Empirical Paper

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Poland and global value chains at the beginning of the 21st century – An opportunity or a threat?

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Abstract: This article aims to examine and present trade relations in global value chains (GVCs) and their impact on Polish trade, emphasizing Poland's ability to react to rapid changes in the global economy, as in the case of the COVID-19 pandemic. For this purpose, the author proposed a two-stage study. The first stage focuses on analyzing selected indexes describing the Polish share and position in GVCs against the background of the European Union (EU) and OECD countries. The second stage is related to the analysis of the latest economic trade data and the reaction of Poland, the EU, and OECD to changes in international trade in 2020 and 2021 in the context of GVC. The study uses data from the OECD and WTO Trade in Value Added Database and the Eurostat Database. The relatively quick adaptation of Poland to the world's standards indicates great possibilities for adaptation of the Polish economy. The share of foreign value added in Polish exports was consistent with global trends. The export orientation of Polish production increased during the analyzed period, proving Poland's deep commitment to global production chains. Despite a similar decline in import and export in the first months of 2020, as in the OECD and the EU26, the growth dynamics in the following months were higher in Poland. Many industries in Poland are highly dependent on the smooth operation of GVCs. At the same time, the service sector is gaining importance, and its share in exports is systematically growing. The highly flexible nature of Poland's international trade allowed it to reduce the negative impact of the COVID-19 pandemic on its economy.

Keywords: global value chain, GVC, GVC participation, GVC position, trade
JEL Classification: F13, F15, F6

1 Introduction

The changes taking place in the world's economy affect all entities (countries, economic organizations, or multinational enterprises) participating in it through any financial and trade connections they may have with it. Due to fragmentation in global production, world trade is increasingly linked to global production chains (GVC). The globalization of trade flows and the dynamic development of Asian countries affect the trade of all countries around the world. New networks of global production are changing and forming new dimensions. This dynamic structure is continually shifting. In such conditions, individual countries and regions change their position and participation in the global economy. These active processes have a significant impact on smaller economies that must adapt to these changes taking place. Individual

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countries adjust their internal policies to the requirements of a transforming world and, in turn, influence other countries.

A good example is Poland, which, as a relatively small country, had to adapt to the dynamically changing global economy in recent decades and deal with many problems related to its history and economic past. The political transformation of the 1990s took place relatively quickly. One can even talk about "shock actions," which, on the one hand, led to an increase in unemployment or high inflation and, on the other hand, made it possible to adopt capitalist solutions. As a result, in a relatively short time, i.e., in about 15 years, Poland became a European Union (EU) member. At that time, not only due to the adaptation to the common market rules but also the dynamic development of trade, Poland became part of the global network of trade connections.

The following years, i.e., after 2004, were still a demanding period of economic changes for Poland. Poland not only continues to adapt its economy to regional challenges but also has to respond to global challenges through global production networks. One of the first challenges was the global financial crisis of 2008–2009. Its impact on the Polish economy was relatively smaller than on most European countries [Domańska, 2012; Hagemejer and Tyrowicz, 2017; Denkowska et al., 2021). Another shock for the world economy and Polish economy came in 2020, when due to the COVID-19 pandemic, there was an unprecedented reduction in economic activity practically all over the world [McKibbin and Fernando, 2020]. Local lockdowns and transport restrictions disrupted world trade. As a result, there was a sharp slump in international trade volume in a world economy through the links in global value chains (GVCs) [Evenett, 2020; Gereffi, 2020]. How did Poland deal with this situation? Has there been a sharp decline in trade? Were these changes permanent, and were they comparable to those of other EU member states and developed countries? The study aims to examine and present trade relations in GVCs and their impact on the Polish trade, emphasizing Poland's ability to react to rapid changes in the global economy as in the case of a COVID-19 pandemic.

The article compares Poland's share and position in the GVC with the European Union (EU) and the Organisation for Economic Co-operation and Development (OECD) countries since the mid-2000s. The data illustrate the shift in Polish participation and position in GVCs. Based on this, it is possible to determine the relative dependence of the Polish economy on GVCs in relation to other developed economies. The next step of the study is to analyze and compare changes in Poland's international trade against the EU and OECD via standard international trade parameters.

2 Materials and methods

The fragmentation of production related to the development of technology as well as the search for access to markets and resources means that we must look at the connections in the global economy in a new and different way. It is less and less common to talk about a trade in finished products made in one country, and more and more often we deal with "trade in tasks" [Grossman and Rossi-Hansberg, 2008]. Thus, the typical description of "Made in" products becomes obsolete and description of "Made in the Word" becomes more important. The world economy is changing and international trade is expanding, which create GVCs. GVC is broadly defined as an interpenetrating production process carried out in different countries [World Trade Organization, 2014]. These processes also include the initial production steps, such as creating a project/concept, and the final steps, such as service and utilization [Cattaneo et al., 2010]. This perception of trade means that widely used trade statistics do not describe the real links between economies. Research programs aimed at preparing international input–output tables meet this challenge. The new statistics make it possible to research in the field of measuring international trade with added value [World Bank, 2017; Antras, 2020]. An example of such activities is the joint initiative of the OECD and World Trade Organization (WTO) to prepare the Trade in Value Added (TiVA) database [OECD, 2013].

The use of data on the share of value added in international trade makes it possible to estimate how the economy and its international trade are dependent on other economies. Not only is the participation in the GVC important for an economy but also its position. Subsequent authors in scientific works prepared,

created, and developed measures to describe the position and participation at the country level or the country-industry level [Backer and Miroudot, 2013; Cieślik et al., 2016; Hummels et al., 2001; Koopman et al., 2010; UNCTAD, 2013; OECD, 2016, 2017, 2018a; Johnson, 2017; Amendolagine et al. 2019]. The following indicators will be used in the analysis where:

c – country of value added origin
p – country of value added final demand
t – total (sum of all industries)
i – industry

1. *Backward participation index* helps assess foreign suppliers' share in the total value of exports of a country/sector. It is a "FVA intensity measure" frequently discussed as an "import content of exports" and considered as a measure of "backward linkages" in the analyzes of GVCs. It is defined as the foreign value added (FVA) of a country/sector embodied in country/sector total gross exports (EXGR). In the case of country analysis, the denominator is total exports, and in the case of industry analysis, the denominator is industry exports.

$$\mathrm{GVC}_{\text{backward participation}} = \frac{\mathrm{FVA}_{c,t,i,p}}{\mathrm{EXGR}_{c,t,i,p}} \times 100 \tag{1}$$

2. *Export orientation index* shows the share of the country's/industry's value added that finally meets foreign final demand. It reflects the measure of a country's/industry's reliance on foreign final demand. It is defined as exported domestic value added (DVA) from country/industry meeting foreign final demand as a percentage of the total value added produced by country/industry (VALU).

$$\text{Index of export orientation} = \frac{\mathrm{DVA}_{c,t,i,p}}{\mathrm{VALU}_{c,t,i}} \times 100 \tag{2}$$

3. *Intensity index of DVA in industry's exports* measures the share, in total country gross exports (EXGR), of exported DVA in an industry's exports. It captures the magnitude compared to other industries (the denominator is total exports).

$$\text{Measure the intensity} = \frac{\mathrm{DVA}_{c,i}}{\mathrm{EXGR}_{t}} \times 100 \tag{3}$$

4. *Intensity index of FVA in industry's exports* measures the share, in total country gross exports (EXGR), of exported FVA in an industry's exports. It captures the magnitude compared to other industries (the denominator is total exports).

$$\text{Measure the intensity} = \frac{\mathrm{FVA}_{c,i}}{\mathrm{EXGR}_{t}} \times 100 \tag{4}$$

5. *Position index* in the GVC makes it possible to estimate the country/industry position in GVCs, i.e., to indicate whether a given entity specializes in the first or last production stages. If a country specializes in the early stages of the production chain, it is likely to have a high measure of forward linkages. In such a situation, position index takes positive values. If, on the other hand, the backward participation index is relatively high, the country probably imports a lot of intermediate goods and specializes in the final stages of production (index takes negative values).

$$\mathrm{GVC}_{\text{position}} = \ln\left(1 + \frac{\mathrm{IDVA}}{\mathrm{EXGR}}\right) - \ln\left(1 + \frac{\mathrm{FVA}}{\mathrm{EXGR}}\right) \tag{5}$$

Moreover, the methods of descriptive statistics will be used in the analysis of trends in international trade. The data for analysis are from the TIVA database and cover the years 2005–2015.[1]

3 Results

Figure 1 presents the share of FVA in Polish, EU, and OECD exports. The trend in Poland reflected that of other developed countries, although it should be noted that the share of Poland was lower than in the EU26.[2] The years 2005–2008 were a period of continuous growth of ties, which were sharply halted by the global financial crisis. The upward trend then continued after 2009 for 2 years. The next period, i.e., the years 2012–2014, was characterized by a stabilization of the share of FVA in Polish exports. However, at the same time, the average share of backwards links in the supply chains of other analyzed countries began to decline. Poland joined this trend after 2014.

The comparison of the export orientation index is presented in Figure 2. Countries with a higher share of DVA in foreign final demand rely more on foreign markets to consume their production [OECD, 2017]. The index increased for all analyzed economies, both in the total and in the individual industries. The total share of Polish value added in final foreign demand increased from 25% to >33%, which is the highest among the analyzed economies. This proves a significant increase in the export orientation of Polish production, both in the manufacture and the service sectors. In Poland, in the analyzed period, the industries that increased their export orientation to the greatest extent were those related to food production (agriculture and food production) and information and communication. At the same time, the industries with the highest export orientation in 2016 were:

- machinery and equipment, nec (83.6%);
- computers, electronic and electrical equipment (79.6%);
- transport equipment (71.5%).

Similar industries in the EU26 and OECD also show the highest export orientation index. However, these rates in these economies achieve significantly lower values. These changes prove Poland's deep involvement in global production chains and a strong focus on foreign markets.

The intensity of FVA in exports by the industries is presented in Figure 3. In almost all the cases, regardless of the economy, the intensity of FVA in the analyzed industries increased. Two industries that in

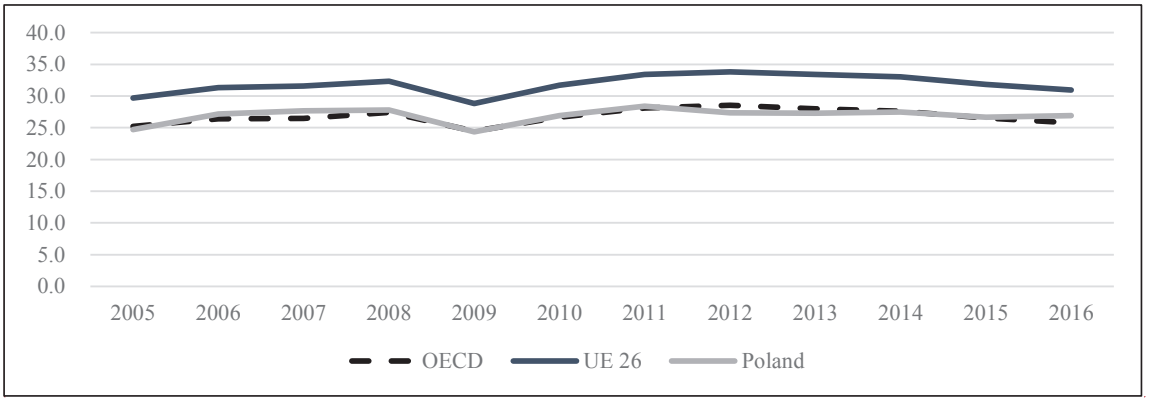


Figure 1. Backward participation index, in %, in 2005–2016.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. TiVA, Trade in value added.

1 Data on exports in total and broken down into industries are analyzed. Thus far, the TiVA database has had several releases. Until 2016, statistics were compiled according to the SNA 1993. The introduction of SNA 2008 in 2018 TiVA release resulted in revisions in GDP and made the 2018 TiVA release incomparable to previous releases [OECD, 2018b] The new 2020 TiVA release will contain harmonized data for 1995–2018, but until June 2021 new statistics have not been published.

2 Poland and the United Kingdom were not included in the EU data.

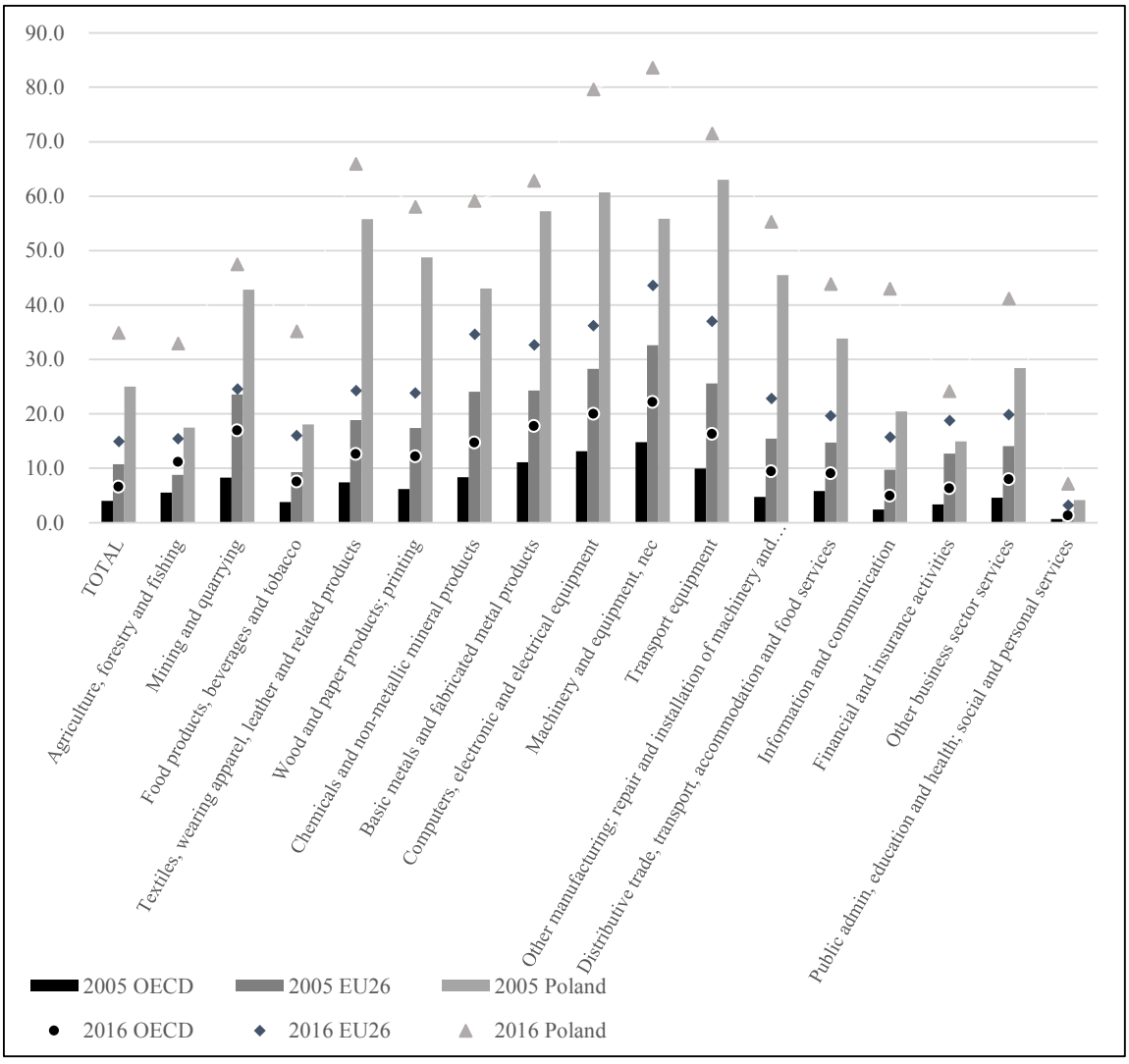


Figure 2. Export orientation index in OECD, EU26, and Poland, in %, in 2005 and 2016.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. EU, European Union; TiVA, Trade in value added.

2015 recorded a lower intensity compared to 2005 is basic metals and fabricated metal products in Poland and machinery and equipment, nec in EU26. In Poland, the intensity of FVA in exports increased the most, by about 30%, in the case of food products, beverages, and tobacco, mining and quarrying, and agriculture, forestry, and fishing. In the latter industry, high increases also took place in the EU26 and OECD, by 27% and 20%, respectively. However, high increases do not necessarily mean that the respective industry is characterized by a higher intensity of FVA in exports. Foreign content share of gross exports is highest for transport equipment, computers, electronic and electrical equipment, and chemicals and non-metallic mineral products. In most cases, the average share of "imports in exports" is the highest in the EU26 and the lowest in Poland. It should be noted, however, that these differences are not large. Economies or industries with high intensity of FVA in exports are heavily dependent on the smooth functioning of GVCs.

Figure 4, as opposed to Figure 3, shows the share of foreign trade value dominated by total gross export. It indicates the relative magnitude of each industry's value-added contribution, both domestic and foreign, to the total gross exports of an analyzed economy. Therefore, not only is the share in gross export important but also the division into domestic and foreign added value. The transport equipment industry is a very good example of this. Its participation in Polish gross exports in 2015 was 10.4% (the third most important industry in 2015). At the same time, this industry was characterized by a very high share of FVA, and, as a

Industry (ISIC Rev.4)	2005 OECD	2015 OECD	2005 EU26	2015 EU26	2005 Poland	2015 Poland
Agriculture, forestry, and fishing	17.8	21.3	20.5	26.0	17.5	22.8
Mining and quarrying	16.6	18.8	21.3	23.8	12.1	15.8
Food products, beverages, and tobacco	22.2	25.3	25.2	29.7	18.3	24.0
Textiles, wearing apparel, leather, and related products	28.2	29.7	30.8	32.1	26.3	28.9
Wood and paper products; printing	25.0	26.8	28.6	30.8	23.1	26.1
Chemicals and non-metallic mineral products	33.5	34.9	37.9	39.1	34.9	35.7
Basic metals and fabricated metal products	32.1	33.1	36.6	38.4	32.9	31.4
Computers, electronic, and electrical equipment	34.6	35.9	39.8	40.2	36.9	44.1
Machinery and equipment, nec	31.0	31.5	35.4	35.2	32.7	36.2
Transport equipment	36.0	36.6	40.4	40.7	38.8	39.8
Other manufacturing; repair and installation of machinery and equipment	24.6	25.0	27.5	27.6	25.0	26.3
Distributive trade, transport, accommodation, and food services	16.0	17.6	18.6	21.5	13.5	14.4
Information and communication	14.1	16.6	18.5	20.7	12.5	15.2
Financial and insurance activities	10.7	12.8	16.3	18.5	9.3	10.8
Other business sector services	12.1	13.9	15.8	17.8	12.0	12.9
Public admin, education, and health; social and personal services	9.5	10.0	11.9	12.5	9.9	10.2

Figure 3. Foreign value-added content of gross exports, as a percent of industry gross exports, by industry, in 2005 and 2015.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. EU, European Union; TiVA, Trade in value added.

result, the share of DVA was only 6.4%. Thus, the share of DVA in transport equipment was slightly higher than in exports of food products, beverages and tobacco (5.2%), although the latter industry was sixth highest in total exports in 2015. In all analyzed economies, distributive trade, transport, accommodation, and food services generated the highest source of DVA.

The most important trade partner of Poland in 2015, both in export and import, was Germany (Figure 5). The analysis of export data allows us to indicate interesting examples of the United Kingdom, France, and the USA, to which Poland exported less in traditional terms than in terms of added value. This means that a part of the Polish value added was transferred to the markets of the countries mentioned above via export intermediaries. A similar conclusion can be drawn by analyzing the import data for China. Direct import from China in gross terms was lower than the Chinese value added. So, Poland imported Chinese value added from third countries. The data indicate a significant underestimation of exports to the US, with a simultaneous overestimation of that to the Czech Republic. In the case of Poland's imports from Germany, trade data indicate an approximate 9% overestimation of traditional statistics in relation to the real value of imports.

An important determinant for gaining benefits from participation in GVC is the position of the country/industry in the GVC. It is assumed that the position at the beginning (positive values of position index) or at the end (negative values of position index) of the chain is conducive to achieving a higher margin, which at the same time means higher income. The most challenging situation is for entities in the middle of the chain (values around 0 of position index). This position means similar links up and down the supply chain, which in most cases means small margins obtained by producers. Among the analyzed economies, OECD countries are characterized by a relatively high position index (Figure 6), regardless of the industry. In 2005–2015, the position index decreased in most manufacturing industries, except agriculture, forestry, and fishing and mining and quarrying. The most significant changes concerned

Industry (ISIC Rev.4)	Indicator	2005 OECD	2015 OECD	2005 EU26	2015 EU26	2005 Poland	2015 Poland
Agriculture, forestry, and fishing	DVA	1.8	2.2	1.6	2.1	1.3	1.5
	FVA	0.1	0.1	0.4	0.7	0.3	0.4
Mining and quarrying	DVA	2.2	2.6	0.6	0.5	2.1	0.9
	FVA	0.1	0.1	0.1	0.1	0.3	0.2
Food products. beverages, and tobacco	DVA	3.1	3.7	3.3	3.5	4.1	5.2
	FVA	0.2	0.3	1.1	1.5	0.9	1.6
Textiles, wearing apparel, leather, and related products	DVA	1.7	1.2	2.5	1.5	2.2	1.2
	FVA	0.2	0.2	1.1	0.6	0.8	0.5
Wood and paper products; printing	DVA	1.8	1.8	3.0	2.6	3.3	2.8
	FVA	0.1	0.1	1.1	1.0	1.0	1.0
Chemicals and non-metallic mineral products	DVA	10.3	11.0	7.2	7.4	7.3	8.5
	FVA	1.5	1.7	4.4	4.9	3.9	4.7
Basic metals and fabricated metal products	DVA	6.8	6.1	4.0	3.6	5.3	5.0
	FVA	0.7	0.8	2.3	2.3	2.6	2.3
Computers, electronic, and electrical equipment	DVA	12.5	9.4	4.5	3.4	4.0	4.8
	FVA	1.3	1.6	3.8	2.8	2.4	3.8
Machinery and equipment, nec	DVA	9.0	7.1	3.2	3.2	3.1	2.7
	FVA	0.5	0.6	1.5	1.6	1.5	1.5
Transport equipment	DVA	8.6	9.2	4.2	4.5	7.8	6.4
	FVA	0.5	0.8	3.2	3.6	5.0	4.3
Other manufacturing; repair and installation of machinery and equipment	DVA	1.2	1.4	1.7	1.7	3.9	3.5
	FVA	0.1	0.1	0.6	0.6	1.3	1.2
Distributive trade, transport, accommodation, and food services	DVA	23,6	21.9	21.1	19.2	23.6	20.7
	FVA	1.0	1.1	4.9	5.2	3.7	3.5
Information and communication	DVA	1.4	2.6	2.6	3.3	1.8	3.1
	FVA	0.0	0.1	0.8	1.3	0.3	0.6
Financial and insurance activities	DVA	2.7	3.5	3.0	2.9	0.6	0.8
	FVA	0.1	0.1	2.8	3.7	0.1	0.1
Other business sector services	DVA	4.9	6.2	5.0	5.8	3.2	4.1
	FVA	0.1	0.2	0.9	1.3	0.4	0.6
Public admin, education, and health; social and personal services	DVA	1.1	1.5	1.4	1.7	0.4	0.8
	FVA	0.0	0.0	0.3	0.4	0.1	0.1

Figure 4. Intensity index of domestic and FVA in industry's exports, in %, in 2005 and 2015.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. DVA, Domestic value added; FVA, Foreign value added; TiVA, Trade in value added.

computers, electronic and electrical equipment. During the same period, the service industries maintained their values. In the analyzed EU countries, the average position index for the entire economy had decreased and is close to 0. This is due to the fact that, depending on the industry, position index takes both positive (mining and quarrying) and negative (financial and insurance activities) values. In Poland, there was also a downward trend in the average overall position index. This is mainly due to the reduction in the index for most manufacturing industries. The decrease in the position index is also visible in most service industries, except financial and insurance activities. Significant changes in the position index in the case of Poland prove the above-average adjustment of the economy to changes taking place in the global economy.

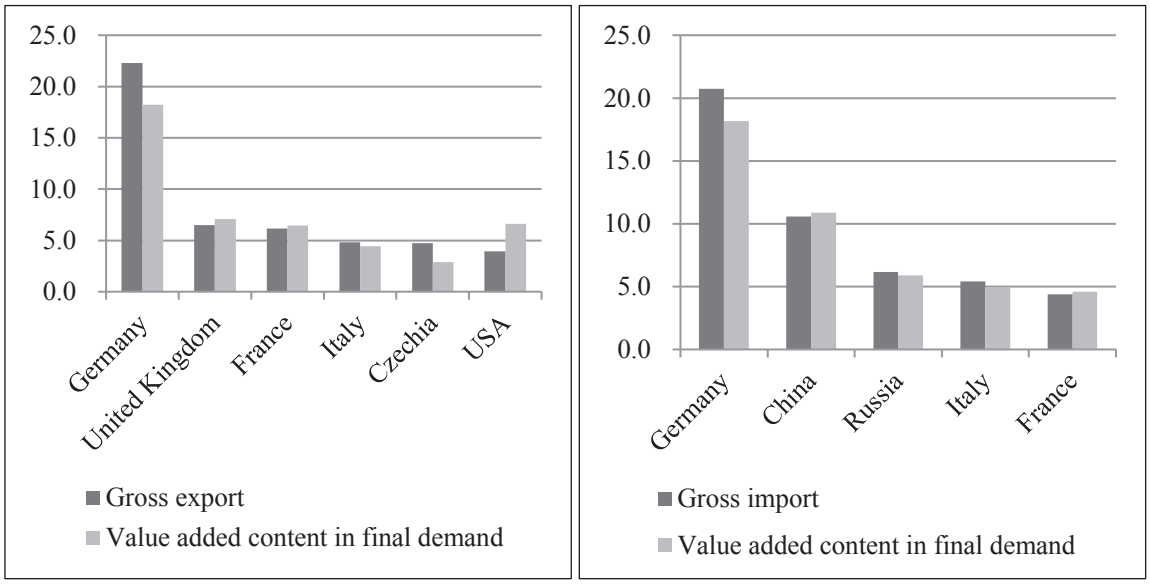


Figure 5. Export and import, by major trading partners, as a share in gross exports and imports and as a share in exports and imports of value added, in 2015.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. TiVA, Trade in value added.

The analysis of import and export trends shows similar tendencies in all analyzed economies (Figure 7). However, it is worth emphasizing that in the case of Poland in 2005–2020, there was a higher increase in trade turnover than in the EU26 and OECD. This trend should not be a surprise for the years 2005–2008 because it can be considered as characteristic for the economy, which, after opening the market along with the accession to the EU, increases its economic openness. However, even after the crisis period, Poland's import and export growth was higher than in the other two economies. These changes correspond to the increasing share of Poland in the GVC and the increase in the export orientation index.

Figure 8 shows changes in the volume of imports and exports in 2020 compared to 2019. Values >100% indicate an increase in the year of the COVID-19 pandemic. In the case of exports, its reduction in Poland and the OECD, as a whole, was noticeable with a short delay of about a month in relation to the EU26. The declining trend in February–April was very similar in all three economies. From May to the end of 2020, a clear upward trend can be noted; but it is worth emphasizing that this dynamic was higher in Poland. In July 2020, Polish exports reached the level of 2019, and in the case of EU26 in September. Similar changes took place in imports. Both in the case of exports and imports, and even the decline in international trade which reached a similar level, Poland was doing better than the other EU countries.

4 Conclusions

The globalization of the global economy related to the creating of new trade links between economies is observable in the changes taking place in Poland. The analyzed data confirm quick adjustments to global trends joining GVCs. The level of the share of FVA in Polish exports was consistent with global trends. Exports gained importance, as indicated by Polish production's export orientation, which increased from 25% in 2005 to >33% in 2015. This also proves Poland's deep commitment to GVC. Hagemajer and Mućk [2019] support the idea of exports playing a predominant role in the shaping of economic growth. The level of changes depends on the analyzed industry, but in the case of Poland, many sectors are highly dependent on the smooth operation of GVCs. Similar relationships are observed in other developing and developed economies of the OECD and the EU. Research suggests that many factors influence the economic potential and involvement of GVCs [Cieślik et al., 2019]. However, in Poland, the level of adjustment to the new, unexpected conditions of the functioning of international trade is more noticeable than in the other

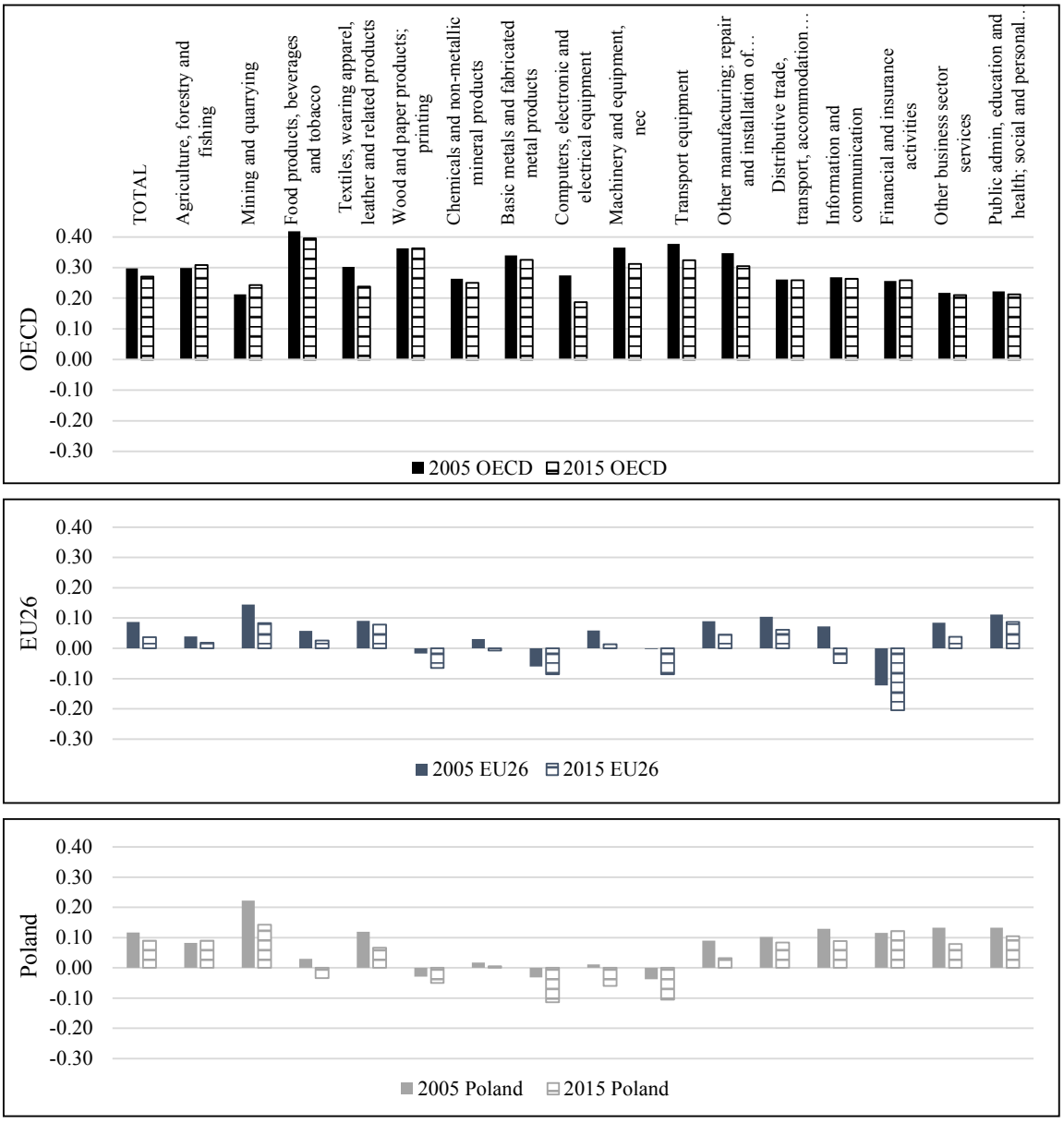


Figure 6. Position index in GVC in OECD, EU26, and Poland, in 2005 and 2015.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: May 11, 2021]. EU, European Union; GVC, Global value chains; TiVA, Trade in value added.

analyzed economies. Despite a similar decline in imports and exports in the first months of 2020, as in the OECD and the EU26, the growth dynamics in the following months were higher in Poland. Trade data also confirm the analysis of gross domestic product changes, which in the case of Poland, were more favorable. Thus, it can be concluded that although the external economic impacts are more significant when countries and regions are linked to a network of GVCs, not all economies react similarly. The Polish economy made much better use of the adaptation skills that may have resulted from the acquisition of transformation competencies by Polish economic entities at the end of the 20th century and the beginning of the 21st century. This confirms the research hypothesis that the high flexibility of Poland allowed it to reduce the negative impact of the COVID-19 pandemic on its economy. As a result, trade links in GVC have become an opportunity that Poland can take advantage of.

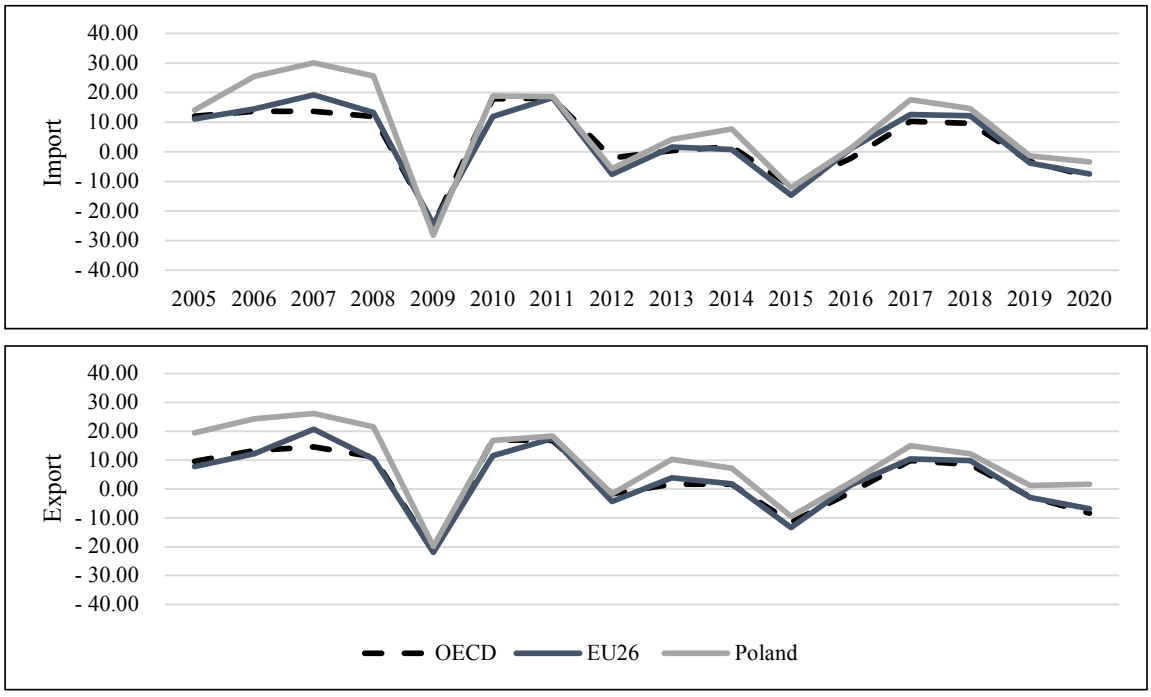


Figure 7. Import and export of goods for selected economies, growth rate Y/Y-1 in %, in 2004–2015.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: July 01, 2021]. EU, European Union; TiVA, Trade in value added.

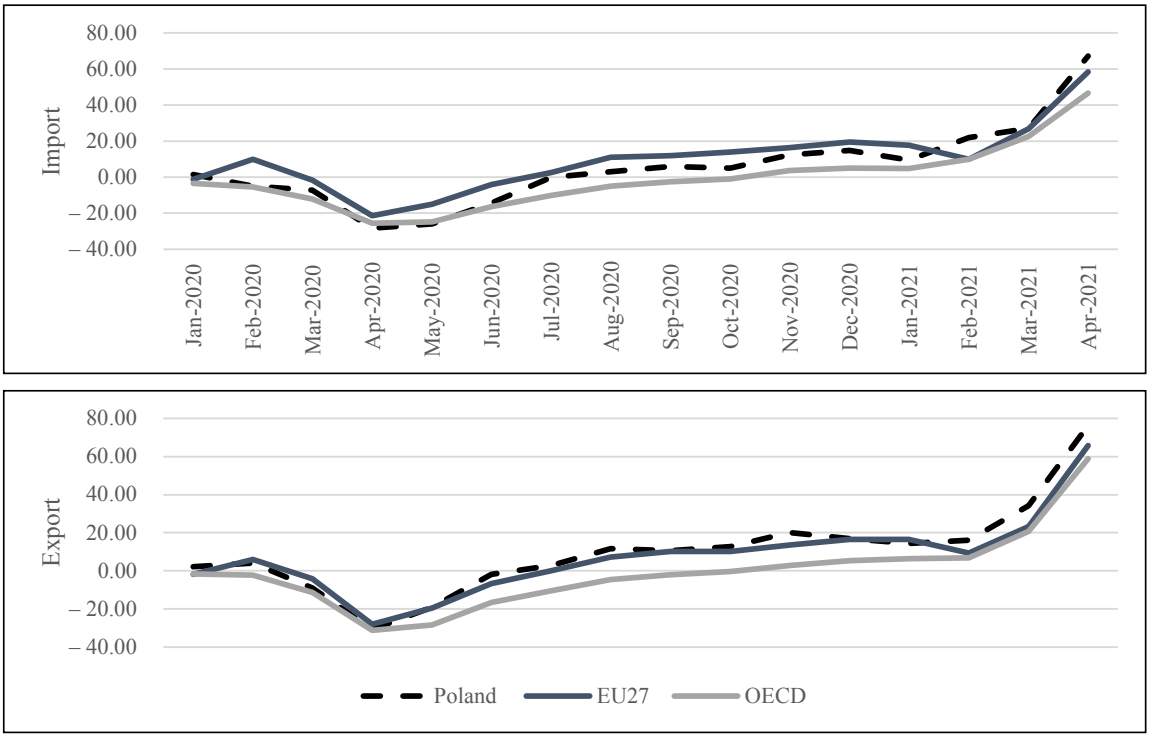


Figure 8. Import and export of goods for selected economies in 2020, growth rate M/M-12 in %.
Source: Own study based on TiVA data, www.oe.cd/tiva [access: July 01, 2021]. EU, European Union; TiVA, Trade in value added.

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