


National Mechanical Engineering in Conditions of Economic Globalization

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Abstract

The study was conducted to assess and substantiate the key systemic problems of the national engineering of different countries in the context of economic globalization. To achieve this goal, the study used the author's method to assess the dependence of mechanical engineering in Ukraine, Poland and Germany on imports of intermediate goods. According to the results, it was determined that in the periods of increasing economic globalization of mechanical engineering in Ukraine, Poland and Germany has undergone systemic destructive changes and is in a threatening state, from the standpoint of economic security. In particular, in Ukrainian and Polish mechanical engineering, the dependence on imports of high-tech intermediate goods is excessively high. In contrast, German engineering, unlike Ukraine's and Poland's, is less dependent on imports of high-tech products, but requires much more resource-intensive intermediate goods. It is analytically substantiated that the identified problems with the import dependence of mechanical engineering in Ukraine, Poland and Germany are the result of irrational, one-sided perception of economic globalization by the main economic entities of these countries.

Keywords

Global-range economic systems, Regional-range economic systems, Transnational business modeling, Descriptive analytics, Economic models, Economic globalization, National mechanical engineering, Transnational corporations, Indicators of economic globalization.

Introduction

Mechanical engineering is the most important centre of intersectoral relations and the economic basis of developed economies. On the one hand, mechanical engineering creates fixed assets and intermediate goods (raw materials, etc.) for all sectors of the economy (agriculture, industry, IT, trade, transport, construction, medicine, defence, etc.) and final consumption goods household items and tools, means of transportation). On the other hand, mechanical engineering is associated with almost all sectors of the economy due to the use of their products and services in their production activities. In recent decades, the functioning and development of mechanical engineer-

ing took place under the influence of economic globalization. In the article, economic globalization means the liberalization of foreign trade, the movement of investments, and the development of logistics. One of the key tools of economic globalization is the abolition or reduction of tariff and non-tariff barriers in foreign trade between countries.

Economic globalization has had a positive impact primarily on the consumer market of engineering products. In particular, the products of world manufacturers of cars, transport, computer and special equipment have become available in almost all countries. At the same time, the impact of economic globalization on the functioning and development of national machine-building industries and, as a consequence, on the socio-economic sphere, is a multifaceted and ambiguous process. For example, Poland has rapidly increased its machine-building output since joining the EU (Rogiński, 2010). Today, the Polish car industry is one of the largest in the EU. The volume of products of the Polish automotive industry in 2018 amounted to more than 37 billion. euro or 13% of the processing industry (Zduniuk, 2019).

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The Polish automobile industry employs more than 180,000 people and about the same number in related industries, and the average wage of an employee is 8% higher than in the economy as a whole. However, the last Polish Polonaise car was built in 2002 (Raports, 2018) and Poland still does not have its own car brand. Instead, the country ranks fifth in the EU in terms of production of various parts and spare parts for cars. In 2018, 59% (compared to 41% in 2005) of the Polish automotive industry accounted for spare parts and accessories for cars. At the same time, about 80–85% (or 32 billion euros) of automotive products produced in Poland are consumed in European markets. Foreign companies play a major role in the development of the Polish automotive industry. They account for 95% of the largest companies in this sector (Zduniuk, 2019), while Polish companies involved in the automotive industry are increasingly specializing in the production of metal products, electrical appliances and various parts, and are gradually increasing their participation in the design. At the same time, experts believe that in order to rise above the level of suppliers of spare parts and accessories, Poland needs to start producing its own cars (Reports, 2018). Instead, Polish national car companies suffer from a lack of investment, low innovation, technology and digitalization of production processes (Ostrowski, 2021), high competition, car overproduction, lower prices with increasing material costs (Włodarczyk & Janczewski, 2014). The problems with the functioning of the automotive industry in the Czech Republic, Slovakia and Hungary are similar. In particular, it is the high export orientation of products, high importance in this segment of transnational corporations (TNCs). At the same time, the national productions of these countries are suffering from the protectionist policies of large countries, the rapid changes caused by Industry 4.0. (Hlušková, 2019).

The prospects of Ukrainian engineering under the influence of economic globalization, in particular the signing of the FTA with the EU, are also ambiguous. These may be the advantages due to the possibility of using the scientific and technological achievements of European countries to modernize national production processes. However, there is room for risks, primarily due to increased imports into Ukraine of final and intermediate consumption products of machine-building industries (Geyets & Ostashko, 2016). Uncertainty about the prospects of this industrial sector in Ukraine is due to a number of other internal problems. In particular, it is high depreciation of fixed assets, lack of working capital, low innovation and competitiveness of Ukrainian engineering products in do-

mestic and foreign markets, financial, economic and political instability, dependence on imports of components (Amosha & Bulyeyev, 2017; Smerichevskyi et al., 2017; Deyneko, 2018; Sokolova & Stoyka, 2019; Hurochkina & Menchynska, 2020).

Economic globalization has an ambiguous impact on the engineering industry and the developed countries and transnational corporations (TNCs) involved in the sector. Thus, on the one hand, machine-building TNCs, using offshoring and outsourcing, derive economic benefits from reduced labour costs, logistics, raw materials, tax optimization, etc. (Tobolska, 2011; Szymańska & Płaziak, 2014; Strykiewicz, 2009). However, on the other hand, the countries of origin of TNCs (mostly developed economies) are losing a significant number of jobs in general and scientific potential in particular. Thus, US TNCs invest in training and improving the skills of talented engineers in China, Taiwan, India and South Korea. On the one hand, for the salary of one qualified US engineer through outsourcing, you can hire three or four possible more talented and qualified engineers from China or India. However, on the other hand, the use of international outsourcing on a large scale carries the risk of reducing the skills of US engineers (Ivypanda, 2019). From this it is obvious that the impact of economic globalization on the functioning of national machine-building industries is a very multifaceted and ambiguous issue, and therefore requires further research. In most of the reviewed and other studies, the analysis and evaluation of mechanical engineering development in the context of economic globalization was mostly carried out using absolute key socio-economic indicators: sales, exports, imports, high-tech products, number of cars sold, number of employees, average wages and etc. Of course, these indicators are important, but they reflect general trends rather than systemic processes or problems in the functioning of national engineering. In addition, it is important to monitor the interactions (or at least their directions) between economic globalization and performance of mechanical engineering.

In this regard, the study was conducted *to assess and substantiate the key problems of the functioning of national engineering in the context of economic globalization*.

To achieve this goal, the study performed the following tasks:

- development and testing of a methodological approach to assess the dependence of national machine-building industries on imports of intermediate goods;
- analytical assessment of trends in key indicators of mechanical engineering development and their

relationship with indicators of economic globalization;

- formation of the author's hypothesis on the functioning of mechanical engineering in the context of economic globalization.

The de facto economic globalization index (KOF Globalization Index 2021) was chosen as the key indicator of economic globalization used in the study. This indicator reflects the level of openness of the country's economy in the field of foreign economic activity and includes trade globalization (trade in goods and services, diversification of trading partners) and financial globalization (direct and portfolio foreign investments, foreign debt, foreign reserves). In addition, this indicator is a reflection of the level of tariff and non-tariff barriers existing in foreign trade of countries, a certain assessment of the level of liberalization of foreign trade. The higher the value of this index, the more open and integrated the economy is.

Additional separate aspects of economic globalization were reflected in the study using indicators: the share of imports in costs (intermediate consumption) of production; the share of production controlled by foreign enterprises in the total volume of production; comparison of export and import trends.

Mechanical engineering of Ukraine, Poland and Germany were chosen as the object of research.

Methods and methodology

To calculate the dependence of a particular sector on intermediate consumption products, the indicator of the share of imports in the amount of sectoral costs (hereinafter – the general indicator) of mechanical engineering is mostly used:

$$\text{ICP} = \frac{S_i}{C}, \quad (1)$$

where: ICP – the imported component of production; S_C – the total amount of imports of intermediate goods (costs) consumed by the studied production; C – the total amount of intermediate consumption (costs) consumed by the studied production.

In this regard, to achieve the objectives, the authors have developed and tested a new methodological approach to determining the dependence of national engineering on imports of intermediate goods. This approach is based on the calculation of the share of the import component in each of the basic elements of the sectoral cost structure (intermediate consumption) of machine-building industries, and also takes into account the cross-sectoral links of this industry

segment:

$$\begin{aligned} \text{ICP} &= \frac{S_i}{C} = \frac{s_{i1} + s_{i2} + s_{i3} \dots + s_{in}}{c_1 + c_2 + c_3 \dots + c_n} \\ &= \frac{S_i \left(\frac{S_i}{S_i} \right) \left(\frac{s_{i1}}{S_i} + \frac{s_{i2}}{S_i} + \dots + \frac{s_{in}}{S_i} \right)}{C \left(\frac{C}{C} \right) \left(\frac{c_1}{C} + \frac{c_2}{C} + \frac{c_3}{C} \right)}, \quad (2) \end{aligned}$$

where: $\frac{S_i}{C}$ – the share of imports in the costs of the studied production, %; $s_{i1} + s_{i2} + s_{i3} \dots + s_{in}$ – import of intermediate consumption products (costs) in terms of foreign trade, consumed by the studied industries; $c_1 + c_2 + c_3 \dots + c_n$ – costs (in terms of foreign trade) of the studied industries; n – number of elements (Type of economic activity).

This approach can be applied by analogy at the micro level to calculate the share of imports in each of the elements of the cost of a particular product. For example, to determine the share of imports in materials, components, units, engines, gearboxes, wheels of a car or tractor.

The assessment of the structure of sectoral expenditures was carried out using traditional methods of economic analysis. To determine the level of economic globalization of the country used the index of economic globalization, de facto (KOF Globalization Index 2021). The general state and trends of national engineering are reflected by such indicators as: the share of innovative products in the volume of sold industrial products, the share of innovation costs in the volume of sold innovative products, the dynamics of capital investment, output, airborne, exports and imports of machinery, the share of TNCs in the Airborne Forces of mechanical engineering and others. The object of the study according to statistical classifiers was mechanical engineering in general (code NACE 26–30) and its production in particular (code: 26, 27, 28, 29, 30). The main source of statistical information used in the study was the input–output tables (SSSU, 2021; OECD, 2021).

Results

Based on the calculation of values overall indicator (f.1) found that the import dependence of mechanical engineering in Ukraine in general is slightly lower (by 2.7 percentage points) compared to Poland, but higher (by 13.01 percentage points) compared to Germany (Fig. 1). In addition, the production of other vehicles (C30) in Ukraine by 3.8 percentage points less dependent on imports than in Germany. From

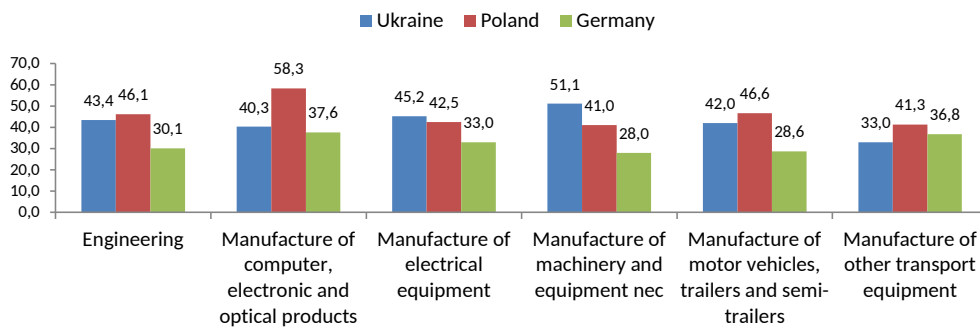


Fig. 1. The share of imports in the costs of mechanical engineering in Ukraine, Poland and Germany, %
 Formed according to: (SSSU, 2022; Eurostat, 2022)

this we can conclude that the overall import dependence of mechanical engineering in Ukraine, compared to Poland and even Germany, is not high. Also definitely positive is the tendency to reduce the values of this indicator during 2017–2019 by 9.9 percentage points (Table 1). This trend was demonstrated by all, without exception, the production of Ukrainian engineering, and most – the production of motor vehicles, trailers and semi-trailers (C29) – by 22.4 percentage points.

Having received the analytical information given in Fig. 1 and Table 1, the authors of the study asked the question: if the degree of import dependence of mechanical engineering in Ukraine, compared to Poland and even Germany, is not too high, then how to explain the fact that: a) the volume of mechanical engineering, especially cars in Ukraine rapidly declining, and the domestic market is filled with imported, mostly worn out and technically and morally obsolete products; b) why the production of Ukrainian engineering in 2019 was more than 10 times inferior to the Polish? It is clear that such trends are primarily due to other systemic factors, but the import dependence of production among them is important. To answer this question, the authors critically approached

the common methodological approach based on the calculation of the overall indicator of import dependence. Indeed, the degree of import dependence, calculated as the share of the import component in the sum of mechanical engineering costs, is a fairly generalized indicator, as it does not reflect the dependence of machine-building industries on imports of products and services of those types economic activities, for the activities of this industrial sector. Accordingly, the assessment of the import dependence of mechanical engineering is more objective if it is carried out element by element, i.e. in terms of the most important and important (in terms of functionality, strategic) elements of costs or technological operations. The application of this approach allowed for a detailed assessment of the import dependence of the national engineering industry and to obtain the following analytical information.

In the sectoral structure of machine-building costs of Ukraine, Poland, and Germany, the following type of economic activity occupies the largest share: machine-building (C26–C30), metallurgical production; wholesale and retail trade; repair of motor vehicles and motorcycles; manufacture of fabricated metal products, except machinery and equipment;

Table 1
 The share of imports in the costs of mechanical engineering in Ukraine,%

Type of economic activity	NACE code	2013	2014	2015	2016	2017	2018	2019
Mechanical engineering, including:	C26–C30	46.1	47.1	48.0	53.3	46.9	45.4	43.4
Manufacture of computers, electronic and optical products	C26	61.8	52	46.9	42.6	40.8	41.3	40.3
Manufacture of electrical equipment	C27	47.7	45.4	48.1	50.4	46.9	44.2	45.2
Manufacture of machinery and equipment nec	C28	50.7	49.6	49.0	56.1	51.4	54.4	51.1
Manufacture of motor vehicles, trailers and semi-trailers	C29	67.1	67.3	64.4	64.4	57.1	44.5	42.0
Manufacture of other transport equipment	C30	30.8	30.9	35.6	48.3	35.3	36.2	33.0

Formed according to: (SSSU, 2022)

supply of electricity, gas, steam and air conditioning; transport, warehousing (including transport mark-up); other business sector services (Table 2).

However, the values of the shares of type of economic activity in the costs of mechanical engineering of the analyzed countries are different. This may be due to the different degree of resource intensity of mechanical engineering products in these countries. Thus, the shares of mechanical engineering products in general and, in particular, the production of finished metal products, except machinery and equipment, as well as the production of rubber and plastic products in the costs of machine building in Ukraine are significantly lower than in Poland and Germany. On the other hand, the shares of metallurgical production and supply of electricity, gas, steam and air conditioning, on the other hand, are significantly higher. The fact that in Poland in the cost structure of mechanical engineering the share of the trade sector; manufacture of fabricated metal products, except machinery and equipment; transport, warehousing (including transport margins) are larger compared to Ukraine and Germany, is a sign that the Polish engineering industry is focused on assembly production and partly – on the production of individual parts.

The relatively high share (9.4%) in the structure of German engineering costs of other business sector services is evidence of the greater focus of German engineering on scientific and technical development, design, outsourcing and more. Such services, especially research, engineering, technical testing, advertising, etc. form an innovative basis for the development of high-tech industries, and thus determine the level of competitiveness of engineering products.

It should also be noted that in Ukraine and Poland in the structure of engineering costs in general, the products of mechanical engineering accounted for 33.4% and 34.6%, respectively, while in Germany – 41.5%. This indicator (the share of engineering products in engineering costs) can be considered one of the indicators of the level of manufacturability: the greater the value of this indicator, the higher the level of raw material processing, and therefore – the higher the level of manufacturability of production processes and products. In addition, it should be noted that the share of the import component in machine-building products used in machine-building is 76.2% in Ukraine, 61.4% in Poland, and only 35.0% in Germany (see Table 2). It follows that the key problematic aspects of mechanical engineering devel-

Table 2

The share of the most important foreign trade and import component in costs (intermediate consumption) of mechanical engineering, %

Type of economic activity	Ukraine		Poland		Germany	
	Share in costs	The share of the import component in costs	Share in costs	The share of the import component in costs	Share in costs	The share of the import component in costs
Engineering	33.4	76.2	34.6	61.4	41.5	35.0
Metallurgical production	22.2	42	7.9	59.8	5.9	41.5
Wholesale and retail trade; repair of motor vehicles and motorcycles	13.5	0.7	14.7	0.1	9.7	27.2
Manufacture of fabricated metal products, except machinery and equipment	5.2	87.5	10.0	30.1	6.5	19.1
Manufacture of rubber and plastic products	2.5	48.9	5.07	45.2	3.7	34.8
Production of chemicals and chemical products	1.1	33.2	1.9	70.8	1.4	44.3
Supply of electricity, gas, steam and air conditioning	4.7	0	0.9	2.3	1.1	5.2
Transport, warehousing (including transport mark-up)	4.2	8.2	4.8	9.4	3.9	21.5
Other business services*	2	6.7	4.5	10.4	9.4	19.7

Note. *Other business sector services are a set type of economic activity under codes M69–M82: M69–M71 – activities in the fields of law and accounting; activity of main departments (head offices); management consulting; activities in the fields of architecture and engineering; technical tests and research; M72 – research and development; M73–M75 – advertising and market research; scientific and technical activities; veterinary activities; M77–M82 – activities in the field of administrative and support services

Formed according to: (SSSU, 2022; Eurostat, 2022)

opment in Ukraine and Poland are, on the one hand, relatively low technology and, at the same time, high resource intensity of production (only the initial links of the value chain), and on the other (as a result) dependence on imported intermediate products of mechanical engineering itself, and not the total of all foreign trade.

It is also necessary to pay special attention to the completely incomprehensible, economically irrational and generally paradoxical situation around the excessively high (87.5%) share of the imported component in metallurgical and finished metal products used in Ukrainian engineering. In Poland, the value of this indicator is 30.1%, and in Germany – respectively 19.1%. The paradox is that Ukraine has a huge potential for the development of metallurgy, whose products occupy the largest share in Ukrainian merchandise exports. However, despite the fact that the intermediate consumption of finished metal products used in mechanical engineering is 87.5% covered by imports. In other words, Ukraine exports iron ore and primary metal products, and imports finished metal products for the production needs of machine-building industries. From the standpoint of rational resource management and protection of economic interests of the country, in particular the engineering sector, this situation is extremely illogical.

The sectoral structure of costs and the degree of dependence on imports of intermediate goods of five machine-building industries (Tables 3–4) reflect in more detail the systemic features of national engineering. In particular, it follows from the sectoral cost structure that all machine-building productions are interconnected by the use of each other's intermediate consumption products and other type of economic activity in their production activities. When analyzing Tables 3–4, due attention should be paid to the following indicators.

Self-consumption (colour filling), i.e. the share of products of a certain production in the costs of the same production. For example, in Ukraine the share of production of motor vehicles, trailers and semi-trailers (C29) in the sectoral structure of costs of the same production (C29) is 13.7%, while in Poland – 31.3%, and in Germany – 39.8 % (see Table 3).

The share of the import component in self-consumption, i.e. the share of the import component in the products of a certain production used in the production activities of the same production. For example, in Ukraine the share of the import component in the production of motor vehicles, trailers and semi-trailers (C29) used in the production of the same production (C29) is 99.2%, in Poland – 75.7%, and in Germany – only 35.1% (see Table 4). It follows that in

Poland the manufacturability of motor vehicles, trailers and semi-trailers (C29) is higher, and import dependence is lower than in Ukraine. In Germany, on the other hand, the manufacturability of this product is significantly higher, and import dependence is much lower compared to Poland and Ukraine. At the same time, a certain advantage or feature of the Ukrainian production of vehicles, trailers and semi-trailers (C29) over Polish and even German is the higher density of intersectoral ties, in particular with related machine-building industries (C28 and C30). The shares of these productions in the sectoral structure of C29 production costs in Ukraine are 14.3% and 15.3%, respectively, while in Poland – 3.6% and 0.2%, and in Germany – 2.3% and 0, 1% (see Table 3). It should also be noted that in Ukraine, compared to Poland, the production of C26, C27, C28, used in the production of C29, is significantly less dependent on imports (see Table 4).

A promising direction in the development of mechanical engineering in Ukraine is the production of other vehicles (C30). At present, the level of its manufacturability is still low, and in the cost structure the largest shares fall on material-intensive products of C28 production, metallurgical production and trade sector. However, the fact that this production is practically independent of the import of mechanical engineering products is a sign of sufficient actual potential for its further effective development, but with an increase in the level of manufacturability.

The peculiarity of Polish mechanical engineering is the predominance of assembly plants, relatively low intersectoral links between themselves and other type of economic activity. At the same time, in Poland, compared to Ukraine, the level of science-intensive machine-building products and R & D is higher. This is confirmed by the larger share of other business sector services in the costs of machine-building industries. In some respects, a common feature of Ukrainian and Polish machine-building industries is their high dependence on imports of basic, high-tech intermediate goods. On the other hand, the feature of German machine-building industries is a significantly higher level of technology and R&D and less dependence on imports of basic intermediate goods. However, it should be noted that German machine-building industries depend significantly on imports of material-intensive industries. In conditions of global instability, this situation increases the risks of breaking the existing supply chains and value formation, loss of investment, etc.

The basic reason or factor that provoked the current state of mechanical engineering in the analyzed countries is the wrong, one-sided perception of eco-

Table 3

The share of the most important foreign trade in the costs of machine-building industries in Ukraine, Poland and Germany, %

Type of economic activity	Ukraine						Poland						Germany					
	C26	C27	C28	C29	C30	C26–C30	C26	C27	C28	C29	C30	C26–C30	C26	C27	C28	C29	C30	C26–C30
Mechanical engineering, incl.	43.5	27	25.9	46.5	39	33.4	50.4	25.6	22.7	37.9	33.8	34.6	29.7	32.5	37.8	47.7	43.1	41.5
<i>Manufacture of computer, electronic and optical products (C26)</i>	41.2	8.6	3.4	2.6	2.4	7.3	36.4	3.0	1.2	0.7	0.6	5.6	23.8	7.0	2.3	0.8	1.2	3.8
<i>Manufacture of electrical equipment (C27)</i>	0.7	7.5	1.2	0.6	0.2	2.1	11.5	17.5	5.9	2.0	2.1	6.7	2.8	19.8	4.0	1.8	2.0	4.4
<i>Manufacture of machinery and equipment nec (C28)</i>	1.2	10.9	20.6	14.3	25.6	17.5	1.6	3.5	13.1	3.6	5.4	4.9	2.4	4.1	26.0	5.3	4.9	10.8
<i>Manufacture of motor vehicles, trailers and semi-trailers (C29)</i>	0.2	0.2	0.4	13.7	0.8	2.0	0.7	1.3	2.3	31.3	2.2	15.7	0.6	1.4	5.5	39.8	1.2	20.3
<i>Manufacture of other transport equipment (C30)</i>	0.2	0.2	0.1	15.3	10.1	4.4	0.1	0.2	0.3	0.2	23.5	1.8	0.1	0.2	0.1	0.1	33.7	2.2
Metallurgical production	3.9	32.2	27.8	16.3	15.7	22.2	4.4	11.0	12.5	6.0	7.9	7.9	3.9	9.2	7.0	5.2	3.5	5.9
Manufacture of fabricated metal products, except machinery and equipment	2.1	2.7	8.9	6.4	2.4	5.2	1.6	6.3	15.2	12.2	8.9	10.0	3.4	4.7	8.1	5.6	13.0	6.5
Wholesale and retail trade; repair of motor vehicles and motorcycles (including trade margins)	38.2	10	9.5	7.9	16.3	13.5	17.9	14.2	12.9	15.0	11.8	14.7	13.4	10.8	9.1	9.2	8.3	9.7
Production of chemicals and chemical products	0.6	1.5	1.4	0.4	0.7	1.1	1.2	3.2	1.8	1.6	1.8	1.9	1.9	1.2	1.4	1.3	1.2	1.3
Manufacture of rubber and plastic products	1.1	4.3	2.3	3.5	1.4	2.5	4.4	7.0	3.5	5.4	1.7	5.1	2.0	2.9	3.5	4.7	1.7	3.7
Supply of electricity, gas, steam and air conditioning	1.9	3.8	7.3	2.2	4	4.7	0.5	1.1	1.7	0.8	1.3	1.0	1.5	1.4	1.2	1.0	0.7	1.1
Other business services	0.9	1.3	1.9	4.5	1.9	2.0	3.2	6.2	6.2	3.1	8.9	4.6	12.2	12.3	10.4	7.4	11.0	9.4
<i>Total selected type of economic activity</i>	<i>92.2</i>	<i>83.2</i>	<i>84.8</i>	<i>87.7</i>	<i>81.5</i>	<i>84.5</i>	<i>83.5</i>	<i>74.6</i>	<i>76.6</i>	<i>82.0</i>	<i>75.9</i>	<i>79.6</i>	<i>68.0</i>	<i>75.0</i>	<i>78.5</i>	<i>82.1</i>	<i>82.5</i>	<i>79.2</i>
Other FEA	7.8	16.8	15.2	12.3	18.5	15.5	16.5	25.4	23.4	18.0	24.1	20.4	32.0	25.0	21.5	17.9	17.5	20.8
Total costs	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Formed according to: (SSSU, 2022; Eurostat, 2022)

conomic globalization by key economic entities. Each of the stakeholders (the state represented by officials, TNCs, national enterprises, citizens) consid-

ered economic globalization, particularly in the engineering segment, unilaterally, from the standpoint of their own selfish interests. Thus, a significant num-

Table 4

The share of the import component of the costs of machine-building industries in Ukraine, Poland and Germany, %

Type of economic activity	Ukraine						Poland						Germany					
	C26	C27	C28	C29	C30	C26–C30	C26	C27	C28	C29	C30	C26–C30	C26	C27	C28	C29	C30	C26–C30
Mechanical engineering, incl.	82.7	87.3	92.2	55.2	65	76.2	83.1	72.3	77.9	75.2	69.1	76.0	71.4	51.1	35.5	35.2	55.0	40.0
<i>Manufacture of computer, electronic and optical products (C26)</i>	84.4	93.3	91.9	76.7	77.8	86.8	87.5	78.1	76.5	80.4	77.7	85.6	80.2	77.4	73.5	63.1	53.2	76.4
<i>Manufacture of electrical equipment (C27)</i>	98.1	92.2	73.4	35	97.1	86.7	72.4	72.5	70.4	65.9	68.6	71.2	42.9	46.8	42.0	43.1	34.7	44.3
<i>Manufacture of machinery and equipment nec (C28)</i>	41.5	82	94.1	68.9	88	87.6	79.4	78.5	85.6	77.9	80.6	81.2	26.5	30.2	31.1	29.1	28.5	30.4
<i>Manufacture of motor vehicles, trailers and semi-trailers (C29)</i>	0	1.5	86.1	99.2	65.1	92	50.8	46.6	61.0	75.7	68.3	74.7	39.7	43.3	36.5	35.1	17.7	35.2
<i>Manufacture of other transport equipment (C30)</i>	0	0	0	0	2.7	1.6	44.0	23.9	25.2	33.8	66.3	62.2	32.6	47.7	35.6	35.9	61.5	60.3
Metallurgical production	2.3	47.5	48.2	49.3	17.5	42	70.9	69.1	59.0	57.6	58.3	62.0	53.5	49.8	42.3	40.6	42.5	43.5
Manufacture of fabricated metal products, except machinery and equipment	96.3	82.8	95.3	81.1	57.3	87.5	32.1	30.7	30.8	31.2	29.1	30.9	19.3	21.4	20.4	20.7	18.2	20.3
Wholesale and retail trade; repair of motor vehicles and motorcycles (including trade margins)	1.2	0.2	0.5	0.3	0.9	0.7	33.5	27.8	29.0	28.4	28.8	29.1	28.4	28.5	29.1	30.3	32.1	29.7
Production of chemicals and chemical products	32.6	32.8	32.8	41.2	32.7	33.2	69.0	71.3	70.5	69.7	70.5	70.4	60.0	55.6	58.4	60.7	58.0	59.3
Manufacture of rubber and plastic products	31.9	32.1	84.7	32.2	32.1	48.9	43.6	42.9	40.9	42.7	40.8	42.6	30.9	31.9	31.5	32.0	32.0	31.8
Supply of electricity, gas, steam and air conditioning	0	0	0	0	0	0	8.9	6.7	3.9	3.8	3.3	4.7	2.2	2.9	2.7	2.3	2.7	2.5
Other business services	6.1	7.4	7	5.9	6.6	6.7	13.4	15.3	17.2	18.1	17.4	16.7	11.7	11.4	9.4	9.5	10.3	10.0
Other type of economic activity	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Total costs	40.3	45.2	51.1	42.0	33	43.4	58.3	42.5	41.0	46.6	41.3	46.1	37.6	33.0	28.0	28.6	36.8	30.1

Formed according to data (SSSU, 2022; Eurostat, 2022)

ber of officials in Ukraine and Poland viewed this global process in the field of mechanical engineering only from the standpoint of positive dynamics of absolute macroeconomic indicators, including employment, output, exports, lower tariffs on imports, and so on. Adherence to this position was primarily due to the need to quickly achieve and maintain a positive political rating, as well as the fact that mostly absolute rather than qualitative indicators are key indicators of national economic strategies and programs.

For TNCs, economic globalization is the ideological basis for expanding global value chains and supply, a tool for minimizing costs. The significant imbalance between low- and high-income countries in the context of economic globalization makes it possible to locate production in regions, countries with cheap and skilled labour, low cost and easy access to natural, energy resources, favourable logistics, loyal authorities and favourable opportunities for minimizing taxes or evading them altogether.

National engineering companies in countries such as Ukraine and Poland saw the economic benefits of economic globalization primarily in the ability to import cheaper spare parts, materials and, thus, potentially increase the competitiveness of their products in the domestic market. Unfortunately, such economic entities did not take into account the other side of globalization processes. In particular, countries that locate TNCs without defending themselves do not take into account real rather than individual or nominal (for example, job creation, export growth in general) state interests, potentially threatened by the breakdown of intersectoral ties and the unity of the economic system, resource depletion, increasing import dependence, loss of economic and political independence, widening the gap between the richest and the poorest, narrowing the middle class and reducing its income, social tensions. As a result, under such conditions, the future of countries, peoples or, at the very least, individual sectors of the economy may well be subordinated to the strategic interests of TNCs and international creditors. It should be noted that one of the most dangerous basic negatives of this situation for countries such as Ukraine and Poland is the imbalance of ties between sectors of the economy, as some units of TNCs do not cooperate with national sectors, but only with other units. In addition, TNCs are not interested in significantly increasing wages. Given that TNCs may be monopolists in the labour market of certain sectors or regions of the country, their activities do not contribute to the growth of purchasing power, social protection. It should be added that TNCs can exert various influences on regional or state authorities. Thus, the significant presence of

TNCs in strategic sectors of the national economy and inadequate regulation of their activities in favour of national economic interests can have negative socio-economic consequences. Note that according to the UNCTAD report, value chains run by TNCs account for more than 80% of the \$ 20 trillion. USD US World Trade Annual UNCTAD (2013).

On the other hand, the aggressive offshore policy of TNCs in conditions of global instability leads to increased risks such as: loss of intellectual property, investment, reduced competitiveness of products due to uncertainty of potential buyers as products manufactured in low-income countries. It is important to add that in the context of globalization, labor migration is spreading rapidly, leading to a shortage of skilled workers in low-income countries. As a result, TNCs are forced to raise wages, which weakens the financial benefits of relocating to third countries.

The potential increase in the competitiveness of national machine-building enterprises in the domestic market due to the liberalization of tariffs on imports of intermediate goods is also debatable. This is primarily due to the fact that most tariff reductions occur not only for intermediate but also final consumption products, as well as for second-hand goods. As a result, instead of potentially increasing the competitiveness of national engineering products in the domestic market, on the contrary, the risk of its reduction increases.

Analytical substantiation of the negative consequences of this problem (incorrect perception of economic globalization) are the authors of the study identified trends in the functioning of mechanical engineering in Ukraine, Poland and Germany.

Example of Ukraine

The development of Ukrainian mechanical engineering since 1990 has been accompanied by the gradual globalization of the national economy. Yes, according to the index of economic globalization (de facto) KOF Globalization Index (2022), since 1996 Ukraine has significantly outperformed Poland in terms of economic openness, and since 2008 – Germany. The higher the value of this index, the more open the economy is to imports and foreign investment. In 2018, in the ranking of 200 countries in the index of economic globalization (de facto), Ukraine ranked 25th, while Germany – 38th, Great Britain – 44th, France – 60th, Poland – 83rd. that, and Italy – the 99th.

In parallel with the processes of economic globalization and their perception by key economic entities in the Ukrainian engineering industry, significant changes have taken place.

In the early 90's of the twentieth century. Ukrainian mechanical engineering (which accounted for a third of the country's industry) was almost independent of imports of intermediate goods. However, this sector required significant capital investment to modernize fixed assets and technological processes. Therefore, during 1998-2008 in Ukraine there were some regulatory instruments of protectionist policy to support the national engineering industry, in particular in the automotive industry. As a result, it was possible to preserve the production potential of key machine-building enterprises and significantly increase production volumes, in particular in the automotive industry. During this period, the volume of passenger car production increased 13 times and reached 402 thousand units. According to this indicator, Ukraine was among the ten largest manufacturers of automotive equipment in Europe. The share of Ukrainian-made cars and buses in total registrations was 54%, and the share of the Ukrainian car industry in the country's GDP was 4% (Ukrautoprom, 2007). The share of cars manufactured by full-scale production in the total number of cars manufactured in Ukraine in this period, although small (did not exceed 8%), but stable. At the same time, despite the positive trends, Ukrainian mechanical engineering at the end of 2007 still needed a major modernization of production processes to increase the competitiveness of products in foreign markets. That is, it was not ready to compete in the international market with global TNCs without state support. However, in 2008, Ukraine joined the WTO, without taking into account national interests in the need to further protect and support the development of national engineering. Thus, since 2008 the modernized and insufficiently competitive Ukrainian machine-building industry has started to function in the conditions of liberalization of foreign trade, consequences of the world economic crisis, abolition of preferences for the automobile industry under the Law of Ukraine "On Stimulating Car Production in Ukraine". As a result, in 2009-2010, the production of passenger cars in general and under the full-scale assembly scheme decreased by more than 6 times. A similar mistake (disregard for national interests) was made when signing the FTA with the EU, and its negative impact was exacerbated by the consequences of Russia's military aggression and hybrid war against Ukraine.

Probably, the disregard for the national interests of mechanical engineering in foreign trade liberalization agreements is due to a one-sided vision of economic globalization. In particular, Ukrainian politicians and some economic experts were of the opinion that the liberalization of foreign trade would help attract for-

eign investment, create new jobs, increase exports, import profitable intermediate goods, increase wages, and so on. In practice, there have indeed been many positive changes, but, unfortunately, only in absolute terms, but not in quality. Yes, foreign investment in mechanical engineering initially increased slightly, but mostly in raw materials. Ukrainian machine-building, especially in the Western oblasts, has begun to turn into centers of foreign TNCs operating exclusively on tolling operations, without cooperation with national machine-building enterprises. Of course, the undoubted positive was the increase in employment in mechanical engineering at the expense of toll companies. However, the multiplier effect of such machine-building enterprises and its impact on the country's economy is relatively minimal. The economic benefit from some growth in machine-building exports is also conditional. The key place in such exports was occupied by products manufactured by tolling operations. Thus, in 2020, 42.6% (compared to 48.5% in 2018) of exports of commodity group XVI. Machinery, equipment and mechanisms; electrical equipment accounted for *finished products made from toll raw materials*. In the Western regions of Ukraine this figure is significantly higher, in particular in the Transcarpathian region in 2018 it reached 99.5%. At the same time, the consumer market of machine-building products in a short period of time turned into a landfill for physically and morally worn-out products that were in use in the EU, USA and others. As a result, due to the one-sided perception of economic globalization, in 2020, compared to 2008, in Ukrainian engineering there was a reduction in sales of industrial products by 60%, innovative products – by 85%, capital investment – by 37%. The share of innovative products in the volume of sold industrial products of mechanical engineering decreased to 4.6% against 16.8% in 2008. During 2012–2019, imports of mechanical engineering products dominated its production, exports and airborne forces (Fig. 2). In particular, in 2019, imports of engineering products (19 billion euros) were 2.3 times higher than output and 5 times higher than exports. The coverage of imports by machine-building exports in 2019 fell to 20% from 83.9% in 2009.

In addition to not taking into account national interests in these international agreements, the negative trends in Ukrainian engineering were due to the libertarian views of some representatives of the government and parliament of Ukraine at the time. According to their understanding, Ukrainian mechanical engineering should develop only under the influence of the market and its conditions, ie supply and demand. From a theoretical point of view, this is a good approach, but only for individual, small, non-strategic



Fig. 2. Airborne Forces, production, export and import of machine building in Ukraine, billion euros
Formed according to: (SSSU, 2022)

segments of developed economies. Instead, in formulating the policy of development of mechanical engineering of Ukraine, according to the authors of this study, the following aspects should be taken into account:

- In almost all developed economies, mechanical engineering as a holistic system was formed not by the market, but by purposeful actions of the state, in particular with the help of protectionist policy instruments. Therefore, the application of libertarianism and liberalism (utopian approaches to the “wisdom” of the non-existent free market) in the formation of mechanical engineering as a center of intersectoral relations are inappropriate and pose a threat to economic security;
- developed countries, such as the United States, the European Union, and China, openly and covertly pursue protectionist policies to protect strategic and non-strategic sectors of their economies. The use of protectionist tools has significantly increased in the context of the COVID–19 pandemic;
- the Ukrainian economy belongs to the type of developing economies; in addition, Ukraine resists Russian aggression and therefore needs special (rather than equal to developed economies) conditions, provisions in the WTO and FTA agreements with the EU, which will stimulate socio-economic development in general and mechanical engineering in particular. Current conditions of foreign trade turn Ukraine into a raw material base of foreign TNCs and a landfill for used and worn-out goods, including engineering;
- Ukrainian mechanical engineering after the collapse of the USSR still needs significant capital investment in modernization, renewal and modernization of machine-building industries to increase the competitiveness of products in domestic and for-

eign markets. This necessitates purposeful actions of the state in the direction of attracting investments, stimulating, taxing and financially promoting the development of this sector of industry.

The example of Poland

The situation with the expectations and reality of the functioning of mechanical engineering in the context of economic globalization in Poland is very similar to the situation in Ukraine. After Poland’s accession to the EU in 2004, Polish engineering was expected to grow in terms of production, foreign investment, exports, innovative products, development and practical implementation of science and technology, wages to level of indicators Germany, Great Britain, etc. It is undeniable that much of this has actually happened, but without a significant positive multiplier effect on the socio-economic development of the country and mechanical engineering in particular (as in the example with Ukraine). Thus, during 2004–2019, Poland’s mechanical engineering output increased by 186%. In 2019, the number of people employed in this sector of industry was 28% (or 125 thousand people) higher than in 2005. The leader in employment in the Polish engineering industry was the production of motor vehicles, trailers and semi-trailers (36% in 2019), while in 2005 there was the production of machinery and equipment not included in other groups (31%). Capital investment in mechanical engineering increased by 245% or € 4,143 million in 2004–2019.

On the other hand, a number of key qualitative indicators of the functioning of Polish machine-building industries are currently low or have increased insignificantly since 2004. First of all, all this applies to

the innovative activities of machine-building companies. Thus, according to (Eurostat, 2022), in 2018 the share of enterprises that introduced product innovations in the total number of innovative enterprises in the Polish engineering industry is almost the lowest in the EU. In particular, the value of this indicator for the most important machine-building industry in Poland (manufacture of motor vehicles, trailers and semi-trailers) was 23.9%. In Germany, the share of enterprises that introduced product innovations in the total number of innovative enterprises reached 47.0%, in France – 45.5%, in Italy – 48.0%. According to this indicator, Poland is ahead of only Romania, Slovakia, Latvia and Greece among the EU countries.

One of the most important indicators that determines the level of competitiveness of production is the share of new or significantly improved products, new to the market, in the volume of innovative products. According to this indicator, Polish engineering was also an outsider in the EU. Thus, in 2018 the share of new or significantly improved products, new to the market, in the volume of innovative products for the production of vehicles, trailers and semi-trailers in Poland was 4.7%, while in Germany – 12.8%, Italy – 15, 1%, Belgium – 27.2%, Portugal – 36.9%. It is important to note that according to the data (CSOP, 2022), in 2006 the value of this indicator in Poland was 13%. It follows that during 2007–2018 the share of products new to the market in the volume of innovative products of Polish production of vehicles, trailers and semi-trailers decreased almost three times. A similar situation was typical for the share of innovation expenditures in the volume of new or significantly improved engineering products: in 2018 in Poland its value was 11.2%, while in Germany – 25.1%, and in France – 23.9%.

The innovative activity of machine-building companies is one of the main indicators of the competitiveness of production in this sector of industry. In addition, increasing product innovation contributes to employment growth and wages (Ishchuk S., Sozansky L. and Pukała R., 2021). In Poland, low innovation activity of enterprises and product innovation, insufficient spending on innovation indirectly indicate a low multiplier effect of the impact of mechanical engineering on the socio-economic sphere of the country. This thesis is confirmed by the conclusions obtained from the results of the author's assessment of intersectoral ties, that Polish machine-building industries do not sufficiently interact with each other and other sectors of the economy.

The considered destructive processes can be interconnected with another extremely important feature of economic globalization – an excessively high level of control over the activities of mechanical engineering by foreign companies and TNCs. Thus, according to (Eurostat, 2022), in 2018 77.4% (against 70.7% in 2008) of machine-building products produced in Poland were controlled by foreign enterprises (Table 5).

Critically high (91.5%) level of control by foreign companies is typical for the production of vehicles, trailers and semi-trailers. It should be noted that high-tech and strategic machine-building productions of Poland are most controlled by foreign companies (C26, C27, C29, C30). In addition, we draw attention to the rapid (by 35.9 percentage points) growth of foreign control over the production of other vehicles (C30). This production, according to NACE_R 2, includes such strategic vehicles as ships and boats, railway locomotives, air and space aircraft, military vehicles and other types of vehicles.

Table 5

The share of products controlled by foreign enterprises in the volume of machine-building products in Poland, %

Type of economic activity	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2008–2018
Engineering, including:	70.7	73.1	75.4	74.7	73.3	74.4	73.9	75.0	76.8	76.3	77.4	6.7
<i>Manufacture of computer, electronic and optical products (C26)</i>	75.1	81.9	75.4	82.4	81.4	78.7	77.2	78.3	78.7	77.4	77.7	2.6
<i>Manufacture of electrical equipment (C27)</i>	69.5	71.0	74.9	64.7	65.9	68.4	68.3	71.4	72.4	71.5	72.0	2.5
<i>Manufacture of machinery and equipment nec (C28)</i>	46.6	49.5	48.2	44.5	40.9	42.4	44.8	45.7	49.6	50.6	48.3	1.7
<i>Manufacture of motor vehicles, trailers and semi-trailers (C29)</i>	86.6	86.2	89.4	91.0	89.3	89.2	88.1	88.7	88.6	87.2	91.5	4.9
<i>Manufacture of other transport equipment (C30)</i>	32.0	38.2	44.6	40.6	50.4	54.9	56.9	55.8	61.1	66.4	67.9	35.9

Formed according to: (Eurostat, 2022)

In 2018, more than 1/2 engineering products (C26–C30) of Poland were controlled by enterprises of EU countries, among which Germany dominates. The influence of German companies on Polish engineering in the 10 years has increased 1.63 times (Table 6). The production of vehicles, trailers and semi-trailers is the most controlled by European companies (C29). Also alarming is the rate (2.3 times) of strengthening foreign control (by the EU) over the production of computers, electronic and optical products (C26). Further spread of these negative trends may lead to a situation where the Polish engineering industry, which is the foundation of the economy, a key base for production and innovation, the center of intersectoral relations, the main strategic sector of the economy will virtually cease to be controlled by this country.

Thus, the results of the analysis give grounds to conclude that in the context of increasing globalization of mechanical engineering, Poland is gradually becoming a large production plant for spare parts, materials for foreign companies, including TNCs, which account for 65.4% of value added of Polish OECD machine-building (2022). In addition to mechanical engineering, the Polish economy as a whole is under significant control of foreign enterprises. Thus, according to (Eurostat, 2022), in 2018 36.97% (against 32.98% in 2009) of value added of Polish enterprises was controlled by foreign companies, which is 9.01 percentage points exceeded the value of the EU-28 (23.97%). In Germany, on the other hand, in 2018 the share of value added controlled by foreign companies in mechanical engineering was 18.52%, in France – 16.97%, and in Italy – 16.12%. At the same time, in countries such as the Czech Republic, Estonia, Luxembourg, Hungary, Romania and Slovakia, the value of this indicator was in the range of 40–50%.

The example of Germany

At first glance, it may seem that economic globalization has helped to reach new heights in the world leadership in engineering, especially in Germany. In particular, the liberalization of foreign trade in Eastern and South-Eastern Europe and the expansion of the EU's geographical borders have opened up new opportunities for a significant increase in exports and output for German engineering. The significant difference between the level of wages in Germany and the countries of Eastern, South-Eastern Europe and Asia has created opportunities to intensify offshoring and outsourcing, and thus optimize the costs of German engineering companies. In 2020, the German automotive industry amounted to 379.3 billion euros or 20% of the country's manufacturing industry. The German automotive industry employs about 809,000 workers, including 120,000 researchers and scientists (Gtai, 2022), Germany accounts for about 25% of cars made in Europe. The German car industry has a high export orientation – more than 75% of manufactured cars are exported to foreign markets.

At the same time, in addition to opening up new opportunities, economic globalization has posed challenges and threats to the functioning of the German car industry. The main challenges are due to the following.

1. Access to potential markets for the export of the automotive industry was opened not only to German manufacturers, but also to their competitors – machine-building enterprises in the United States, France, Great Britain, Italy, China, South Korea and Japan.
2. Products of competitors of the German automotive industry have achieved significant competitive advantages in price, individual technical character-

Table 6

The share of products controlled by German and EU-28 enterprises in the volume of machine-building products in Poland, %

Type of economic activity	Germany		EU-28	
	2008	2018	2013	2018
Mechanical engineering, including:	13.1	21.4	44.2	50.7
Manufacture of computer, electronic and optical products (C26)	1.8	5.5	9.7	22.4
Manufacture of electrical equipment (C27)	12.5	17.6	47.4	47.5
Manufacture of machinery and equipment nec (C28)	7.6	8.9	31.9	28.7
Manufacture of motor vehicles, trailers and semi-trailers (C29)	21.2	33.6	58.9	71.1
Manufacture of other transport equipment (C30)	1.9	9.0	29.5	28.2

Formed according to: (Eurostat, 2022)

- istics, mobility, requirements for modern needs and trends in end-user demand.
3. Many destructive changes (including the wrong economic policy in the context of economic globalization) in the countries of Eastern and South-Eastern Europe have reduced the middle class (in terms of income) and thus potentially solvent demand for products of the German automotive industry. In addition, Asian markets use high tariff barriers, which can exceed 100%, to protect domestic producers of European engineering products.
 4. The global economic crisis caused by the COVID-19 pandemic has led to a decline in the purchasing power of potential buyers of new cars and a shortage of semiconductors. As a result, there was a reorientation of demand from the primary to the secondary market of German cars.
 5. The intensification of competition between global car manufacturers and rapid changes in the development of this sector have necessitated the restructuring of large German machine-building enterprises, optimizing the chains of formation and supply of value in the direction of reorientation to demand. Yes, in the world more and more potential buyers prefer electric cars, cars with options of automatic (without significant participation of the driver) driving. All this necessitates the reorientation of mass production processes to more mobile, able to change the configuration of automotive products in a short time, in accordance with market requirements.

In the context of these challenges, the negative trends of key performance indicators of the German engineering industry and the automotive industry in particular have intensified. Thus, in 2021, Germany produced the smallest number of cars (3.1 million units) in the last thirty years (Fig. 3). At the same time, we emphasize that the low value of this indicator cannot be explained only by the economic consequences of the COVID-19 pandemic and the shortage of semiconductors. Significant and rapid decline

in car production in Germany began long before the pandemic and amounted to: (-1.7%) in 2017, (-9.4%) in 2018, (-24.7%) in 2020. In addition, we draw attention to the fact that during 2014–2016 there was a reduction in the growth rate of this indicator from 2.9% in 2014 to 0.7% in 2016.

The analysis leads to the conclusion that car production in Germany is significantly dependent on global economic processes, and therefore is quite dynamic and unstable. In particular, the global financial and economic crisis of 2008 reduced production almost to the level of 1992. After a further gradual increase and reaching a maximum in 2011 (5.87 million units), German car production slowed down, and after 2017 declined.

According to the results of the correlation analysis, it was found that during 1991–2010 between the number of cars manufactured in Germany and the index of economic globalization, where in fact this country had a linear high correlation – correlation coefficient (r) was 0.83 (Fig. 4). In other words, in the period 1991–2010, in parallel with the increase in the level of economic globalization in Germany, there was an increase in car production in this country and vice versa. On the other hand, during 2011–2018 there was a weak inverse correlation between the analyzed indicators – the correlation coefficient (r) was (-0.37). This means that in this period the opposite trend began to take shape: with the increase of economic globalization in Germany there is a decrease in the number of car production and vice versa.

The next, extremely negative trend is the growth of the average cost of German cars. In particular, in 2020, the average cost of a car made in Germany was 36,340 thousand euros, which is 32.7% more than in 2011 (27,390 thousand euros) (Statista, 2022). Rising average car prices amid declining production, intensifying competition between global manufacturers, economic consequences of the pandemic, global economic instability, declining effective demand significantly reduces the price competitiveness of products

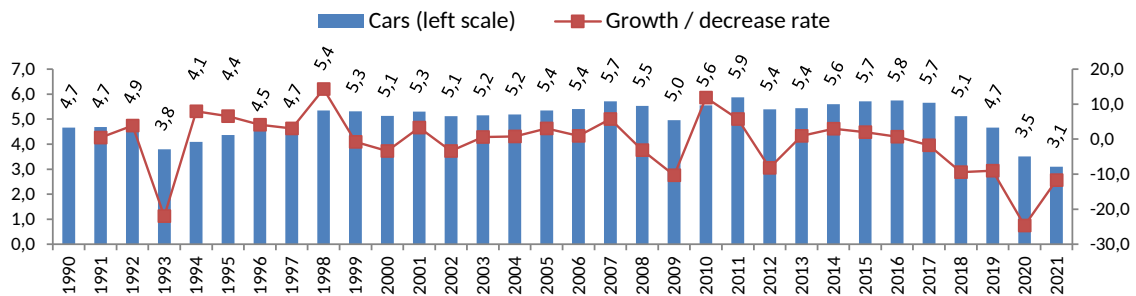


Fig. 3. The volume and dynamics of the number of manufactured cars in Germany
 Formed according to: (Statista, 2022)

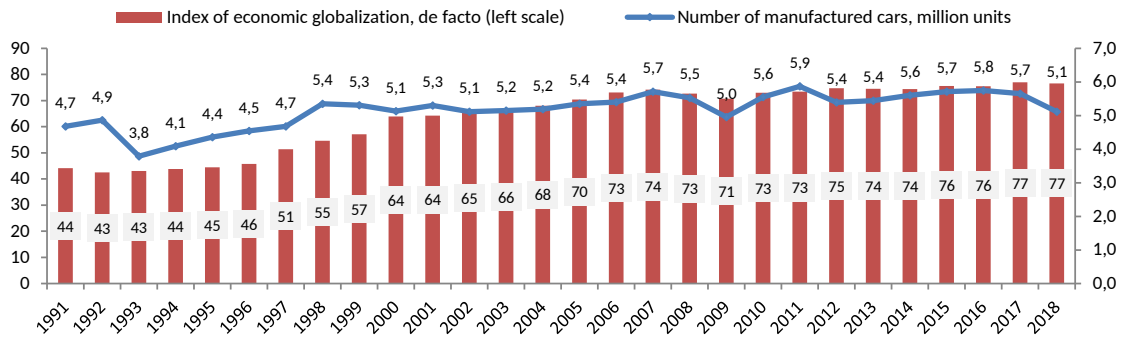


Fig. 4. The number of cars made in Germany and the index of economic globalization, de facto Germany Formed according to: (Statista, 2022); (KOF Globalization Index, 2022)

and prospects for the German automotive industry. Evidence of systemic destructive changes in the German automotive industry is a significant reduction in the level of innovation in this sector of industry. Thus, the share of innovative products in the volume of sold industrial products of motor vehicles, trailers and semi-trailers (C29) in Germany in 2018 was 48.7% against 60.5% in 2006 (ZEW, 2022).

Thus, the identified relationships and trends in key economic indicators confirm the impact of global challenges on the functioning of German engineering. First of all, the excessively high export orientation of the German automotive industry causes its high dependence on world market conditions, the behavior of competitors, the supply of components, global socio-economic change.

Table 7

The share of products controlled by foreign enterprises in the volume of machine-building products (C26–C30) of individual EU countries, %

Country	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Belgium	67.3	68.6	66.0	65.4	64.4	...	56.8	56.5	57.8
Bulgaria	37.3	43.7	49.3	51.1	51.4	53.5	57.2	55.3	57.4	57.3	57.7
Czech Republic	79.0	81.5	83.1	82.9	82.3	82.1	83.4	84.3	86.3	86.6	86.3
Denmark	27.5	28.0	36.3	35.6	35.0	36.3	35.2	33.0	35.9	37.1	32.7
Germany	21.5	15.4	22.7	21.2	23.5	24.5	25.4	23.5	24.8	26.0	23.7
Estonia	66.8	63.8	64.8	84.6	82.9	82.4	82.1	81.2	80.4	76.2	73.4
Spain	52.5	50.2	62.6	65.6	66.1	68.7	69.1	70.1	69.8	71.5	69.5
France	39.0	38.7	32.7	33.7	34.0	31.8	29.0	29.8	24.3	25.6	27.8
Italy	23.7	24.2	23.2	23.5	25.3	23.9	24.8	24.0	24.5	23.5	24.2
Lithuania	38.9	41.5	41.4	47.3	46.3	47.5	42.2	40.8	43.7	42.9	44.1
Hungary	92.0	92.4	93.0	94.1	93.6	93.7	93.9	94.5	94.1	93.9	93.1
Netherlands	...	35.2	34.9	32.1	37.4	37.1	53.9	22.3	22.6	52.7	50.5
Austria	56.3	54.8	60.4	58.1	58.5	57.6	57.2	55.6	57.1	58.7	58.7
Poland	70.7	73.1	75.4	74.7	73.3	74.4	73.9	75.0	76.8	76.3	77.4
Portugal	58.8	58.4	65.3	67.3	67.9	66.4	65.9	68.3	68.7	71.7	73.6
Romania	...	82.8	84.6	85.4	85.7	87.4	87.3	85.5	86.6	85.5	88.6
Slovenia	40.0	47.8	44.0	39.1	41.1	38.8	43.2	45.8	47.9	54.8	62.2
Slovakia	90.8	92.2	92.1	93.0	94.3	90.0	93.5	94.1	94.4	94.1	93.7
Finland	24.0	23.5	23.6	24.3	26.2	28.4		33.3	36.4	35.1	34.4
Sweden	32.9	36.4	37.9	...	39.8	33.0	45.2	53.6	54.0	54.7	51.9

Formed according to: (Eurostat,2022)

General conclusion on the functioning of national engineering in the EU

With the intensification of economic globalization, the functioning of the EU engineering industry can be divided into two types: a) engineering focused on scientific and technical design and production of basic engineering products, has a high export orientation, and production processes are carried out both inside and outside the country; b) mechanical engineering, for the most part, specializes in assembly plants and is controlled by foreign enterprises and TNCs.

Mechanical engineering of the first type is typical for Germany, France, Italy, Denmark and Finland (Table 7). Mechanical engineering of the rest of the considered countries corresponds to the second type. It should be noted that there are a number of EU countries in which the share of mechanical engineering products controlled by foreign companies exceeds 90%. This indicates that in such countries there is almost no national engineering. As a result, in conditions of economic instability, the economy and social sphere of such countries are exposed to significant risks of stable functioning and development.

Hypothesis formation and its theoretical and philosophical justification

The examples are given analytically substantiate the fact that unilateral, short-sighted economic policy of mechanical engineering development in the context of economic globalization has extremely negative consequences for national economies of both low-income countries, including Ukraine and Poland, and high-income countries, including Germany. Failure to take into account the dependence of mechanical engineering on imports of intermediate goods in the economic policy, excessive foreign control over the production of machine-building products, high export orientation of products in this sector prevent socio-economic growth in countries and pose risks to economic security. The results of the analytical study on the example of Ukraine, Poland and Germany, namely: assessment of intersectoral links and dependence of mechanical engineering on imports of intermediate goods; diagnostics of tendencies of functioning and problems of development of machine-building productions in the conditions of strengthening of economic globalization; analytical substantiation of the erroneousness of one-sided, narrow perception of economic globalization by key economic entities became the basis for the formation and justification of the author's hypothesis. Ac-

ording to her, *adherence to a high level provision of national production processes, intermediate consumption products and the optimal level of export orientation of machine-building products, along with reducing the level of monopolization in high-tech segments of the global economy, in the long run will meet the interests of national economies (including entrepreneurship and social sphere) and TNCs.*

The substantiation of this hypothesis, as already mentioned, is the analytical results of the study. *The theoretical basis of the hypothesis* is that the dependence of mechanical engineering on imports of intermediate goods and the monopolization of high-tech markets cause an increase in the gap between individual countries in terms of technology and innovation, income, which production volumes and further – migration, financial and economic crises, social aggravations and armed conflicts. As a result, it negatively affects the interests of all businesses. Instead, reducing the gaps in technology and innovation of industries, import dependence of mechanical engineering, economic self-sufficiency, income and social security between developed and developing countries is a cost-effective and important condition for the functioning of both TNCs and national economies. At the same time, we state that achieving economic and social development of all stakeholders, reducing the mentioned imbalances between high and low income countries requires simultaneous cooperation and purposeful, effective work in this direction of both states and TNCs and enterprises. At the same time, states must take care of national economic interests and promote the positive impact of TNCs on the economy and social sphere of the country. At the same time, TNCs and enterprises, pursuing their own mercantile goals, must take into account the economic and social interests of the country. The state's relations with TNCs and enterprises on the development of the socio-economic sphere of the country are usually regulated by relevant documents. However, regulations often do not take into account all aspects of such interaction and do not keep up with global change. In such circumstances, the hope is to popularize ideas, theories similar to human capitalism, including the hypothesis put forward in this study.

Additional theoretical substantiation of the proposed hypothesis are the following situations-examples.

1. In some developing countries, the authorities are relatively loyal to industries that pollute the environment, the atmosphere, and so on. It becomes a tool for increasing the profits of TNCs without investing in the modernization of production processes and environmental measures. As a result, it

negatively affects the health of the population and the environment not only in countries that allow such activities, but also in high-income countries. In this situation, TNCs are forced to pay more special taxes, invest in the fight against global warming, natural disasters, pandemics in their countries of origin. Therefore, the growth of profits from one activity is offset by additional costs and losses elsewhere from other activities. Instead, if TNCs worked with governments to modernize production, TNCs, the economic and social and environmental spheres of developing countries, would have a positive effect.

2. In low-income countries, TNCs are mostly monopolists in the labour market of the whole country or individual strategic sectors of its economy. It is clear that TNCs resort to offshoring to reduce labour costs, and therefore are not interested in increasing it. In such a situation, the country or sectors whose labour markets have been monopolized by TNCs have no prospects for the development of the social sphere, lose labour resources and human capital. As a result, labour migration from the country is growing, the purchasing power of the population is declining. In the future, all this has a negative impact on the host country of TNCs and does not defend national interests, but at the same time limits the market for products for TNCs. On the other hand, if TNCs were far-sighted, supporting the social and economic sphere of the country in which they operate, positively affecting the purchasing power of its population, in the long run would receive much more profit from expanding the market for their products in this country.
3. The classic stereotypical position of monopolists is that the growth of competition in the field in which they operate will lead to lower profits due to reduced sales of their products and forced lower prices. As a result, TNCs, as monopolists, make every effort to suppress or resist the competitive environment of certain markets or countries. The paradox is that competition is the best stimulus for development, improvement, and ultimately – economic growth for all market participants. This truth has long been discovered and substantiated in economic theory. If TNCs cooperated with small and medium-sized local enterprises in the field of purchase and sale of materials, components, services, joint production, exchange of experience and ideas, the former would benefit from this double economic benefits: a) from such cooperation; b) from the potential increase in the purchasing power of the citizens of this country, and hence the increase in the number of potential consumers

of TNC products. At the same time, competition would only contribute to the expansion of the product range, the development of new innovative industries.

The main idea of the hypothesis is close in philosophical content to the winged phrase of John Donne: “... Any man’s death diminishes me, because I am involved in Mankind; And therefore never send to know for whom the bell tolls; it tolls for thee”.

It follows from the hypothesis and its theoretical justification that the prospects of modern civilization largely depend on how humane economic relations will be, aimed at development, rather than consumption of human capital and personality. We can assume that these ideas are at the core or very close to Islamic banking. It is believed that due to the principles of Islamic banking, the financial system and economy of Islamic countries suffered the least in the world from the financial and economic crisis of 2008.

Failure to comply with the hypothesis put forward and substantiated in the study has a negative impact on national economies, and ultimately increases monopolization, causes destructive changes in the world economy.

Conclusions

The main task of the methodological approach to assessing the dependence of machine-building industries on imports of intermediate goods was to use such approaches that would provide practicality, informative and useful information for key stakeholders – the state, TNCs, enterprises, end users, expert economic environment. In view of this, the assessment of the import dependence of mechanical engineering was conducted at the macro level and the main idea of this approach was to obtain information on how much the machine-building industries of the studied countries provide national raw materials, etc. The study revealed the following. Ukrainian engineering is characterized by a very high dependence on imports of basic high-tech intermediate goods. For example, the automotive industry is heavily dependent on imports of engines, gearboxes, electronics, and so on. During the period of intensifying economic globalization, the machine-building industry of Ukraine refocused on: 1) production of resource-intensive products of primary processing of raw materials; 2) for production according to tolling schemes. In addition, the problem of Ukrainian machine-building enterprises is excessive dependence on imports of finished metal products. This is an absurd situation, as Ukraine exports iron ore and primary metal products, and imports

finished metal products for the production needs of machine-building industries.

Poland's systemic problem is also the high dependence on imports of basic intermediate goods, but, in addition, the predominant specialization in assembly plants with a low content of the national component of value. German engineering, in contrast to Ukrainian and Polish, is less dependent on imports of high-tech products, but instead needs much more resource-intensive intermediate goods.

It is analytically substantiated that the identified problems with the import dependence of mechanical engineering in Ukraine, Poland and Germany are the result of irrational, one-sided perception of economic globalization by the main economic entities of these countries. Thus, Ukraine and Poland did not take into account that economic globalization, along with the creation of new jobs in industries that operate on a tolling basis and run by foreign companies, can reduce the competitiveness of national engineering companies in foreign and domestic markets. Increasing the volume of production and exports of machine-building products with a significant or almost monopoly share of the import component will not contribute to the growth of socio-economic multiplier effect and innovative development of these countries. Almost absolute control by foreign companies of Polish automotive products in conditions of economic instability threatens the existence of this industry in the country, suspends innovation and socio-economic growth and unbalances cross-sectoral economic ties. During the period of economic globalization, Germany's automobile industry first gained leadership in Europe, but later – a number of serious economic challenges due to the escalation of competitive tensions between global manufacturers and the consequences of global instability. In particular, excessive export orientation, offshoring and outsourcing initially brought additional profits to German machine-building companies, but later posed a number of socio-economic challenges to the German economy as a whole.

The methodological and analytical information obtained as a result of the research can be useful for central and regional authorities, as it is an analytical, informative basis for the development or correction of special regulations, strategies aimed at defending national economic interests.

In addition, it is expected that the analytical information obtained will serve as one of the indicators of offshore TNC development strategies. The interest of TNCs in such information is primarily that these organizations, as key players in economic relations in the world and national economies, in addition to their financial interests must take into account so-

cial responsibility. One of the strategic tasks of TNCs, which are far-sighted and profess humane capitalism, is to determine the impact of their activities on the economic and social development of countries or regions in which they work or have business interests. In addition, the methodological approach used in this study at the macroeconomic level, by analogy, can be applied at the micro level, when estimating the cost, its elements, the construction of optimization problems.

The prospect of further author's research and development in this direction will be aimed at expanding the geography of research (in terms of countries and regions) and identifying new features of the functioning of mechanical engineering in economic conditions.

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