Management and Production Engineering Review
Volume 15 • Number 2 • June 2024 • pp. 99–111
DOI: 10.24425/mper.2024.151134

The Impact of Ukraine's Involvement in Global Value Chains on the Development of the Processing Industry

Valerii MYTSENKO[1], Iryna BABETS[2], Ivan MYTSENKO[2], Mariya FLEYCHUK[3], Mariana DOROSH-KIZYM[3]

[1] *Department of Foreign Languages, Central Ukrainian National Technical University, Ukraine*
[2] *Department of International Economic Relations, Central Ukrainian National Technical University, Ukraine*
[3] *Department of Management, Stepan Gzhytskyi National University of Veterinary Medicine and Biotechnologies of Lviv, Ukraine*

Received: 01 December 2023
Accepted: 09 January 2024

Abstract
The relevance of the research is determined as Ukraine, a country with a developed manufacturing industry, opens up new opportunities and challenges in the context of the global economy, which is increasingly based on global value chains, and studying this impact is key to achieving economic growth and competitiveness. The study aims to examine the relationship between Ukraine's participation in global value chains and the development of the manufacturing industry to identify opportunities and prospects for their interaction. The methods used were analytical, functional, system analysis, deduction, synthesis, and comparison. The results showed that industrial development is closely linked to changes in production, exports, and participation in global value chains, which affect production volumes and the number of employees in Ukrainian industries. The practical implications are to facilitate the development of better export strategies and improve sectoral policies to increase the competitiveness and efficiency of Ukrainian enterprises in global value chains.

Keywords
Economic development; International cooperation; Regression analysis; Production efficiency; Technological progress.

Introduction

Recently, the global economy has experienced an intense process of fragmentation in industrial production. It has led to stronger trade ties between countries, increased international trade, and a growing share of intermediate goods in global imports of industrial products. As a result of this global value chain development process, there is now a more profound vertical division of labor. This term refers to organization of tasks based on their level of complexity or specialization. As a consequence, nations are becoming more specialized in producing single parts and subassemblies, meaning that a country's primary competitive advantage is now its position in global value chains rather than the size of its product market. Ukraine actively interacts with global economic processes, as evidenced by the high level of economic openness and the steady growth of the share of foreign trade in gross domestic product (GDP) (Dukhnytskyi, 2023; Silagadze, 2022). The significant share of semi-finished and intermediate products in Ukraine's imports (over 50%) indicates the deep integration of the domestic economy into global value chains (GVCs). This term refers to the international networks of production and distribution through which various stages of the production process are coordinated across different countries to create goods and services. However, it is important to keep in mind that the impact of Ukraine's participation in global value chains is diverse and depends on the country's level of development and other factors, such as its institutional framework and financial and technological capabilities. In this context, the study of Ukraine's participation in global value chains and its impact on the development of the manufacturing industry remains an important and relevant research task.

***Corresponding author**: Iryna Babets – Department of International Economic Relations, Central Ukrainian National Technical University, Ukraine, e-mail: i_babets@ukr.net*

As a result of the integration of the national economy into the GVCs, Nesterov (2023) notes the following effects: growth of the country's resource base (similar to the situation in the G20 countries, where 30% to 60% of resources were imported), as well as stimulation of the development of the service sector. In this sector, exports in the G20 countries accounted for 42% of the total global value chain. Yaroschuk & Okhrimenko (2020), by contrast, highlight other benefits arising from a country's participation in global value chains. These benefits include lower trade costs; increased market openness due to lower tariffs and non-tariff barriers, as they become less profitable when goods move across borders in multiple ways; promotion of mutual investment and investment activity in general; and support for GDP growth. Lower trade costs, in some cases, can account for up to 16% of total costs. Pavlovska et al. (2022) extend the list of factors arising from a country's deep integration into GVCs. This includes raising the technological level of emerging economies, supporting national industrial policy efforts, increasing production capacity, and improving labor force skills, as well as improving the investment climate and eliminating unproductive competition due to increased interdependence.

Kalinichenko (2023) highlights the possibility of increasing employment, especially among women, as well as improving working conditions and increasing wages in certain industries. However, he also highlights the risks associated with inequality, which can increase as a result of participation in global chains, as well as possible negative impacts on the environment and consumers. Khaustova et al. (2020) emphasize the need to increase production efficiency through access to new technologies and best practices, as well as to expand opportunities for innovation and the development of new markets. Hurochkina & Menchynska (2020) argue that there are certain risks, including possible negative impacts on the environment and consumers. Therefore, it is important to manage these processes by relying on new technologies and innovations to improve production efficiency and develop new markets.

The authors note various positive and negative effects of a country's participation in global value chains. Based on the data, it is evident that Ukraine's involvement in global value chains has had a substantial impact on the country's industrial capacities, output, and employment trends. The amount of industrial output and the number of jobs in the sector seem to be significantly influenced by the amount of imported stuff included in Ukraine's exports. The biggest boost comes from foreign value additions to exports of relatively low-tech light sectors, such as basic metals and textiles. However, decreases in domestic industrial activity are linked to higher import intensity in exports of more complex information technology products. However, a more detailed and broader approach is needed to study this topic, covering more diverse aspects and broadening the understanding of a country's participation in global value chains in the manufacturing industry.

The objective of this research was to investigate the dynamics of Ukraine's involvement in international value chains and assess the effects of integration into cross-border production networks on the growth of the nation's manufacturing industry between 2010 and 2022. The quantitative data and regression models showcased calculate the correlations between Ukraine's trade-based integration policies and important industrial performance metrics.

Literature review

Scientific literature focuses on the dependence of economic development and other macroeconomic effects on the state of inclusion of the national economy in international networks of cooperation and the production of final products. Among the foreign studies aimed at examining participation in global value chains to explain the components of economic development, the following are highlighted. Martínez-Galán & Fontoura (2019) investigated the relationship between the degree of a country's participation in global value chains and the cumulative value of foreign direct investment inflows for the countries of the Organization for Economic Co-operation and Development (OECD) and major developing economies, according to the data for 2002–2011. Scientific literature also addresses the relationship between global value chains and economic growth and productivity. Beverelli et al. (2019) point out a consistency between the theory and empirical research on the possibility of increasing productivity and GDP as a result of integration with global value chains.

Hagemejer (2018) analyzed the determinants of total factor productivity and labor productivity in the new EU member states in 1995-2009. The researcher concluded that there is a link between productivity and export activity, foreign direct investment, and position in global value chains. The scholar also found that productivity gains were greater in sectors farther from final demand and those exporting intermediate goods. The microeconomic foundations of the benefits of participation in global value chains were analyzed by Montalbano et al. (2018) The scientists found that both participation and the position of the industry in global value chains have a positive impact on productiv-

ity at the enterprise level. The researchers also pointed to the possibility of increasing productivity through integration into GVCs, for example, through training through technology supply. An empirical test of the hypothesis on the impact of participation in global value chains on economic growth was carried out by Fagerberg et al. (2018). Based on a study of 125 countries in the period 1997–2013, the researchers found that countries with low absorptive capacity, which determines how they will benefit from the global knowledge base, may experience a slowdown in economic growth with increased participation in global value chains. For example, for economies with a lower capacity to absorb knowledge, increased participation in global value chains leads to a slowdown in growth.

Brumm (2019) studied the impact of countries' participation in global value chains on the current account balance. It was found that the impact of the participation indicators used was statistically significant and positive. For instance, a higher degree of participation translates into a larger current account surplus (a smaller deficit), while the channel of influence is the trade balance. Based on a study of the Belgian manufacturing industry in 2002–2010, Gagliardi et al. (2021) analyzed the impact of a company's position in the global value chain on wages. It was established that employees of enterprises that produce goods far from the final demand receive higher wages. Bontadini et al. (2020) pointed out the possibility of increasing productivity through integration into GVCs, especially through learning by doing.

These studies reflect the importance and diversity of the impact of participation in global value chains on economic development and point to the need for further research in this area.

Materials & Methods

The main direction within global value chains is the production of industrial products, although a significant share of the value created is related to services. In this regard, to ensure a country's competitive position in global value chains, it is important not only to consider the impact of factors related to industrial employment, industrial innovation, and investment in the manufacturing sector but also the impact of the country's level of participation in global value chains on the development of the manufacturing industry.

The main research method used was multiple linear regression, which was used to assess the dependence of the main indicators of processing industry development on the degree of integration of its branches into GVCs. The functional dependence of our hypothesis is described by the following equation (1):

$$Y = f(\text{gycb\_share; gvcf\_share; gvc\_share}), \quad (1)$$

where: Y – level of development of the manufacturing industry, which is described by indicators of products sold, the volume of attracted investments, expenditures on innovation, technological upgrades, and the number of employees; gvcb_share – coefficient of backward participation; gvcf_share – coefficient of forward participation; gvc_share – overall indicator of participation in global value chains.

Based on the functional equation (1), an econometric equation can be formulated where α is a constant term, β_i are the coefficients to be estimated, and εt is the error term (2):

$$Y_t = \alpha + \beta_1 \cdot \text{gvcb}_{\text{sharet}} + \beta_2 \cdot \text{gvcf}_{\text{sharet}} + \beta_3 \cdot \text{gvc\_sharet} + \varepsilon t \quad (2)$$

To determine the relationship between the development of the processing industry and the degree of Ukraine's involvement in GVCs, a statistical correlation analysis was used in the study, which involves building a linear regression model. The dependent variables used are indicators characterizing industrial output, investment in industry, innovation activity, and employment in industry, and the independent variables are indicators of Ukraine's overall, direct, and reverse participation in global value chains. The information base for the study was statistical data on the development of the manufacturing industry published by the State Statistics Service of Ukraine, as well as data from the statistical database Trade in Value Added (TiVA) (Organization for Economic Co-operation and Development, 2023).

The research study of cross-border e-commerce was conducted using methods that revealed the content of the object. The analytical method examined academic publications, government statistics, industry reports, databases, and news items about Ukraine's involvement in international value chains and the growth of the manufacturing sector. Ukraine's interactions with global chains were examined through an analysis of production, trade, investment, innovation, and employment statistics using an analytical approach. In addition, materials, parts, technology, and services that Ukraine buys and supplies to cross-border production networks were identified. Ukraine's positions and responsibilities in various stages of global supply chains were also evaluated.

Ukraine's industrial operations and activity sequences were mapped using the functional approach to the various global value chain segments. It looked at

how Ukraine functions in cross-border production systems. The functional approach also found weaknesses, obstructions, and limitations preventing Ukraine from carrying out particular tasks in international chains. Ukraine's participation in international value chains was taken into account by the system analysis approach as a component of the wider, interconnected global economic system. It investigated how Ukraine's place in transnational networks affects its trade partner relationships. The operation of regional and global value chains is impacted by shocks and changes in Ukraine's production capacity, as determined by the systems analysis approach.

The deduction approach used globally accepted theories of value chain analysis to examine the industrial sector in Ukraine. It examined the patterns of trade integration in Ukraine using broad concepts discussed in earlier scholarly publications. The deduction process also produced theories regarding the connection between industrial growth indicators and Ukraine's membership in GVCs. Data, indicators, models, and conclusions from many document sources were combined into an overall assessment using the synthesis approach. The study integrated regression analysis findings with qualitative analysis of economic data and scholarly literature to develop comprehensive conclusions regarding the influence of GVCs integration on Ukraine's industrial performance.

The GVCs participation rates and manufacturing production indicators in Ukraine were examined using the comparison method between 2010–2022. Additionally, it compared the economic trajectory of Ukraine to trends seen in similar developing countries, pointing out structural changes in the country's industrial capacity and trade integration throughout the course of the investigation. In the context of the study, analytical data, statistics, and other sources were combined to understand the complexity of participation in global chains.

Results

Over the past ten years, Ukraine's manufacturing industry has experienced significant reorganization in response to the country's shifting role in global value chains. Changes in Ukraine's cross-border integration have had a direct impact on the country's domestic production capacities and output, given its long-standing industrial base. This readjustment highlights specific details related to import-export dynamics between foreign and domestic value additions in various manufacturing sectors.

The first discernible effect is the apparent increase in gross manufacturing exports from Ukraine between 2010 and 2022, which was exceeded by an even more rapid increase in domestic value added. This suggests that export-oriented production is becoming less dependent on imported materials. Nonetheless, throughout this time, Ukraine's overall participation rates in global value chains declined, which was reflected in the country's industries' reduced integration into cross-border networks. Ukraine's role in these networks has also changed, moving it away from only providing intermediate inputs and towards final output stages.

The manufacturing sector in Ukraine has undergone certain realignments as a result of these influences. The analysis shows that the percentage of foreign value added included in industrial exports significantly influences employment levels and production volumes. Light industries with high import content, such as basic metals and textiles, experienced expansion in tandem. Negative correlations were seen in the highly developed electronics and industrial sectors, though, since rising imports had no positive effect on home performance.

These varied consequences of shifting global value chain participation on parameters including investment, innovation, sales, and jobs across Ukraine's manufacturing industries are further explored in the following results. However, the opening sentences lay out the general effect of Ukraine's shifting trade integration patterns on restructuring the capabilities and composition of domestic production.

One of the most important indicators of the national economy's involvement in GVCs is the share of domestic value added to Ukraine's gross exports. Even though Ukraine's gross exports and domestic value added in 2022 did not increase significantly compared to 2010 (by 5.8% and 11.7%, respectively), the share of the national component in gross exports increased from 70.3% to 74.2% (Fig. 1).

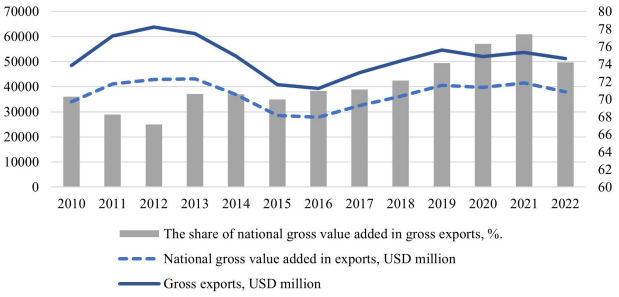

Fig. 1. Dynamics of national gross value added in Ukraine's exports in 2010–2022 based on Organization for Economic Co-operation and Development (2023)

The second way to determine participation in global value chains is to calculate the coefficients of participation in global value chains. Using the data published on

the OECD platform (TiVA), the degree of Ukraine's economy's involvement in GVCs in 2010–2022 was determined (Tab. 1).

Reverse participation, or "upstream," also known as an indicator of a country's vertical specialization, is the percentage of foreign value added to total gross exports. This indicator allows us to assess the importance of imports for a country's exports, and a high value indicates a strong link between them. The decline in the reverse participation ratio for Ukraine from 29.71% in 2010 to 22.91% in 2022 indicates that the dependence of the Ukrainian economy on imports has decreased. Thus, less than a third of Ukraine's exports consisted of previously imported components. The highest level of Ukraine's dependence on imports of intermediate goods used as components of exports was observed in 2012, when the reverse participation ratio was 32.88%. Following the Russian annexation of Crimea and the occupation of parts of the Donetsk and Luhansk regions, the Ukrainian economy lost part of its industrial production capacity. It led to a decrease in Ukraine's reverse participation in global value chains, and a similar situation occurred in 2022.

The downstream direct participation ratio indicates the indirect participation of Ukraine's domestic value added to the gross exports of other countries. This indicator determines the importance of value-added created in Ukraine in the external export operations of other countries. The total participation in global value chains is calculated as the sum of external value added in exports and domestic value added indirectly exported by trading partners. The higher this coefficient, the greater the country's share in the value chain. The calculations show that there has been a decrease in the value of the overall indicator of Ukraine's participation in global value chains – from 50.71% in 2010 to 42.05% in 2022. Accordingly, during the period under study, there was a decrease in the integration of the Ukrainian economy into global value chains. To a large extent, this situation is caused by the fact that many industrial enterprises have lost their ties with Russian companies and, accordingly, their part of the Russian market. And entering new markets requires time to find partners and additional costs for modernizing industrial facilities and promoting products.

Ukraine's position in global value chains was also assessed, which allows us to determine which stages of production (initial or final) the country specializes in. The country's position in the early stages of the production chain is evidenced by the high positive value of the index of position in global value chains. During 2010–2016, Ukraine's reverse participation rate was high. That indicates significant imports of intermediate goods and the country's specialization in the final

Table 1
Indicators of Ukraine's participation in global value chains in 2010–2022 based on Organisation for Economic Co-operation and Development (2023)

Year	Reverse participation ratio, %	Direct participation ratio, %	Total participation rate in the GVCs, %	Country's position in the GVCs
	gvcb_share	*gvcf_share*	*gvc_share*	*gvc_position*
2010	29.71	21	50.71	–0.33
2011	31.74	22	53.74	–0.35
2012	32.88	19	51.88	–0.53
2013	29.4	20	49.4	–0.37
2014	29.44	21	50.44	–0.32
2015	30	20	50	–0.39
2016	29.06	20	49.06	–0.36
2017	28.88	22	50.88	–0.26
2018	27.88	23	50.88	–0.19
2019	25.87	23	48.87	–0.11
2020	23.7	22	45.7	–0.07
2021	23.41	22	44.11	–0.06
2022	22.91	22	42.05	–0.03

stages of production, as the index of position in global value chains had a negative value, which increased from –0.33 in 2010 to –0.36 in 2016. Since 2017, a gradual decline in Ukraine's position in global value chains has occurred, reaching –0.03 in 2022, although the index remains negative. In addition, the global supply chain position index illustrates how production fragmentation has affected Ukraine's trade. During the period under review, the negative position decreased. This indicates an increase in imports of materials and semi-finished products, while exports of finished goods increased.

The results of the analysis of Ukraine's participation in global value chains confirmed that during the period from 2010 to 2022, there was a decrease in the country's economy's dependence on imported components and inputs used in the production of goods for export. According to the study, there was a decrease in the overall level of Ukraine's participation in global value chains, which indicates a decrease in its integration into global value chains. To test the hypothesis about the impact of the degree of Ukraine's involvement in GVCs on the main indicators of manufacturing industry development, a linear regression method was used. In this regression, the independent variables are the coefficients of Ukraine's indirect, direct, and total participation in global value chains, as well as the indicators of foreign and domestic gross value added in Ukraine's exports (Tab. 2).

As a dependent variable, indicators that characterize the development of Ukraine's manufacturing industry were used: the number of innovative products introduced; the volume of manufacturing products sold; the share of industrial enterprises that used innovative methods; the total number of industrial enterprises; and the number of people employed in the industry (Tab. 3).

The regression analysis revealed no dependence of industrial development indicators on the coefficients of Ukraine's reverse, direct, and total participation in global value chains, as well as on changes in the content of national gross value added in Ukraine's exports. At the same time, the number of employees in the industry and the volume of sales of raw material processing enterprises were found to be directly dependent on changes in the share of foreign value added to Ukraine's exports (Tab. 4). The correlation coefficient was 0.766, and the statistical error in calculating the constant exceeded 10%. Because of that, the relationship between the number of people employed in industry and the import component of exports is relatively weak. Nevertheless, with a probability of 58.8%, it is possible to state that a 1% increase in the content of foreign value added in exports would result in a 0.582% increase in the number of people employed in industry, ceteris paribus. The statistical error of this relationship did not exceed 1%, and the calculated value of Fisher's criterion exceeded its tabular value, which indicates the acceptability of the results.

Table 2
Dynamics of foreign and national gross value added in Ukraine's exports in 2010–2022 based on Organization for Economic Co-operation and Development (2023)

Year	Share of foreign gross value added in Ukraine's exports, USD million USA	National gross value added in exports, USD million USA
	For_ comp	*Nat_ comp*
2010	14387	34039
2011	19109	41096
2012	20985	42836
2013	17967	43150
2014	15355	36810
2015	12246	28578
2016	11406	27848
2017	13189	32472
2018	14010	36240
2019	14142	40519
2020	12333	39708
2021	13566	41202
2022	11108	38740

The relationship between the volume of manufacturing exports and the import component of Ukraine's exports is strong ($R = 0.93$). A significant impact of the independent variable on the dependent variable was found: each 1% increase in the independent variable causes an increase in the dependent variable by 1.279%, with other factors held constant. The statistical error in the calculation of the constant exceeds 10%. Despite this fact, the estimate of the dependence of the volume of manufacturing sales on changes in the foreign content of gross value added in exports is statistically significant, as the error did not exceed 1%. The coefficient of determination shows that the change in the volume of sales of manufacturing products by 86.5% depended on the import of intermediate products as a component of exports and by 13.5% on other factors. The calculated value of Fisher's criterion was higher than its tabulated value, indicating a strong relationship between the various variables under test.

Table 3
Indicators of Ukraine's industrial development in 2010–2022

Years	Indicators of Ukraine's industrial development in 2010–2022	Sales of processing industry products, USD million	Share of industrial enterprises that used innovative methods about the total number of industrial enterprises, %	Number of people employed in industry, thousand people
	Innov_prod	*Prod_ind*	*Innov_ent*	*Empl_ind*
2010	2408	88693.57	11.5	3461.5
2011	3238	107102.7	12.8	3352.7
2012	3403	109029.6	13.6	3236.7
2013	3138	102344.7	13.6	3170
2014	3661	76071.99	12.1	2898.2
2015	3136	52161.78	15.2	2573.9
2016	4139	51378.83	16.6	2494.8
2017	2387	61207.38	14.3	2440.6
2018	3843	69316.4	15.6	2426
2019	2148	70755.7	13.8	2461.5
2020	4066	69709.77	14.9	2358.6
2021	5121	80896.27	16.1	2313.2
2022	3576	41253.25	15	2219.2

Table 4
Dependence of Ukraine's industrial development indicators on the indicators of involvement in GVCs in 2010–2022

Factors	Dependent variables	
	Empl_ind	*Prod_ind*
Number of observations	11	11
Constant values	2.341 (1.558)	–1.051 (1.611)
For_comp	0.582*** (0.162)	1.279*** (0.167)
R	0.766	0.93
R^2	0.588	0.865
F-criteria	$F(1.9) = 12.856$	$F(1.9) = 58.145$

Note: * – statistical allowance 10%; ** – statistical allowance 5%; *** – statistical allowance 1%.

Given the lack of correlation between industrial development indicators and most of the indicators characterizing Ukraine's participation in global value chains, an additional study was conducted using the share of foreign value added in exports by major industries as independent variables. The dependent variables are the same as in the previous regression analysis (Tab. 5).

The calculations revealed no significant correlation between industrial development indicators like innovative product introduction, manufacturing product sales, and foreign-added value in Ukraine's main industries' gross exports. There was no statistically significant relationship between the number of innovative industrial enterprises, the number of people employed in industry, and the share of foreign value added in imported inputs in Ukraine's gross exports, particularly in food production, wood, paper, chemicals, and vehicles. There was also no statistically significant relationship between the number of people employed in industry and the volume of import components.

At the same time, the study revealed a direct, significant ($R = 0.783$) relationship between the number of innovative industrial enterprises and changes in foreign value added in textile and clothing exports, with a 1% increase in the independent variable. The dependent variable increased by 0.475%, provided that other factors were stable (Tab. 6). The coefficient of determination indicates that the introduction of innovations at industrial enterprises depended by 61.3%

Table 5
Share of foreign added value embodied in imported inputs in Ukraine's gross exports in 2010–2022, % based on Organization for Economic Co-operation and Development (2023)

Year	Food, beverages, tobacco	Textiles, clothing	Wood and paper products	Chemical and pharmaceutical products	Basic metals and finished metal products	Computers, electronic and electrical equipment	Machinery and equipment	Transport equipment
	Food	*Textile*	*Wood*	*Chem.*	*Metal*	*Comp.*	*Machin.*	*Transp.*
2010	24.7	15.8	34	46	46.5	30.2	30.7	31.7
2011	26.4	18.4	37.4	48	48.3	34.4	34.8	36.4
2012	29.7	23.6	41.1	48.6	50	39.4	39.1	36.4
2013	29	22.3	39.9	47.1	49.4	39.5	36.1	30.9
2014	28.2	22.9	38.1	43.6	45.8	38.1	35.9	31.8
2015	27.7	25	38.3	44.2	47.2	39.3	37.2	34.6
2016	28.5	26.5	37.9	42	43.6	38.4	35.7	34.5
2017	29.1	27.8	37.2	42.6	42.1	37.3	35.2	33.3
2018	28.5	27.9	36.7	41.5	38.6	36.5	34	34.4
2019	28.2	27.4	34.4	40.2	36.2	35.1	32.9	33.1
2020	25	25.7	32	37.3	34.3	35.1	33.3	33.4
2021	27.1	27.5	35.8	40.5	35.9	35.7	34.4	33.8
2022	25.2	26	31.1	35.3	34.3	35	34	31.9

on the content of imported components in exports of textile products and clothing. This indicates the modernization of enterprises in this sector. The value of Fisher's criterion went beyond the table values, which indicates a close relationship between the various variables. The statistical significance of the calculation results is acceptable since the level of statistical error in the regression did not exceed 5%.

The regression analysis also revealed a strong relationship between the number of people employed in industry and the share of foreign value added in exports of basic metals and finished metal products, computers, and electronic and electrical equipment ($R = 0.917$). There was a direct correlation between the number of people able to work and the import component in exports of basic metals and finished metal products: a 1% increase in the independent variable led to a 1.045% increase in the dependent variable, with other factors held constant. At the same time, the relationship between the number of people employed in the industry and the content of imported value added in exports of computers, electronic, and electrical equipment was inverse: a 1% increase in the independent variable led to a 0.916% decrease in the dependent variable, with other factors held constant. The coefficient of determination indicates that 91.7% of the change in the number of people employed at industrial enterprises depended on the import component of exports of computers, electronic, and electrical equipment, and only 8.3% depended on other factors. The calculated value of Fisher's criterion confirms the high interconnectedness between the independent and dependent variables, as it exceeds the table value. The level of statistical error of the regression, which did not exceed 1%, confirms the statistical significance of the results.

A regression analysis examining the relationship between key indicators of industrial development and the share of final products exported by Ukraine in selected industries during 2010–2022 was performed. It showed a significant ($R = 0.868$) direct impact of exports of finished wood products on the volume of manufacturing output: a 1% increase in the volume of the independent variable led to a 2.54% increase in the volume of the dependent variable, with all other variables held constant (Tab. 7).

The determination coefficient shows that 86.8% of the variation in the volume of industrial products sold was due to adaptation to the export of wood and wood

Table 6
Dependence of Ukraine's industrial development indicators on the share of foreign value added in exports by industry sector in 2010–2022

Factors	Dependent variables	
	Innov_ ent	*Empl_ ind*
Number of observations	11	11
Constant values	1.13** (0.398)	7.292*** (1.012)
Textile	0.475*** (0.125)	–
Metal	–	1.045*** (0.167)
Comp.	–	–0.916*** (0.268)
R	0.783	0.917
R^2	0.613	0.841
F-criteria	$F(1.9) = 14.303$	$F(2.8) = 21.275$

Note: * – statistical allowance 10%; ** – statistical allowance 5%; *** – statistical allowance 1%.

Table 7
Dependence of Ukraine's industrial development indicators on the share of final products in exports by industry sector in 2010–2022

Factors	Dependent variables	
	Prod_ ind	*Empl_ ind*
Number of observations	11	11
Constant values	4.586*** (1.263)	–4.055** (1.312)
Wood	2.54*** (0.482)	–
Textile	–	2.732*** (0.299)
R	0.868	0.95
R^2	0.754	0.902
F-criteria	$F(1.9) = 27.673$	$F(1.9) = 83.455$

Note: * – statistical allowance 10%; ** – statistical allowance 5%; *** – statistical allowance 1%.

products. At the same time, the remaining 13.2% of the variation was influenced by other factors. The calculated value of Fisher's criterion is higher than the table value ($F(1.9) = 27.673$). It shows that there is a tight relationship between the variables under consideration. The statistical error of the regression did not exceed 1%, which confirms the statistical significance of the results. The analysis revealed a strong direct correlation ($R = 0.95$) between the number of employees in industrial enterprises and the percentage of textile output that is exported. A 1% increase in exported textile products resulted in a 2.732% increase in the number of employees at industrial enterprises, with other factors held constant. The coefficient of determination indicates that 90.2% of the change in the number of employees in factories was related to the percentage of textile and clothing exports, while 9.8% of the change was due to other causes. The calculated value of Fisher's criterion exceeds the tabulated value ($F(1.9) = 83.455$), which indicates a strong relationship between the analyzed variables. The statistical error of the regression did not exceed 5%, which indicates the reliability of the results.

The regression analysis did not reveal a statistically significant relationship between industrial development factors like innovation introduction, innovation application ratio, and major industrial sector participation in total exports. Similarly, there is no statistically significant relationship between industrial output volume, industry employee count, and exports of major industrial products like food, chemicals, pharmaceuticals, metals, computers, electronics, machinery, and vehicles. Some other relationships, such as the relationship between the number of employees in industry and exports of wood and paper products, and between the volume of industrial output and exports of textiles and clothing, were also not found to be statistically significant.

Discussion

The study shows that Ukraine's participation in global value chains has a significant impact on industry, especially in terms of the number of employees and production volumes. An important feature of this impact is the dependence of these factors on the presence of foreign components in export-oriented production. The increase in foreign value added in the production and export of textiles, clothing, basic metals, and fabricated metal products has a key impact on industry, stimulating innovation and employment in this sector (Zagoruiko & Petkova, 2023; Kerimkhulle et al., 2023). On the other hand, an increase in imported components in electronic production leads to a decrease in industrial activity, especially in the number of employees. This goes without a significant impact on other aspects of the development of these industries. The

growth in the share of exports of finished goods in the wood and textile sectors has a positive impact on industrial output and employment in these industries. This growth indicates that these industries are being included in global chains at later stages of production (Revak & Kondro, 2020).

Engaging in global value chains can be challenging in several keyways. Firstly, it is important to bear in mind that this process creates dependence on external factors. This can become a risk factor in the face of geopolitical or economic changes. Global market volatility, currency fluctuations, or geopolitical conflicts may affect the profitability and stability of production chains (Artyukh et al., 2023; Oladipo et al., 2023). In addition, engaging in global supply chains may require high costs to adapt to new technologies and production standards. Transitioning to new systems or modernizing production often requires significant investment and time to ensure that businesses can remain competitive and comply with international requirements (Trusova et al., 2021; Danchuk et al., 2015).

De Marchi & Alford (2022) examined the role of public policy in the context of global value chains. The researchers argued that management decisions made at the state level are aimed at ensuring participation in global value chains and enhancing value capture through the use of strategies aimed at facilitating this process. Regulatory mechanisms and public procurement of goods and services are used to achieve social and environmental goals. However, there are conflicting results, indicating a tension between policies aimed at economic enhancement and social and environmental enhancement. The authors' results, as well as this study, highlight the importance of a country's participation in global value chains and its impact on the industrial sector. At the same time, these results focus on different aspects of this participation and have different emphasis on analyzing changes in export structure and practical approaches to improve the efficiency of enterprises.

The analysis by (Antràs & Chor (2022) shows a significant impact of global value chains on the country's economy, in particular on its GDP growth. The main factors in this impact are the increase in exports and the expansion of new markets for the country's products through participation in global chains. The authors emphasized the importance of implementing a public policy aimed at supporting these chains. These policies should promote innovation and stimulate industry to improve the country's participation in global value chains. The authors focused more on the overall impact of global value chains on GDP, in particular on export growth and industrial development, without going into details about changes in the structure of exports and specific impacts on individual industries.

Carballa Smichowski et al. (2021) concluded that active participation in global value chains, while contributing to export growth, has negative consequences. In particular, it can lead to a decrease in domestic consumption in the country, as enterprises participating in global chains often direct their products for export. This can reduce access to goods and services on the domestic market for the local population. In addition, such active participation may increase the country's external dependence on changes in foreign markets. This can complicate economic stability and pose risks to the domestic economy. Public policy should carefully consider these factors when developing strategies for the country's participation in global value chains and the development of its economy. In particular, it is necessary to consider possible negative consequences, such as reduced domestic consumption or increased external dependence, which may hinder economic stability.

Vandenbussche et al. (2022) studied the impact of a country's participation in global chains on the overall level of employment in the economy. Their research indicates that an increase in export volumes can stimulate the creation of new export jobs. However, this may come at the expense of job losses in industries that do not have direct links to global value chains. This calls for a careful balance in policy formulation to maintain stability and balance in employment, considering both export opportunities and sectors that do not participate in global value chains. It should be added that this factor makes employment less stable and may pose risks to the country's economic development. Therefore, it is necessary to address these aspects of economic management to avoid the negative effects of employment imbalances and to equalize growth opportunities between exports and sectors that are excluded from them.

Kano et al. (2020) highlighted the potential of the country's involvement in GVCs. In particular, the researchers emphasized the potential for improving the environmental efficiency of production through participation in these chains. The study showed that companies participating in global chains are active in reducing negative environmental impacts in the production of goods destined for the international market. This suggests that involvement in these chains can encourage companies to adopt more environmentally friendly production methods, which can lead to a reduction in negative environmental impact. This approach, which is actively used by companies participating in global value chains, is one of the strategic aspects aimed at improving environmental sustainability in the production of goods for global consumers (Kataeva et al., 2019). This strategy may involve the active in-

troduction of new technologies and methods aimed at reducing the negative impact on the environment.

Bodendorf et al. (2023) studied the impact of global chains on the social stability of a country. The authors emphasized that involvement in these chains can lead to increased inequality in society due to unequal access to the benefits that export activity provides. This means that although participation in global chains can create new opportunities for economic growth through exports, these benefits can be distributed unevenly among different segments of society, increasing social inequalities. This aspect is one of the key issues of corporate social responsibility and is of high importance in the context of sustainable development. It becomes important to develop and implement policies aimed at creating more equal conditions, distributing benefits, and creating opportunities for all social groups.

In general, the research results of various authors show that a country's participation in global value chains has a diverse impact on the economy and society. They emphasize the importance of careful analysis and the development of effective economic policies to ensure sustainable economic development, considering various aspects of a country's participation in global value chains.

Conclusions

This study examined the dynamics of Ukraine's participation in the GVCs and its impact on the country's manufacturing industry. The development of Ukraine's manufacturing industry in 2010–2022 significantly reflected the impact of the country's integration into the GVCs. The main factor behind this impact was the dependence of the number of employees employed in the industry and the volume of industrial products sold on the foreign content of gross value added in exports. The study of Ukraine's participation in global value chains from a sectoral perspective revealed that the development of the manufacturing industry was most influenced by the growth of foreign value added in exports of textiles, clothing, basic metals, and finished metal products. This helped stimulate the innovation activity of industrial enterprises and increase employment in these industries. The increase in the import component of exports of computers, electronic, and electrical equipment led to a decrease in the number of people employed in the industry but did not have a significant impact on other indicators of the development of these industries. A positive impact on the volume of industrial output sold and the number of people employed in industry was due to an increase in the share of final products in exports of wood, textiles, and clothing. This indicator is an indication of the involvement of these industries in global value chains at the last stages of the production process.

Further research could include a detailed study of individual industries in the context of their participation in global value chains. This will help to understand the specifics of the interaction of these industries with global chains and to find out which processes can ensure greater efficiency of participation in these chains. The impact of global chains on different regions of Ukraine should also be considered to find out whether these processes have the same impact on economic development and employment in different regions of the country.

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