2002	EST	Estonia
3	0.8972	10.5149	13.7072	-0.0863	3.3472	1.3350	0.4521	43.368	19.607	2003	EST	Estonia
3	0.9304	8.9486	13.6255	-0.0817	3.3623	3.0481	0.4299	45.221	19.442	2004	EST	Estonia
3	0.9702	21.6744	13.5478	-0.0778	3.3774	4.0797	0.4174	46.033	19.213	2005	EST	Estonia
3	0.9962	10.3283	13.4681	-0.0797	3.3963	4.4376	0.4133	47.272	19.536	2006	EST	Estonia
3	1.0284	13.5112	13.4068	-0.0613	3.4152	6.6013	0.4276	47.41	20.271	2007	EST	Estonia
3	0.9630	8.1230	13.3709	-0.0359	3.4342	10.3624	0.4290	47.734	20.476	2008	EST	Estonia
3	0.9190	9.5059	13.3452	-0.0258	3.4534	-0.078	0.4243	45.13	19.148	2009	EST	Estonia
3	0.9554	13.2776	13.3148	-0.0304	3.4726	2.9720	0.3900	48.294	18.837	2010	EST	Estonia
3	0.9605	4.8210	13.2744	-0.0404	3.4924	4.9819	0.3743	47.895	17.928	2011	EST	Estonia
3	0.9700	7.7646	13.2270	-0.0474	3.5124	3.9334	0.3772	47.927	18.079	2012	EST	Estonia
3	0.9631	4.3715	13.1800	-0.0470	3.5326	2.7806	0.3717	46.964	17.456	2013	EST	Estonia
3	0.9740	6.6894	13.1455	-0.0345	3.5531	-0.106	0.3795	46.773	17.751	2014	EST	Estonia
3	0.9656	-3.12	13.1541	0.0086	3.5738	-0.492	0.3900	46.38	18.089	2015	EST	Estonia
3	0.9795	3.8457	13.1579	0.0038	3.5948	0.1487	0.3869	46.123	17.846	2016	EST	Estonia
3	1.0000	6.4469	13.1738	0.0159	3.6161	3.4172	0.3991	46.245	18.455	2017	EST	Estonia
3	1.0338	4.0241	13.2198	0.0459	3.6377	3.4363	0.4110	46.29	19.026	2018	EST	Estonia
4	0.9315	0.4772	46.2003		2.7981	3.9501	0.5762	21.274	12.259	1995	HRV	Croatia
4	0.9712	2.0518	45.5710	-0.6293	2.8201	4.3000	0.4461	24.699	11.019	1996	HRV	Croatia

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
4	1.0196	2.4824	45.3492	-0.2218	2.8423	4.1707	0.4313	23.594	10.175	1997	HRV	Croatia
4	1.0312	3.9020	45.3214	-0.0279	2.8647	6.3967	0.4364	24.607	10.738	1998	HRV	Croatia
4	1.0090	6.1566	45.1260	-0.1954	2.8873	4.0191	0.5444	22.23	12.101	1999	HRV	Croatia
4	1.0146	4.6546	44.6830	-0.4430	2.9101	4.6113	0.6043	23.876	14.428	2000	HRV	Croatia
4	1.0214	4.4573	42.9964	-1.6866	2.9377	3.7767	0.5704	24.018	13.701	2001	HRV	Croatia
4	1.0489	3.6211	43.0217	0.0253	2.9656	1.6718	0.5779	23.047	13.319	2002	HRV	Croatia
4	1.0640	5.2721	43.0340	0.0123	2.9938	1.7673	0.4412	23.77	10.487	2003	HRV	Croatia
4	1.0759	3.1280	43.0460	0.0120	3.0222	2.0554	0.4470	25.92	11.585	2004	HRV	Croatia
4	1.0904	3.9593	43.1015	0.0555	3.0509	3.3172	0.4551	25.408	11.563	2005	HRV	Croatia
4	1.0932	6.5729	43.1116	0.0101	3.0858	3.1898	0.4403	27.229	11.989	2006	HRV	Croatia
4	1.0976	7.6610	43.1022	-0.0094	3.1211	2.8993	0.4698	26.467	12.433	2007	HRV	Croatia
4	1.0707	7.3997	43.0971	-0.0051	3.1568	6.0770	0.5586	22.867	12.774	2008	HRV	Croatia
4	0.9813	4.8474	43.0518	-0.0452	3.1929	2.3785	0.5757	19.922	11.469	2009	HRV	Croatia
4	0.9753	2.5466	42.9543	-0.0975	3.2294	1.0306	0.5488	23.154	12.707	2010	HRV	Croatia
4	0.9860	1.9697	42.8062	-0.1480	3.2680	2.2727	0.5414	26.106	14.135	2011	HRV	Croatia
4	0.9805	2.5538	42.6756	-0.1306	3.3078	3.4121	0.5284	26.568	14.039	2012	HRV	Croatia
4	0.9835	1.6364	42.5569	-0.1187	3.3486	2.2166	0.5572	25.465	14.19	2013	HRV	Croatia
4	0.9619	5.4427	42.3839	-0.1730	3.3905	-0.215	0.5691	24.799	14.113	2014	HRV	Croatia
4	0.9844	0.0700	42.0360	-0.3479	3.4337	-0.465	0.5846	24.466	14.303	2015	HRV	Croatia
4	0.9972	0.8088	41.7435	-0.2925	3.4780	-1.125	0.5974	23.025	13.756	2016	HRV	Croatia
4	1.0000	0.8013	41.2453	-0.4982	3.5237	1.1294	0.5501	24.522	13.489	2017	HRV	Croatia

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
4	1.0013	2.1098	40.8784	-0.3669	3.5706	1.5001	0.5667	23.548	13.345	2018	HRV	Croatia
5	0.8572	10.3480	103.2897		2.8818	28.3055	0.4185	29.278	12.254	1995	HUN	Hungary
5	0.8511	7.0489	103.1124	-0.1773	2.8977	23.4690	0.3865	29.347	11.342	1996	HUN	Hungary
5	0.8590	8.8042	102.9049	-0.2075	2.9136	18.3051	0.3775	30.887	11.659	1997	HUN	Hungary
5	0.8740	6.6965	102.6657	-0.2392	2.9297	14.1538	0.4004	29.316	11.737	1998	HUN	Hungary
5	0.8698	6.8978	102.3753	-0.2904	2.9459	9.9977	0.4505	25.542	11.507	1999	HUN	Hungary
5	0.8925	5.8192	102.1097	-0.2656	2.9621	9.8036	0.4514	25.372	11.452	2000	HUN	Hungary
5	0.9183	7.5513	101.8758	-0.2340	2.9920	9.1168	0.4606	25.97	11.963	2001	HUN	Hungary
5	0.9467	5.3890	101.5861	-0.2897	3.0222	5.2654	0.5287	24.352	12.874	2002	HUN	Hungary
5	0.9627	4.8748	101.2955	-0.2906	3.0526	4.6610	0.4982	26.8	13.351	2003	HUN	Hungary
5	0.9939	4.3585	101.0715	-0.2241	3.0834	6.7443	0.4972	27.972	13.909	2004	HUN	Hungary
5	1.0281	24.2818	100.8707	-0.2008	3.1145	3.5615	0.4720	29.993	14.156	2005	HUN	Hungary
5	1.0505	16.1419	100.7137	-0.1569	3.1459	3.9303	0.4634	31.708	14.693	2006	HUN	Hungary
5	1.0447	50.3837	100.5578	-0.1559	3.1776	7.9587	0.5144	28.381	14.598	2007	HUN	Hungary
5	1.0457	47.4388	100.3819	-0.1759	3.2096	6.0425	0.4290	33.515	14.377	2008	HUN	Hungary
5	0.9853	-2.13	100.2265	-0.1554	3.2420	4.2117	0.4934	26.43	13.041	2009	HUN	Hungary
5	0.9876	-15.7	100.0002	-0.2263	3.2747	4.8556	0.4516	30.328	13.697	2010	HUN	Hungary
5	1.0025	7.5671	99.7173	-0.2830	3.2902	3.9299	0.4925	30.435	14.989	2011	HUN	Hungary
5	0.9810	8.3965	99.2036	-0.5136	3.3058	5.6521	0.4687	32.335	15.157	2012	HUN	Hungary
5	0.9840	-2.64	98.9308	-0.2728	3.3215	1.7332	0.5143	31.079	15.985	2013	HUN	Hungary
5	0.9820	9.2603	98.6647	-0.2661	3.3372	-0.228	0.5309	30.245	16.058	2014	HUN	Hungary

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5	0.9939	-4.21	98.4303	-0.2344	3.3531	-0.062	0.5395	30.575	16.496	2015	HUN	Hungary
5	0.9800	54.1803	98.1402	-0.2900	3.3690	0.3948	0.5482	29.89	16.387	2016	HUN	Hungary
5	1.0000	-8.48	97.8797	-0.2606	3.3850	2.3482	0.5719	29.455	16.846	2017	HUN	Hungary
5	1.0275	-40.1	97.7556	-0.1240	3.4010	2.8502	0.5529	30.775	17.015	2018	HUN	Hungary
6	0.6252	0.9223	36.2910		2.7450	39.6476	0.8615	16.16	13.922	1995	LTU	Lithuania
6	0.6463	1.8181	36.0161	-0.2749	2.7763	24.6252	0.6696	18.079	12.105	1996	LTU	Lithuania
6	0.6813	3.5804	35.7514	-0.2648	2.8079	8.8810	0.6302	20.565	12.96	1997	LTU	Lithuania
6	0.7053	8.1745	35.4933	-0.2581	2.8398	5.0676	0.5753	22.572	12.985	1998	LTU	Lithuania
6	0.7035	5.1455	35.2424	-0.2509	2.8721	0.7276	0.6390	22.139	14.146	1999	LTU	Lithuania
6	0.7067	3.2996	34.9954	-0.2470	2.9048	0.9816	0.7047	23.621	16.645	2000	LTU	Lithuania
6	0.7538	3.6152	34.7082	-0.2872	2.9379	1.3671	0.6787	22.739	15.434	2001	LTU	Lithuania
6	0.7790	4.6339	34.4307	-0.2775	2.9715	0.2815	0.6749	23.834	16.086	2002	LTU	Lithuania
6	0.8356	1.1575	34.1521	-0.2785	3.0053	-1.134	0.6471	26.161	16.928	2003	LTU	Lithuania
6	0.8469	3.8870	33.7708	-0.3814	3.0396	1.1641	0.6610	26.711	17.657	2004	LTU	Lithuania
6	0.8792	4.9527	33.2253	-0.5455	3.0743	2.6585	0.6697	26.667	17.858	2005	LTU	Lithuania
6	0.9168	7.4855	32.6991	-0.5262	3.0892	3.7391	0.6055	29.277	17.728	2006	LTU	Lithuania
6	0.9646	6.5532	32.3129	-0.3862	3.1042	5.7372	0.6689	29.854	19.968	2007	LTU	Lithuania
6	0.9654	3.6138	31.9823	-0.3306	3.1193	10.9259	0.6370	30.049	19.141	2008	LTU	Lithuania
6	0.8728	-0.96	31.6292	-0.3531	3.1344	4.4530	0.6691	27.248	18.231	2009	LTU	Lithuania
6	0.8879	2.9699	30.9728	-0.6563	3.1497	1.3192	0.6150	29.733	18.286	2010	LTU	Lithuania
6	0.9283	4.3202	30.2812	-0.6917	3.1652	4.1303	0.6351	30.867	19.603	2011	LTU	Lithuania

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6	0.9445	1.5775	29.8777	-0.4034	3.1810	3.0900	0.6534	30.009	19.609	2012	LTU	Lithuania
6	0.9637	1.6522	29.5769	-0.3008	3.1970	1.0475	0.6604	29.623	19.563	2013	LTU	Lithuania
6	0.9780	0.7362	29.3237	-0.2532	3.2131	0.1038	0.6504	29.72	19.33	2014	LTU	Lithuania
6	0.9704	2.5026	29.0491	-0.2746	3.2295	-0.884	0.7068	28.652	20.251	2015	LTU	Lithuania
6	0.9616	2.7354	28.6823	-0.3668	3.2460	0.9055	0.6938	29.309	20.335	2016	LTU	Lithuania
6	1.0000	2.8973	28.2840	-0.3983	3.2627	3.7229	0.6923	30.479	21.1	2017	LTU	Lithuania
6	1.0120	2.4182	28.0154	-0.2686	3.2796	2.6979	0.6912	31.033	21.449	2018	LTU	Lithuania
7	0.5883	4.2155	24.8506		2.7205	24.9759	0.6896	33	22.758	1995	LVA	Latvia
7	0.6011	5.5454	24.5722	-0.2783	2.7421	17.6105	0.5585	36.627	20.455	1996	LVA	Latvia
7	0.6354	7.2665	24.3285	-0.2437	2.7638	8.4474	0.5341	37.061	19.793	1997	LVA	Latvia
7	0.6659	5.1826	24.1002	-0.2283	2.7857	4.6442	0.5656	33.864	19.152	1998	LVA	Latvia
7	0.6817	4.6205	23.9048	-0.1954	2.8077	2.3648	0.7007	31.097	21.79	1999	LVA	Latvia
7	0.7191	4.0733	23.6755	-0.2293	2.8299	2.6543	0.6354	35.043	22.268	2000	LVA	Latvia
7	0.7344	2.0748	23.3717	-0.3038	2.8563	2.4870	0.6047	37.743	22.824	2001	LVA	Latvia
7	0.7719	1.6751	23.1017	-0.2700	2.8828	1.9389	0.6015	37.685	22.669	2002	LVA	Latvia
7	0.8135	2.6899	22.8796	-0.2222	2.9096	2.9426	0.5654	39.588	22.385	2003	LVA	Latvia
7	0.8584	4.0981	22.6312	-0.2483	2.9367	6.1924	0.5338	40.855	21.809	2004	LVA	Latvia
7	0.8978	4.7629	22.3880	-0.2432	2.9640	6.7485	0.5323	41.719	22.205	2005	LVA	Latvia
7	0.9394	7.9076	22.1836	-0.2044	2.9769	6.5362	0.4912	45.179	22.191	2006	LVA	Latvia
7	0.9773	8.7376	22.0033	-0.1803	2.9900	10.0930	0.5122	45.007	23.053	2007	LVA	Latvia
7	0.8935	4.0003	21.7732	-0.2300	3.0031	15.4023	0.5283	44.969	23.759	2008	LVA	Latvia

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7	0.8465	-0.5680	21.4167	-0.3565	3.0162	3.5341	0.5194	42.139	21.889	2009	LVA	Latvia
7	0.8425	1.9827	20.9756	-0.4411	3.0294	-1.085	0.5023	44.524	22.364	2010	LVA	Latvia
7	0.8789	5.5307	20.5971	-0.3785	3.0429	4.3707	0.4883	46.875	22.89	2011	LVA	Latvia
7	0.9054	3.8366	20.3432	-0.2539	3.0566	2.2578	0.4615	47.451	21.898	2012	LVA	Latvia
7	0.9100	3.2753	20.1265	-0.2167	3.0704	-0.03	0.4536	47.529	21.56	2013	LVA	Latvia
7	0.9170	3.3298	19.9378	-0.1887	3.0843	0.6205	0.4512	46.881	21.151	2014	LVA	Latvia
7	0.9511	2.9815	19.7753	-0.1626	3.0984	0.1742	0.4527	47.314	21.42	2015	LVA	Latvia
7	0.9706	1.1944	19.5954	-0.1799	3.1127	0.1406	0.4485	48.276	21.653	2016	LVA	Latvia
7	1.0000	3.9037	19.4225	-0.1729	3.1271	2.9304	0.4352	48.895	21.281	2017	LVA	Latvia
7	1.0174	1.2324	19.2717	-0.1507	3.1417	2.5345	0.4579	48.012	21.985	2018	LVA	Latvia
8	0.7805	2.5715	385.9500		2.8990	27.9514	0.5439	29.304	15.939	1995	POL	Poland
8	0.7960	2.8091	386.2437	0.2937	2.9225	19.7950	0.5569	29.334	16.335	1996	POL	Poland
8	0.8066	3.0811	386.4966	0.2529	2.9463	14.9132	0.5458	30.178	16.47	1997	POL	Poland
8	0.8076	3.6540	386.6348	0.1382	2.9702	11.5979	0.5700	30.475	17.371	1998	POL	Poland
8	0.8131	4.3563	386.6027	-0.0321	2.9944	7.1541	0.6124	30.201	18.494	1999	POL	Poland
8	0.8451	5.4204	382.5863	-4.0164	3.0187	9.9002	0.6255	33.053	20.673	2000	POL	Poland
8	0.8492	2.9737	382.4808	-0.1055	3.0383	5.4083	0.6467	32.35	20.92	2001	POL	Poland
8	0.8708	2.0550	382.3036	-0.1771	3.0581	1.9053	0.6447	32.012	20.637	2002	POL	Poland
8	0.8917	2.4657	382.0457	-0.2579	3.0780	0.6827	0.6323	31.474	19.9	2003	POL	Poland
8	0.9129	5.4361	381.8222	-0.2235	3.0980	3.3826	0.6193	33.742	20.898	2004	POL	Poland

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8	0.9154	3.6065	381.6545	-0.1678	3.1181	2.1838	0.6052	35.653	21.577	2005	POL	Poland
8	0.9284	6.2309	381.4127	-0.2418	3.1403	1.2847	0.5935	37.1	22.017	2006	POL	Poland
8	0.9378	5.8343	381.2056	-0.2071	3.1626	2.4587	0.5681	38.118	21.656	2007	POL	Poland
8	0.9276	2.7312	381.2576	0.0520	3.1850	4.1650	0.5701	37.146	21.178	2008	POL	Poland
8	0.9314	3.1894	381.5160	0.2584	3.2076	3.7954	0.6127	31.632	19.38	2009	POL	Poland
8	0.9593	3.8979	380.4279	-1.0881	3.2304	2.5807	0.5959	34.785	20.73	2010	POL	Poland
8	0.9783	3.4730	380.6326	0.2046	3.2540	4.2394	0.6105	35.896	21.916	2011	POL	Poland
8	0.9703	1.4498	380.6316	-0.0009	3.2780	3.5604	0.6073	35.643	21.646	2012	POL	Poland
8	0.9627	0.1995	380.4020	-0.2297	3.3024	0.9920	0.6282	34.818	21.872	2013	POL	Poland
8	0.9612	3.7944	380.1174	-0.2846	3.3272	0.0538	0.6345	34.806	22.084	2014	POL	Poland
8	0.9672	3.2693	379.8641	-0.2532	3.3524	-0.874	0.6598	34.765	22.938	2015	POL	Poland
8	0.9737	3.7764	379.7009	-0.1633	3.3781	-0.665	0.6539	34.628	22.643	2016	POL	Poland
8	1.0000	2.2871	379.7483	0.0474	3.4042	2.0759	0.6279	35.897	22.538	2017	POL	Poland
8	1.0355	3.2616	379.7475	-0.0008	3.4308	1.8130	0.6145	36.804	22.616	2018	POL	Poland
9	0.7355	1.1193	226.8427		2.8573	32.2425	0.8614	17.685	15.233	1995	ROU	Romania
9	0.7459	0.7120	226.1900	-0.6527	2.8732	38.8293	0.5052	29.309	14.808	1996	ROU	Romania
9	0.6999	3.4153	225.5398	-0.6503	2.8891	154.7635	0.5564	26.394	14.685	1997	ROU	Romania
9	0.6825	4.8712	225.0734	-0.4663	2.9051	59.0966	0.6328	25.51	16.143	1998	ROU	Romania
9	0.6773	2.8955	224.7204	-0.3530	2.9213	45.8038	0.4824	33.034	15.936	1999	ROU	Romania
9	0.6880	2.7836	224.4297	-0.2907	2.9375	45.6666	0.7110	28.015	19.92	2000	ROU	Romania
9	0.7155	2.8642	221.3197	-3.1100	2.9506	34.4770	0.7029	28.234	19.847	2001	ROU	Romania

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9	0.7801	2.4834	217.3050	-4.0147	2.9638	22.5399	0.7488	25.423	19.038	2002	ROU	Romania
9	0.8064	3.1900	215.7433	-1.5617	2.9771	15.2735	0.6926	27.112	18.779	2003	ROU	Romania
9	0.8628	8.5938	214.5175	-1.2258	2.9904	11.8744	0.6545	30.369	19.878	2004	ROU	Romania
9	0.8900	6.6008	213.1969	-1.3206	3.0038	9.0149	0.6182	32.678	20.201	2005	ROU	Romania
9	0.9276	9.0201	211.9376	-1.2593	3.0227	6.5585	0.5801	35.709	20.714	2006	ROU	Romania
9	0.9333	5.7869	208.8298	-3.1078	3.0418	4.8373	0.5174	40.407	20.908	2007	ROU	Romania
9	0.9608	6.3775	205.3788	-3.4511	3.0609	7.8508	0.5161	41.637	21.488	2008	ROU	Romania
9	0.8978	2.6637	203.6749	-1.7039	3.0802	5.5874	0.5926	32.711	19.386	2009	ROU	Romania
9	0.8665	1.8901	202.4687	-1.2062	3.0997	6.0914	0.6189	33.238	20.571	2010	ROU	Romania
9	0.8726	1.2305	201.4753	-0.9934	3.1185	5.7893	0.5897	36.694	21.637	2011	ROU	Romania
9	0.8793	1.7013	200.5804	-0.8949	3.1374	3.3349	0.5631	38.174	21.496	2012	ROU	Romania
9	0.8983	2.0311	199.8369	-0.7434	3.1564	3.9847	0.5824	38.35	22.334	2013	ROU	Romania
9	0.9108	1.9374	199.0898	-0.7471	3.1756	1.0683	0.5844	37.928	22.167	2014	ROU	Romania
9	0.9333	2.4273	198.1562	-0.9336	3.1948	-0.594	0.6187	37.049	22.921	2015	ROU	Romania
9	0.9577	3.3742	197.0227	-1.1335	3.2142	-1.545	0.6582	34.478	22.695	2016	ROU	Romania
9	1.0000	2.8327	195.8872	-1.1355	3.2337	1.3390	0.6518	35.992	23.459	2017	ROU	Romania
9	1.0250	3.0181	194.7397	-1.1474	3.2533	4.6255	0.6320	36.795	23.256	2018	ROU	Romania
10	0.6354	0.5223	1483.7579		2.8900	197.4143	1.0846	22.129	24.002	1995	RUS	Russian Federation
10	0.6216	0.6585	1481.6013	-2.1566	2.9436	47.7520	1.1133	22.726	25.3	1996	RUS	Russian Federation
10	0.6309	1.2014	1479.1536	-2.4477	2.9982	14.7613	0.9997	25.301	25.294	1997	RUS	Russian Federation
10	0.6066	1.0191	1476.7078	-2.4458	3.0538	27.6857	1.1628	21.466	24.96	1998	RUS	Russian Federation

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10	0.6424	1.6623	1472.1478	-4.5601	3.1104	85.7465	1.1659	22.23	25.919	1999	RUS	Russian Federation
10	0.6992	1.0312	1465.9687	-6.1791	3.1681	20.7988	1.2580	23.45	29.501	2000	RUS	Russian Federation
10	0.7326	0.9287	1459.7648	-6.2039	3.1799	21.4770	1.2352	23.923	29.549	2001	RUS	Russian Federation
10	0.7658	1.0055	1453.0650	-6.6999	3.1917	15.7887	1.1560	25.334	29.286	2002	RUS	Russian Federation
10	0.8149	1.8424	1446.4862	-6.5788	3.2036	13.6633	1.2284	24.736	30.385	2003	RUS	Russian Federation
10	0.8618	2.6062	1440.6732	-5.8130	3.2155	10.8886	1.3406	24.719	33.139	2004	RUS	Russian Federation
10	0.8992	2.0298	1435.1881	-5.4850	3.2274	12.6853	1.4042	25.08	35.218	2005	RUS	Russian Federation
10	0.9466	3.7977	1430.4964	-4.6918	3.2414	9.6687	1.4409	25.47	36.699	2006	RUS	Russian Federation
10	0.9918	4.2989	1428.0511	-2.4452	3.2555	9.0073	1.4975	25.102	37.589	2007	RUS	Russian Federation
10	1.0177	4.5027	1427.4237	-0.6275	3.2696	14.1108	1.5128	25.07	37.927	2008	RUS	Russian Federation
10	0.9476	2.9921	1427.8535	0.4298	3.2838	11.6473	1.4921	21.846	32.597	2009	RUS	Russian Federation
10	0.9718	2.8308	1428.4947	0.6412	3.2981	6.8494	1.6597	21.889	36.33	2010	RUS	Russian Federation
10	0.9912	2.6924	1429.6091	1.1144	3.3126	8.4405	1.7204	22.579	38.844	2011	RUS	Russian Federation
10	1.0063	2.2908	1432.0172	2.4081	3.3273	5.0747	1.7001	22.472	38.204	2012	RUS	Russian Federation
10	1.0149	3.0194	1435.0700	3.0527	3.3422	6.7537	1.6170	22.687	36.684	2013	RUS	Russian Federation
10	1.0196	1.0699	1438.1967	3.1267	3.3572	7.8234	1.5771	23.225	36.628	2014	RUS	Russian Federation
10	0.9911	0.5026	1440.9687	2.7720	3.3723	15.5344	1.4807	23.861	35.331	2015	RUS	Russian Federation
10	0.9901	2.5485	1443.4240	2.4553	3.3876	7.0424	1.6344	21.707	35.477	2016	RUS	Russian Federation
10	1.0000	1.8141	1444.9674	1.5434	3.4030	3.6833	1.6024	22.997	36.85	2017	RUS	Russian Federation
10	1.0181	0.5301	1444.7786	-0.1888	3.4186	2.8783	1.5666	23.655	37.057	2018	RUS	Russian Federation
11	0.6624	0.9138	53.6200		3.2238	9.8411	0.9227	18.89	17.429	1995	SVK	Slovak Republic

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
11	0.6902	1.2563	53.7336	0.1136	3.2296	5.7758	0.7966	21.347	17.005	1996	SVK	Slovak Republic
11	0.7139	0.6378	53.8329	0.0993	3.2353	6.1420	0.7390	22.618	16.715	1997	SVK	Slovak Republic
11	0.7253	2.1658	53.9052	0.0723	3.2410	6.6657	0.8612	20.938	18.032	1998	SVK	Slovak Republic
11	0.7244	1.1125	53.9602	0.0550	3.2467	10.5704	0.9227	20.874	19.261	1999	SVK	Slovak Republic
11	0.7368	7.4656	53.8872	-0.0730	3.2525	12.0358	1.1449	17.361	19.877	2000	SVK	Slovak Republic
11	0.7459	4.9794	53.7887	-0.0985	3.2995	7.3296	1.0611	18.266	19.382	2001	SVK	Slovak Republic
11	0.7748	11.9340	53.7691	-0.0196	3.3471	3.1271	1.0551	17.871	18.855	2002	SVK	Slovak Republic
11	0.8129	2.0656	53.7337	-0.0354	3.3955	8.5541	0.9271	19.658	18.224	2003	SVK	Slovak Republic
11	0.8296	7.0747	53.7228	-0.0109	3.4445	7.5485	0.9328	20.778	19.382	2004	SVK	Slovak Republic
11	0.8490	6.2468	53.7281	0.0053	3.4942	2.7091	0.9357	20.61	19.285	2005	SVK	Slovak Republic
11	0.8920	8.0566	53.7305	0.0025	3.5176	4.4833	0.8644	21.842	18.88	2006	SVK	Slovak Republic
11	0.9498	5.8433	53.7462	0.0157	3.5412	2.7567	0.8463	22.016	18.633	2007	SVK	Slovak Republic
11	0.9626	4.6004	53.7923	0.0461	3.5649	4.5982	0.8129	21.938	17.833	2008	SVK	Slovak Republic
11	0.9145	1.7014	53.8641	0.0717	3.5887	1.6151	0.8507	19.495	16.584	2009	SVK	Slovak Republic
11	0.9525	2.3209	53.9143	0.0502	3.6128	0.9570	0.8413	21.32	17.937	2010	SVK	Slovak Republic
11	0.9562	5.4358	53.9838	0.0696	3.6375	3.9193	0.8102	22.822	18.491	2011	SVK	Slovak Republic
11	0.9636	1.8775	54.0758	0.0919	3.6626	3.6061	0.7946	23.224	18.453	2012	SVK	Slovak Republic
11	0.9663	1.0147	54.1339	0.0581	3.6881	1.4005	0.8306	22.141	18.39	2013	SVK	Slovak Republic
11	0.9741	-0.36	54.1865	0.0526	3.7139	-0.076	0.8314	22.661	18.841	2014	SVK	Slovak Republic
11	0.9902	1.7102	54.2380	0.0515	3.7402	-0.325	0.8616	22.424	19.321	2015	SVK	Slovak Republic
11	0.9878	5.2726	54.3080	0.0700	3.7668	-0.520	0.8392	22.172	18.607	2016	SVK	Slovak Republic

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
11	1.0000	4.4178	54.3923	0.0843	3.7938	1.3119	0.8040	23.505	18.898	2017	SVK	Slovak Republic
11	1.0152	2.1207	54.4677	0.0754	3.8212	2.5140	0.7788	24.409	19.009	2018	SVK	Slovak Republic
12	0.7710	0.7044	19.8987		3.1898	13.4637	1.3753	9.219	12.679	1995	SVN	Slovenia
12	0.8020	0.8058	19.8863	-0.0124	3.2045	9.8645	1.7753	7.285	12.933	1996	SVN	Slovenia
12	0.8390	1.6110	19.8596	-0.0267	3.2193	8.3597	1.7244	7.664	13.216	1997	SVN	Slovenia
12	0.8407	0.9740	19.8163	-0.0433	3.2342	7.8912	1.5677	8.815	13.819	1998	SVN	Slovenia
12	0.8524	0.4694	19.8305	0.0142	3.2492	6.1556	1.3886	10.544	14.641	1999	SVN	Slovenia
12	0.8640	0.6693	19.8893	0.0588	3.2642	8.9117	1.5894	9.802	15.579	2000	SVN	Slovenia
12	0.8770	2.4008	19.9206	0.0313	3.2709	8.3797	1.7590	9.094	15.996	2001	SVN	Slovenia
12	0.8769	7.8749	19.9453	0.0247	3.2775	7.4808	1.7120	9.24	15.819	2002	SVN	Slovenia
12	0.8901	1.8073	19.9573	0.0120	3.2842	5.5442	1.6873	9.027	15.231	2003	SVN	Slovenia
12	0.9069	2.2174	19.9701	0.0128	3.2909	3.5930	1.9396	8.228	15.959	2004	SVN	Slovenia
12	0.9427	2.6813	20.0047	0.0346	3.2976	2.4515	2.0052	8.059	16.16	2005	SVN	Slovenia
12	0.9755	1.7528	20.0687	0.0639	3.3161	2.4579	2.0965	7.899	16.56	2006	SVN	Slovenia
12	1.0020	3.9205	20.1812	0.1125	3.3347	3.6575	2.0929	8.08	16.911	2007	SVN	Slovenia
12	0.9931	1.9375	20.2132	0.0319	3.3534	5.6474	1.9943	8.629	17.209	2008	SVN	Slovenia
12	0.9210	-0.69	20.3967	0.1835	3.3722	0.8393	1.7651	8.816	15.561	2009	SVN	Slovenia
12	0.9406	0.6620	20.4858	0.0891	3.3911	1.8012	2.0405	8.489	17.322	2010	SVN	Slovenia
12	0.9584	1.6981	20.5284	0.0426	3.4105	1.8029	2.2599	8.508	19.227	2011	SVN	Slovenia
12	0.9419	0.0720	20.5716	0.0432	3.4301	2.5974	2.2703	8.541	19.391	2012	SVN	Slovenia
12	0.9267	0.2149	20.5995	0.0279	3.4500	1.7692	2.3244	8.453	19.648	2013	SVN	Slovenia

countryid	tfp	fdi	innovation	difinnovation	human capital	inflation	rgvcfb	gvcbackward	gvcforward	year	countrycode	countryname
12	0.9375	2.0389	20.6198	0.0203	3.4702	0.1993	2.1814	9.134	19.925	2014	SVN	Slovenia
12	0.9423	4.0136	20.6353	0.0155	3.4906	-0.526	2.1868	9.458	20.683	2015	SVN	Slovenia
12	0.9686	3.2307	20.6504	0.0151	3.5113	-0.055	2.1091	9.586	20.218	2016	SVN	Slovenia
12	1.0000	2.4619	20.6639	0.0135	3.5322	1.4291	2.2240	9.094	20.225	2017	SVN	Slovenia
12	1.0241	2.8391	20.7389	0.0751	3.5534	1.7386	2.3290	8.562	19.941	2018	SVN	Slovenia

Source: PWT 10.01, OECD TiVA and World Bank Open Data

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Chunying Wang

18/05/2013