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Poland in International Supply Chains in 1995-2020: Global Value Chains and Shift-Share Analysis

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Abstract:

Purpose: *To analyse Poland's position within international supply chains in 1995-2020, focusing on changes in Global Value Chains (GVCs).*
Design/Methodology/Approach: *The study employs Global Value Chains analysis and shift-share analysis (SSA) to assess the dynamics of Poland's integration into global networks. Data from the OECD Trade in Value Added Database is used to measure changes in domestic and foreign value-added contributions from 1995 to 2020.*
Findings: *The analysis reveals significant changes in Poland's GVC participation, with increased reliance on foreign inputs and enhanced domestic value-adding capabilities. The impact of the COVID-19 pandemic highlighted the need for greater supply chain resilience. The study is limited by the availability and granularity of data from the OECD database.*
Practical Implications: *Insights can guide policymakers in strengthening Poland's economic resilience and competitiveness in global markets. Enhanced understanding of GVCs can inform strategies to mitigate employment vulnerabilities in highly integrated sectors.*
Originality/Value: *This study provides a comprehensive analysis of Poland's evolving role in GVCs.*

Keywords: *Global value chains, GVC, export, international supply chains, resilience.*

JEL codes: *F15, F16.*

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1. Introduction

The aim of this article is to analyse the positioning of Poland within international supply chains in 1995-2020, with a particular focus on Global Value Chains (GVCs). The study examines the dynamics of Poland's integration into these global networks, evaluating changes in domestic and foreign value-added contributions to Polish exports over the period from 1995 to 2020. The research also assesses the impact of the pandemic on these supply chains and explores Poland's economic resilience and structural transformation in the face of global disruptions.

This study employs a combination of Global Value Chains (GVC) analysis and shift-share analysis (SSA) to dissect the changes in Poland's participation in international supply chains. The GVC analysis focuses on the value added at each stage of production, highlighting Poland's role in global production networks. The SSA methodology, developed by E. Dunn (1960), is utilized to break down the changes in Domestic Value Added (DVA).

Data for this analysis is sourced from the OECD Trade in Value Added Database, focusing on the domestic value added embodied in foreign final demand across various industrial sectors. This comprehensive approach allows for a nuanced understanding of Poland's economic integration and competitiveness within the global economy.

2. An Overview of the Literature

International supply chains are complex networks of businesses, suppliers, and customers from different countries that collaborate to deliver products or services to the global market. Supply chains encompass all stages of production, from sourcing raw materials through production to delivering the final product or service to the consumer.

Supply chains are an essential part of production. However, Porter argued that companies spend too much time and financial resources on performing certain stages of production and supporting activities where they do not have a competitive advantage (Porter, 2008). He identified pre-production and post-production stages as well as supporting activities of the main operational activity. He encouraged companies to focus on what they do best and outsource the rest.

The evolution of transport and technology enabled the possibility of relocating stages of production offshore, with some stages being moved while others remained unchanged. Interestingly, the value added along the value chain appeared to shift away from the offshored stages (Baldwin, 2012). This phenomenon is referred to as the "smile curve," illustrating the value added at each stage of production. According to this curve, fabrication, particularly final assembly, contributes less to value

creation today compared to before the second unbundling, indicating a deepening of the smile curve.

In recent years, there has been an increasing amount of research examining globalization processes through the framework of 'value chains (Baldwin and Freeman, 2021; Bolwig *et al.,* 2010; Gereffi, 2011; Khan *et al.,* 2019; Ponte *et al.,* 2014; Schwarz *et al.,* 2016). Many scholars have embraced the concept that international trade in goods and services should be understood not just as numerous arm's-length market transactions, but also as a complex network involving multinational enterprises and various governance systems that link firms through diverse sourcing and contracting arrangements.

Research focused on specific industries such as garments, electronics, and agricultural commodities has provided valuable insights into the pivotal role of lead firms in shaping these chains (Gereffi *et al.,* 2001). These lead firms, predominantly located in developed countries, encompass not only multinational manufacturers but also major retailers and well-known brands. They wield significant influence in determining what products are produced, how they are produced, and by whom.

The COVID-19 pandemic has underscored the heavy reliance of industrialized nations on suppliers from China, sparking discussions about the need to boost resilience by diversifying sources of supply within global value chains (GVCs) (Javorcik, 2020). Among many studies in this area, the following studies have examined the impacts of COVID-19 on GVCs.

Pichler *et al.* (2020) analyse the economics and epidemiology of different scenarios for a phased restart of the UK economy. Other study (Zhao and Kim, 2021) develops a conceptual model illustrating the connections among various value chain segments in Cand T that have been affected due to the COVID-19 pandemic. Across different industry segments, distribution channels, and geographies, companies have to seek unique opportunities, explore new operating models, and provide more personalized experiences to each customer.

Inoue and Todo (2020) study quantifies the economic effect of a possible lockdown of Tokyo to prevent the spread of COVID-19. The negative effect of such a lockdown may propagate to other regions through supply chains because of supply and demand shortages. George *et al.* (2020) focus on the epidemiological dynamics, that is, the transmission of diseases across countries and industries, through supply chains.

Chatterjee *et al.* (2024) examine the influence of global risk management capability on MNEs' GVC capability to become more resilient to withstand such crises and further enhance their performance. Furthermore, the issue of GVC's resilience is broadly investigated (Arbolino *et al.,* 2023; Gopalan *et al.,* 2023; Gupta *et al.,* 2024; Koligiannis *et al.,* 2023; Krykavskyy *et al.,* 2023; Kadlubek *et al.,* 2022a; 2022b).

3. Research Methods

To achieve the established aim, the analysis was conducted in two stages. The first stage involved an analysis of the dynamics of global value chain (GVC) indicators, including domestic value added (DVA), foreign value added (FVA), GVC employment, and key trading partners. This aimed to characterize Poland's participation in GVCs from 1995 to 2020 and identify major trends. The second stage comprised shift-share analysis

The shift-share analysis (SSA) employed in this study provides a nuanced approach to dissecting the drivers of changes in DVA within specific industrial sectors. This method allows to distinguish between the impacts of national growth, industry mix shifts, and regional competitiveness, thereby offering insights into Poland's relative performance in the global context.

The share shift model, belongs to the group of structural and demographic analyses. It allows to examine and assess the level of development of a given region (given OECD country) against the background of the level of development of the reference area (OECD Member States). The method was developed and presented by E. Dunn (1960). It provides valuable information whether changes in a given economy result from general environmental trends or whether they are the result of certain endogenous factors characteristic of a given country / region.

The classical analysis examines the formation of the variable X quantified in the form of a complex absolute increment or rate of change. The use of SSA analysis in research involves decomposing the total change of the localized variable into three components reflecting (Suchecki and Antczak, 2010):

- the effect of total OECD countries E_i growth,
- the effect of changing the sectoral structure of S_i,
- effect of competitiveness of the R_i region.

E (The OECD Growth Effect), is the effect of OECD countries growth. It explains to what extent the increase in the share of a given country can be explained by the overall growth of the OECD economy: if the whole of the OECD economy is growing, then generally positive changes can be expected in every industry in a given country (the proverbial analogy: "the growing wave that lifts all boats").

S (Sectoral Mix Effect), is the effect of the sector mix. It represents the share of sector growth (in this case the value of DVA) in a given country, explained by the growth of a specific sector at OECD level. It can be expected that if the share of DVA increases in all OECD countries, it will also increase in a given country.

R (Regional Competitive Effect), is the effect of regional competitiveness. The regional competitive effect is the most interesting of the three indicators. It explains

how many changes in a given industry result from the unique competitive advantage of the region (country), because the growth cannot be explained by the trends of OECD countries in this industry or the entire economy. This effect is calculated by assuming the total regional development of a given sector and subtracting OECD growth for the same sector.

The classic shift-share equation for increments of the variable under consideration takes the form:

$$\Delta x_i = x_{i,t} - x_{i,t-1} = E_i + S_i + R_i \quad (1)$$

which means:

Change in the share of high technology goods in export in a given country	=	The share of high technology goods in a given country present year	-	The share of high technology goods in a given country in the first year	=	
	=	Change as a result of global trends	+	Change as a result of trends in the high technology goods sector in OECD countries	+	Change as a result of a unique competitive advantage in the region

The effect coefficients are measured as follows:

$$E_i = x_{i,t-1} * \frac{Xt - Xt-1}{Xt-1} \quad (2)$$

$$S_i = x_{i,t-1} * \left(\frac{Xi,t - Xi,t-1}{Xi,t-1} - \frac{Xt - Xt-1}{Xt-1}\right) \quad (3)$$

$$R_i = x_{i,t-1} * \left(\frac{xi,t - xi,t-1}{xi,t-1} - \frac{Xi,t - Xi,t-1}{Xi,t-1}\right) \quad (4)$$

where:
x – value of the variable for a given country,
X - variable value for all OECD countries.

The data utilized in this analysis originates from the OECD Trade in Value Added Database, focusing on the DVA embodied in foreign final demand.

4. Results of the Research

4.1 Indicators of Poland's Participation in Global Value Chains

In traditional trade statistics, exports are measured based on the gross value of goods and services crossing borders, counting the full value of a product each time it is traded internationally. This often leads to double-counting and inflates the value of trade.

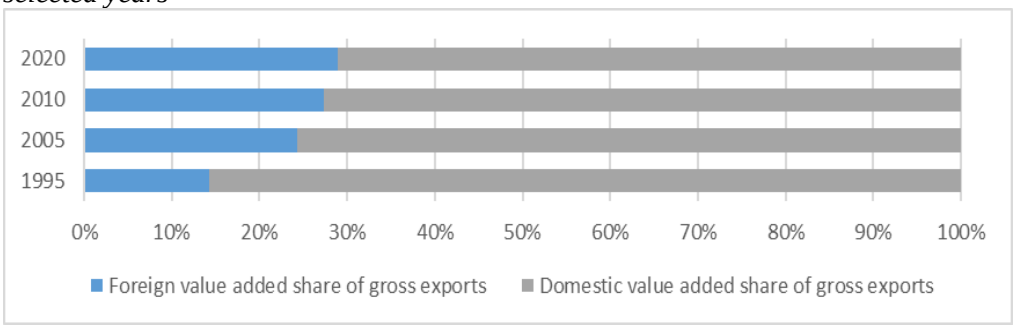
In contrast, Global Value Chains (GVC) and Trade in Value Added (TiVA) focus on the value added by each country in the production process. TiVA accounts for the value added at each stage of production, subtracting the value of intermediate goods and services imported from other countries. This provides a more accurate picture of a country's actual contribution to international trade, highlighting its role in global production networks.

4.1.1 Domestic and Foreign Value Added in Export Statistics

Statistics, which provide a collection of metrics in value added, offer insights into global production networks and supply chains, surpassing the capabilities of conventional trade statistics. Principal indicators trace the origins of value added in exports, imports, and final demand.

The main indicator of gains from Global Value Chains (GVCs) is domestic value added (DVA) in gross exports, because it effectively influences the level of GDP and eliminates the problem of double counting products, which cross borders twice – once as a semi-product, and again as a final product. The changes in the share of domestic and foreign value added in exports of Poland are presented in Figure 1.

Figure 1. *Foreign and domestic value added share of gross exports of Poland in selected years*



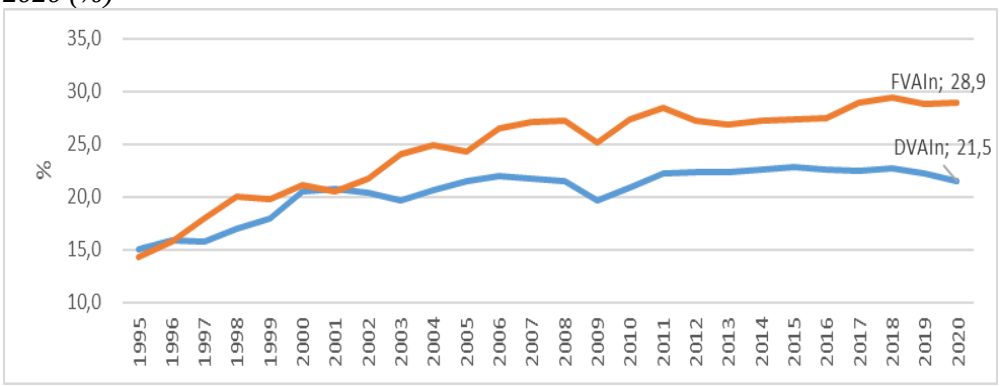
Source: *TiVA 2023 Ed. Principal Indicators.*

In a period of over twenty years domestic value added in polish exports markedly decreased. In 2020 it constituted hardly over 70% of total VA. This signalize significant increase in import's absorbency of polish exports. Simultaneously participation in GVC expands.

A standard method to assess the degree of internationalization through trade in intermediate goods is the measurement of foreign value added in gross exports. This is referred to as backward participation. On a global scale, indicators based on OECD data suggest that since the financial crisis of 2008-2009, there has been a slowdown in the integration of countries within GVCs. Between 2008 and 2020, foreign value added in Polish exports increased from 29.5% to 30.2% (with the OECD average at 27.6%).

Figure 2 provides a detailed view of the evolution of Domestic Value Added. Domestic value added in foreign exports as a share of gross exports (DVAIn) and foreign value added share of gross exports (FVAIn) in Poland's gross exports from 1995 to 2020. Analyzing these trends offers valuable insights into Poland's economic integration and structural transformation within the context of Global Value Chains (GVCs).

Figure 2. *Domestic value added (DVA) in foreign exports as a share of gross exports and foreign value added (FVA) share of gross exports of Poland in 1995-2020 (%)*



Source: (*TiVA 2023 Ed. Principal Indicators.*

Over the observed period, DVAIn exhibited a notable upward trajectory from 15.1% in 1995, peaking at 22.9% in 2016, before experiencing minor fluctuations and stabilizing at 21.5% in 2020. This trend reflects Poland's increased domestic production capabilities and its ability to generate higher value within the country before exporting. Such a rise in domestic value addition suggests improvements in domestic industries' productivity, technological advancements, and possibly the effectiveness of economic policies aimed at strengthening local production capacities. For economists, this could indicate a shift towards a more diversified and

resilient domestic economy, less susceptible to external shocks due to a robust internal value-adding process.

Simultaneously, the consistent increase in FVAIn from 14.3% in 1995 to 28.9% in 2020 signifies Poland's growing reliance on foreign inputs for its export products. This trend is emblematic of deeper integration into GVCs, where intermediate goods and services cross multiple borders before reaching the final consumer.

The rise in FVAIn indicates that Polish industries are increasingly embedded in global production networks, utilizing foreign intermediate goods to enhance their competitive advantage in export markets. For academics, this trend highlights the dual nature of modern economic integration, where local economies are both contributors to and beneficiaries of global production processes.

In the early years (1995-2000), the lower DVAIn compared to FVAIn suggested a high dependency on imported inputs, which could be attributed to the transition phase post the economic restructuring of the early 1990s. As Poland integrated into the European Union and aligned its economic policies with EU standards, the gap between DVAIn and FVAIn began to narrow, reflecting improved domestic value-adding processes.

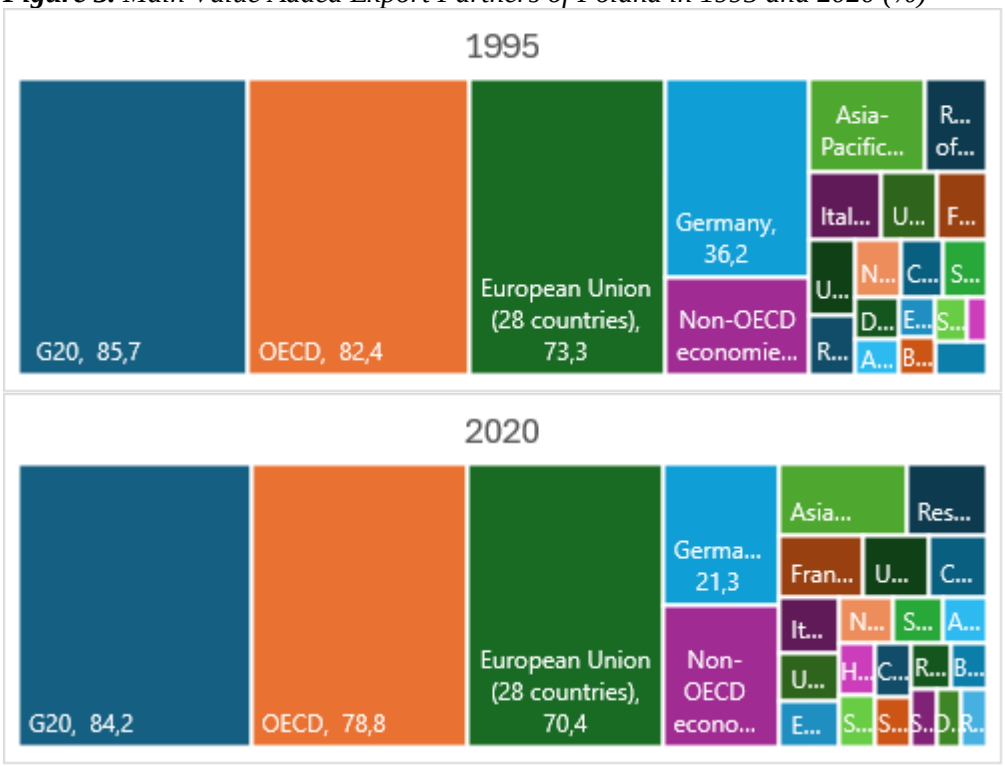
The middle period (2001-2010) saw both DVAIn and FVAIn increase, indicating Poland's solidifying role in GVCs. This period coincides with Poland's EU accession in 2004, which likely provided an impetus for both domestic and foreign investments, enhancing Poland's production capabilities and its role as a critical node in European and global supply chains.

In recent years (2011-2020), the data shows a stabilization of DVAIn around 22% and a peak of FVAIn at 29.4% in 2018. This stabilization suggests that Poland has reached a mature phase of integration within GVCs, where both domestic and foreign value-added components are significant. The slight fluctuations in DVAIn during this period could be reflective of global economic conditions, such as the financial crisis of 2008-2009 and subsequent recovery phases, affecting the balance between domestic production and foreign input reliance.

4.1.2 Main Value Added Export Partners

The dataset examining Poland's gross exports by partner shares from 1995 to 2020 (Figure 3) illuminates compelling trends in the nation's trade dynamics. Over this period, Poland's export landscape witnessed a remarkable consistency, with G20 and OECD countries commanding a significant majority, while European destinations remained pivotal, though experiencing nuanced shifts, reflecting the evolving global economic landscape.

Figure 3. *Main Value Added Export Partners of Poland in 1995 and 2020 (%)*



Source: *(TiVA 2023 Ed. Principal Indicators, n.d.)*

The dataset on Poland's gross exports by partner shares from 1995 to 2020 shows significant trends in its trade relationships. Throughout the period, the G20 countries consistently accounted for a substantial majority of Poland's exports, maintaining a share of around 85% to 90%. The OECD countries also held a dominant share, although slightly lower, fluctuating between 77.9% and 86.6%.

Europe remained the primary export destination, with its share staying above 78%, while the European Union (EU28) countries, particularly the EU27 post-Brexit, saw a gradual decrease from over 73% in the late 1990s to around 65% in recent years. Germany, as Poland's largest individual trading partner, showed a declining trend from 36.2% in 1995 to around 21.3% in 2020.

Non-OECD economies saw an increase in their share, indicating a diversification of Poland's export markets. Significant European partners like France, the UK, and Italy remained relatively stable, whereas emerging markets like China saw an increase, reflecting broader global economic shifts. Overall, while Poland's export base remains heavily European and OECD-centric, there is a noticeable trend towards diversification in global trade partners.

4.1.3 Employment in GVC

Table 1 displays the share of domestic employment in Poland embodied in foreign final demand across different sectors for the years 1995, 2010, and 2020. The data illustrates a notable increase in the proportion of domestic employment influenced by foreign final demand over the years across most sectors.

Table 1. *Share of domestic employment in Poland embodied in foreign final demand*

Sector	**1995**	**2010**	**2020**
D01T03: Agriculture, hunting, forestry and fishing	12,49	22,96	32,47
D05T09: Mining and quarrying	26,24	32,64	39,43
D10T33: Manufacturing	39,46	48,13	59,59
D35T39: Electricity, gas, water supply, sewerage, waste and remediation activities	14,59	20,71	26,07
D41T43: Construction	3,29	8,19	12,7
D45T82: Total Business Sector Services	23,15	34,66	45,42
D84T98: Public admin, education, health and other personal services	2,25	3,43	4,35

Source: *(Trade in Employment by Characteristics, n.d.).*

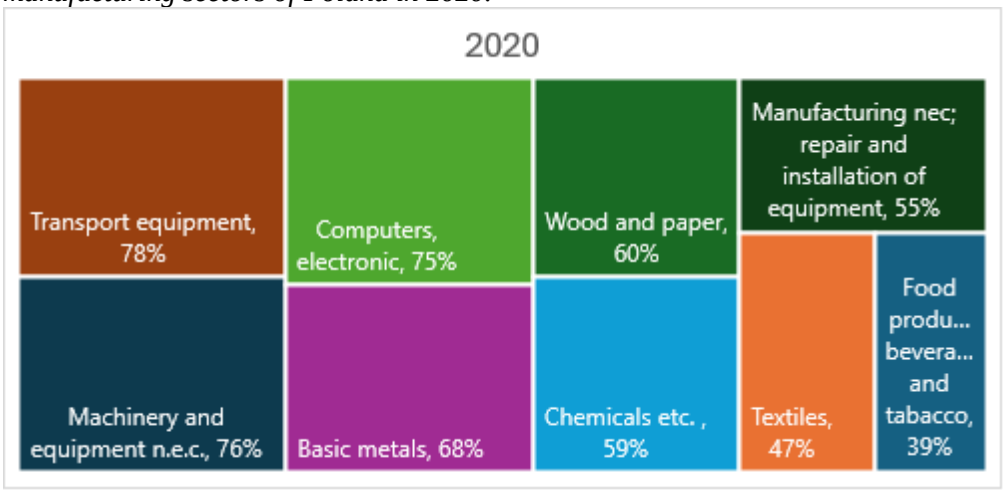
In 1995, the manufacturing sector had the highest share at 39.46%, followed by business sector services at 23.15%. By 2020, manufacturing experienced a substantial rise to 59.59%, indicating a significant dependency on foreign demand for employment within this sector. Similarly, business sector services saw a substantial increase to 45.42%, reflecting a growing integration into the global economy.

Other sectors also showed considerable growth in their share of employment influenced by foreign final demand. Mining and quarrying increased from 26.24% in 1995 to 39.43% in 2020, while electricity, gas, water supply, and related activities rose from 14.59% to 26.07% during the same period. Construction and public administration, education, health, and other personal services also experienced noticeable increases in their shares.

Overall, the data underscores the increasing interconnectedness of Poland's economy with global markets, as reflected in the rising share of domestic employment driven by foreign final demand across various sectors.

Figure 4 offers a detailed breakdown of the share of domestic employment influenced by foreign final demand within various sectors of Poland's industrial landscape. The figures depict a striking pattern of high dependency on global markets across several industries.

Figure 4. *Share of domestic employment influenced by foreign final demand within manufacturing sectors of Poland in 2020.*



Source: *Trade in Employment by Characteristics, n.d.*

The data underscores the vulnerability of Poland's labor market to external shocks due to its significant integration into global value chains (GVCs). Sectors such as transport equipment (77.89%), machinery and equipment n.e.c. (75.92%), and computer, electronic, and electrical equipment (74.67%) have particularly high shares of domestic employment dependent on foreign final demand.

This heavy reliance on international markets implies that any external disruptions, such as global economic downturns, trade conflicts, or supply chain interruptions, could have pronounced negative impacts on employment within these sectors. Similarly, industries like basic metals and fabricated metal products (67.92%), and chemicals and non-metallic mineral products (58.76%) also face considerable exposure.

Such dependence suggests that external shocks could lead to significant job losses, highlighting the need for robust economic policies and diversification strategies to mitigate potential risks. Developing stronger domestic markets and enhancing sectoral resilience can help buffer the labor market against global disruptions, ensuring more stable and sustainable employment.

4.2 Results of Shift-Share Analysis

The shift-share analysis reveals substantial growth in Domestic Value Added (DVA) across most sectors in Poland compared to the average growth in OECD countries. Key sectors like chemicals, electronics, and machinery significantly contributed to this growth, reflecting Poland's active participation in Global Value Chains (GVCs).

Table 2. *Domestic Value Added (DVA) in various industrial sectors in both OECD countries and Poland*

USD, millions	DVA (domestic value added embodied in foreign final demand) in industrial sectors in **OECD countries**					DVA in industrial sectors in **Poland**				
Sectors	2010	share (%)	2020	share (%)	Change (%)	2010	share (%)	2020	share (%)	Change (%)
D10T12: Food products, beverages and tobacco	45872,5	4,9%	63129,4	5,9%	37,6%	4606,2	10,3%	7374,3	10,8%	60,1%
D13T15: Textiles, wearing apparel, leather and related products	19490,3	2,1%	22640,6	2,1%	16,2%	1566,2	3,5%	1634,3	2,4%	4,3%
D16T18: Wood and paper products and printing	40976,6	4,4%	46438,5	4,3%	13,3%	3790,0	8,5%	6123,0	8,9%	61,6%
D19T23: Chemicals and non-metallic mineral products	217574,5	23,1%	275464,4	25,5%	26,6%	11634,1	26,1%	16099,9	23,5%	38,4%
D24T25: Basic metals and fabricated metal products	143223,7	15,2%	139788,1	13,0%	-2,4%	6146,4	13,8%	10795,9	15,8%	75,6%
D26T27: Computer, electronic and electrical equipment	165567,0	17,6%	198963,8	18,4%	20,2%	4261,3	9,6%	6456,1	9,4%	51,5%
D28: Machinery and equipment n.e.c	132382,7	14,1%	136556,4	12,7%	3,2%	2971,3	6,7%	3985,6	5,8%	34,1%
D29T30: Transport equipment	139369,0	14,8%	147317,0	13,7%	5,7%	5872,8	13,2%	8571,7	12,5%	46,0%
C31T33: Manufacturing nec; repair and installation of machinery and equipment	36616,8	3,9%	48199,5	4,5%	31,6%	3703,8	8,3%	7446,5	10,9%	101,1%
Total industries	**941073,1**		**1078497,7**			**44552,1**		**68487,3**		

Source: Own elaboration based on *TiVA 2023 Ed. Principal Indicators.*

The data indicates robust overall economic growth, with Poland showing a larger percentage increase in total DVA than the OECD average. Sectors such as food products, chemicals, electronics, and machinery saw notable increases, suggesting Poland's specialization and comparative advantage in these industries. The positive

growth in technologically advanced sectors like computer and electronic equipment and machinery highlights Poland's involvement in higher value-added stages of global production networks.

This diversification across multiple sectors points to Poland's broadening economic activities within GVCs, enhancing regional competitiveness. Despite overall positive trends, certain sectors like basic metals experienced declines, presenting challenges that need addressing. Understanding these dynamics is crucial for sustaining and enhancing Poland's role in international supply chains and driving sustainable economic growth.

Table 3. *The results of shift-share analysis for domestic value added embodied in foreign final demand in Poland between 2010-2020*

Sectors	**National growth Effect (OECD share)**	**Industry Mix Effect**	**Regional Competitive Effect**
D10T12: Food products, beverages and tobacco	672,64	1060,18	1035,28
D13T15: Textiles, wearing apparel, leather and related products	228,71	24,44	-185,05
D16T18: Wood and paper products and printing	553,45	-48,27	1827,82
D19T23: Chemicals and non-metallic mineral products	1698,92	1396,55	1370,32
D24T25: Basic metals and fabricated metal products	897,56	-1044,99	4796,94
D26T27: Computer, electronic and electrical equipment	622,28	237,28	1335,25
D28: Machinery and equipment n.e.c	433,90	-340,22	920,62
D29T30: Transport equipment	857,60	-522,69	2363,98
C31T33: Manufacturing nec; repair and installation of machinery and equipment	540,86	630,73	2571,11

Source: *Own elaboration based on: TiVA 2023 Ed. Principal Indicators.*

The shift-share analysis reveals (Table 3) that Poland experienced substantial growth in Domestic Value Added (DVA) across most sectors compared to the average growth in OECD countries. Key sectors such as food products, chemicals, electronics, and machinery showed significant contributions from national growth, favorable industry mix, and strong regional competitiveness.

For instance, the "D10T12" sector (food products, beverages, and tobacco) benefited from positive national growth, a favorable industry mix, and regional competitive advantages, indicating robust overall growth. Similarly, sectors like "D19T23"

(chemicals and non-metallic mineral products) and "D26T27" (computer, electronic, and electrical equipment) also demonstrated strong growth driven by these factors.

However, some sectors faced challenges. The "D13T15" sector (textiles, wearing apparel, leather, and related products) showed positive national growth and industry mix but struggled with regional competitiveness. Conversely, the "D24T25" sector (basic metals and fabricated metal products) had strong regional competitive effects but was hindered by a negative industry mix effect.

Overall, the analysis highlights Poland's strategic positioning and active participation in Global Value Chains (GVCs), driven by its alignment with global growth trends, sectoral strengths, and competitive advantages. These dynamics underscore Poland's increasing role in higher value-added stages of global production networks and its enhanced regional competitiveness within the global economy.

Table 4. *Domestic Value Added (DVA) in various industrial sectors in both OECD countries and Poland in the first year of Covid-19*

USD, millions	DVA (domestic value added embodied in foreign final demand) in industrial sectors in **OECD countries**					DVA in industrial sectors in **Poland**				
Sectors	2010	share (%)	2020	share (%)	Change (%)	2010	share (%)	2020	share (%)	Change (%)
D10T12: Food products, beverages and tobacco	66151,0	5,7%	63129,4	5,9%	-4,6%	8141,4	12,0%	7374,3	10,8%	-9,4%
D13T15: Textiles, wearing apparel, leather and related products	25289,1	2,2%	22640,6	2,1%	-10,5%	1627,0	2,4%	1634,3	2,4%	0,4%
D16T18: Wood and paper products and printing	49683,1	4,3%	46438,5	4,3%	-6,5%	5953,4	8,8%	6123,0	8,9%	2,8%
D19T23: Chemicals and non-metallic mineral products	293806,0	25,3%	275464,4	25,5%	-6,2%	15385,8	22,7%	16099,9	23,5%	4,6%
D24T25: Basic metals and fabricated metal products	154184,8	13,3%	139788,1	13,0%	-9,3%	10641,9	15,7%	10795,9	15,8%	1,4%
D26T27: Computer, electronic and electrical equipment	211939,4	18,2%	198963,8	18,4%	-6,1%	5208,4	7,7%	6456,1	9,4%	24,0%
D28: Machinery and equipment n.e.c	147472,2	12,7%	136556,4	12,7%	-7,4%	3 953,3	5,8%	3985,6	5,8%	0,8%

D29T30: Transport equipment	165451,1	14,2%	147317,0	13,7%	-11,0%	9 515,2	14,0%	8571,7	12,5%	-9,9%
C31T33: Manufacturing nec; repair and installation of machinery and equipment	48406,5	4,2%	48199,5	4,5%	-0,4%	7335,5	10,8%	7446,5	10,9%	1,5%
Total industries	**1162383,2**		**1078497,7**			**67761,9**		**68487,3**		

Source: Own elaboration based on: *TiVA 2023 Ed. Principal Indicators*.

Table 5. *The results of shift-share analysis for domestic value added embodied in foreign final demand in Poland between 2019-2020*

USD, millions	**National growth Effect (OECD share)**	**Industry Mix Effect**	**Regional Competitive Effect**	**Total change in DVA**
D10T12: Food products, beverages and tobacco	-587,5	215,7	-395,2	-767,1
D13T15: Textiles, wearing apparel, leather and related products	-117,4	-53,0	177,7	7,3
D16T18: Wood and paper products and printing	-429,6	40,8	558,4	169,6
D19T23: Chemicals and non-metallic mineral products	-1110,3	149,8	1674,6	714,1
D24T25: Basic metals and fabricated metal products	-768,0	-225,7	1147,7	154,0
D26T27: Computer, electronic and electrical equipment	-375,9	57,0	1566,6	1247,7
D28: Machinery and equipment n.e.c	-285,3	-7,3	324,9	32,3
D29T30: Transport equipment	-686,7	-356,2	99,4	-943,5
C31T33: Manufacturing nec; repair and installation of machinery and equipment	-529,4	498,0	142,4	111,0

Source: *Own elaboration based on: TiVA 2023 Ed. Principal Indicators.*

The shift-share analysis (SSA) conducted in this study provides valuable insights into the dynamics of Poland's participation in Global Value Chains (GVCs) and the changes in Domestic Value Added (DVA) over the period from 1995 to 2020. By breaking down the DVA into three components—OECD Growth Effect (Ei), Sectoral Mix Effect (Si), and Regional Competitive Effect (Ri)—we can better understand the factors driving Poland's economic performance within international supply chains.

The OECD Growth Effect (Ei) measures the impact of overall economic growth in OECD countries on Poland's DVA. Our analysis shows that Poland's economic

integration has benefited significantly from the general economic expansion within the OECD region. This component highlights that as OECD countries experienced growth, Poland's exports and DVA also increased, reflecting the country's deep integration into these economies' supply chains. The positive correlation between OECD growth and Poland's DVA suggests that Poland has effectively capitalized on broader economic trends within the OECD, leveraging its connections to drive domestic economic growth.

The Sectoral Mix Effect (Si) assesses the influence of sector-specific growth trends at the OECD level on Poland's DVA. Our results indicate that Poland's industrial structure has been well-aligned with sectors that experienced robust growth within the OECD. This alignment has facilitated the country's integration into high-growth industries, enhancing its participation in GVCs. Sectors such as automotive, electronics, and machinery, where Poland has developed significant capabilities, have driven much of this growth. The positive sectoral mix effect underscores the importance of strategic alignment with global industry trends, suggesting that Poland's economic planners have successfully positioned the country within thriving global sectors.

The Regional Competitive Effect (Ri) evaluates Poland's unique competitive advantages that cannot be explained by OECD-wide or sector-specific trends. The analysis reveals that Poland has developed distinct competitive strengths, contributing to its DVA independently of broader trends. These strengths include a skilled labor force, cost competitiveness, and a favorable geographic location within Europe, which have attracted significant foreign investment and facilitated integration into GVCs. The positive regional competitive effect demonstrates Poland's ability to outperform other regions due to these intrinsic advantages, highlighting the importance of domestic policies and investments that enhance competitiveness.

During the COVID-19 pandemic, Poland's GVC participation experienced notable shifts. Industries such as automotive and electronics, which are heavily integrated into global supply chains, faced disruptions due to supply chain bottlenecks and reduced global demand. Despite these challenges, Poland's diversified industrial base and strong regional competitiveness allowed it to adapt relatively quickly. The pandemic underscored the importance of supply chain resilience and the need for countries to develop flexible and adaptive economic strategies.

Overall, the shift-share analysis indicates that Poland's increased participation in GVCs is driven by a combination of favorable external economic conditions, strategic sectoral alignment, and strong regional competitiveness. These findings suggest that Poland's integration into global supply chains has been multifaceted, with each component of the SSA contributing to its economic resilience and growth. The positive trends observed in the OECD Growth Effect, Sectoral Mix Effect, and Regional Competitive Effect collectively point to Poland's successful adaptation and

strategic positioning within the global economy, especially during the pre-pandemic period and throughout the pandemic.

5. Discussion/Limitation and Future Research

This study's findings on Poland's evolving role in international supply chains align with existing literature on global value chains (GVCs) and their response to global disruptions. Similar studies, such as those by Baldwin and Freeman (2020) and (Miroudot and Nordström, 2020), have emphasized the importance of flexible and resilient supply chains in mitigating the adverse impacts of global crises. The results corroborate these findings, showing that Poland's increased reliance on foreign inputs and enhanced domestic value-adding capabilities have positioned it more robustly within GVCs. The analysis reveals that countries with diversified industrial bases tend to better withstand global shocks, a trend consistent with other research in the field.

Several limitations and difficulties were encountered during this research. The study relies on data from the OECD Trade in Value Added Database, which, while comprehensive, may not capture all nuances of Poland's industrial activities. The granularity of data, especially for the post-pandemic period, is limited, affecting the depth of analysis. Additionally, the study period extends up to 2020, and more recent data could provide a clearer picture of the ongoing adjustments in GVCs post-pandemic. The shift-share analysis (SSA) used in this study, although effective in breaking down changes in Domestic Value Added (DVA), may oversimplify the complex interactions within GVCs. Future studies might benefit from employing more sophisticated econometric models.

Future research should address these limitations and explore additional areas to enrich our understanding of Poland's integration into GVCs. Incorporating more recent data will be crucial to analyzing the long-term impacts of the COVID-19 pandemic on Poland's supply chain integration and economic resilience. A deeper sector-specific analysis could reveal more detailed insights into which industries have adapted most successfully and which remain vulnerable within the GVC framework.

Comparative studies involving other Central and Eastern European countries could provide a broader context and identify regional patterns and shared challenges in GVC participation. Investigating the impact of specific government policies aimed at enhancing supply chain resilience and economic competitiveness would also offer practical insights for policymakers.

By addressing these areas, future research can build on the findings of this study, offering a more comprehensive understanding of Poland's role in the global economy and the broader dynamics of international supply chains.

6. Conclusions

Before the COVID-19 pandemic (2010-2020), Poland showcased a broad-based and expanding role in global value chains (GVCs). Positive growth was observed in various sectors, indicating a diverse economic landscape. Sectors like food products, chemicals, and electronic equipment demonstrated growth, reflecting Poland's increasing involvement in higher value-added activities. The country appeared to be transitioning toward more technologically advanced and complex production processes, emphasizing its evolving position in the global economy.

During the COVID-19 pandemic, a shift-share analysis revealed a mixed impact across different sectors. Some sectors, such as food products and transport equipment, faced challenges with negative changes in Domestic Value Added (DVA), indicating economic contractions. However, others, including wood and paper products and chemicals, exhibited resilience and growth, driven by positive Industry Mix and Regional Competitive Effects.

The data underscored the strategic importance of industries like computer and electronic equipment, which experienced substantial growth during the pandemic, possibly due to increased demand for technology-related products. The positive influence of Regional Competitive Effects across various sectors highlighted the critical role of regional competitiveness in mitigating economic challenges and supporting growth.

In summary, Poland's role in GVCs has been characterized by diversification, specialization, and resilience. The country demonstrated strengths in industries ranging from food production to high-tech manufacturing. While certain sectors faced challenges during the pandemic, the overall data provides valuable insights for policymakers and industry stakeholders to formulate targeted strategies, investments, and innovation initiatives, ensuring Poland's sustained and competitive participation in the evolving global economic landscape.

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