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Industrial Sector of the Economy of Ukraine in the Conditions of Global Challenges: Assessment of Structural Changes

Abstract. A comparative (with individual EU countries) assessment of the economic efficiency of the processing industry of Ukraine was carried out in the section of 16 productions according to the indicator of the share of gross added value in the output. The technological structure of the output of the domestic industry during 2013–2022 was studied. The main causes of negative structural transformations in the industrial sector of the national economy during the specified period have been identified. The impact of Russia's full-scale military aggression on indicators of the dynamics and structure of industrial products sold in Ukraine and abroad is analyzed. The desired directions of structural changes in the output of the processing industry are analytically substantiated, based on the importance of its strategic segments, primarily mechanical engineering.

Keywords: industry, production, efficiency, structural transformation, development
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1. Introduction

Russia's full-scale military aggression caused enormous damage to the industrial potential of Ukraine, as the hostilities covered mostly those regions where it was most developed. These are primarily the Kharkiv, Zaporizhzhya, and Dnipropetrovsk regions, as well as parts of the Donetsk and Luhansk regions that were not previously controlled by Ukraine. The production capacities of many industrial enterprises were completely or partially destroyed, and others were significantly damaged. Some of these enterprises belonged to high-tech enterprises, and therefore it will be quite difficult and expensive to restore them. Some of the capacities were relocated to other regions or even to neighboring countries. In particular, about 800 enterprises have moved their activities to safer (mostly western) regions of Ukraine, more than 600 of them have already resumed work at their new location. However, these are mostly trade and IT companies. Less than a third of the relocated enterprises belong to the processing industry. At the same time, the vast majority of operating enterprises experience significant problems with demand and logistics, access to credit resources, etc. This can intensify the deindustrialization of Ukraine, which began long before the full-scale invasion of Russia and even before the start of the war in 2014, as evidenced, in particular, by the negative dynamics of the share of industry in the domestic export of goods and services. So, if in 2003 the value of this indicator was 82%, then in 2013 — 66%, and in 2021 — 61%. That is, the economy of Ukraine gradually lost its industrial potential and increasingly became agrarian and, at the same time, oriented towards raw material exports. This conclusion is confirmed by the data on the share of the processing industry in Ukrainian exports (which decreased by almost half during 2008–2021 — from 73% to 38%) and in GDP (10% in 2021 against 18% in 2007).

2. Analysis of Research and Publications

Given the strategic importance of the industrial sector for ensuring socio-economic development, many thorough works of leading scientists of the National Academy of Sciences of Ukraine are devoted to its research. For example, in Zbarazsjka (2022). The results of the analysis of compliance with world and European trends of dynamic and structural development of domestic industrial production are presented. The processes of implementation in the national industry of the sectoral goal of SDG-9 as a set of tasks within the concept of sustainable and inclusive development of production were studied. The basic scenario of the long-term development of Ukraine's industry until 2035 is given in Okhtenj (2013). The conceptual

approach to the selection of a system of anticipatory indicators of the development of the national industry is covered in Soldak (2022). The consequences of Russia's full-scale armed aggression for Ukrainian industry are described in Dejneko et al. (2022). Current issues of export activity of industrial enterprises in the conditions of war are studied in Ishhuk & Protseviat (2022).. In particular, based on the assessment of the structure of commodity exports of Ukraine and its regions, changes in the export specialization of the latter by main commodity groups were determined. Key trends and problems in the formation and development of domestic export potential in the face of external challenges and threats are outlined.

The purpose of the article is to identify structural transformations in the industrial sector of Ukraine's economy caused by external challenges, in particular, Russian armed aggression.

3. Research Results

Over 40% of the GVA of the processing industry was formed by two types of production — food and metallurgical. On the other hand, the share of mechanical engineering in the structure of the airborne industry has decreased by 2.6 times over the past 13 years — from 16.7% in 2007 to 6.4% in 2021. These and other negative trends reduce the efficiency of Ukrainian industry and the economy in general, and dependence on raw materials sectors, the products of which prevail in domestic exports, increases instability and vulnerability to fluctuations in the situation on international markets. As a result, domestic industrial enterprises are significantly inferior to European ones in terms of operational efficiency, one of the key ones being the level of labor productivity. The value of this indicator in Ukraine is 3 times less than in Poland, and 9 times less than in Germany. The economic efficiency of the Ukrainian processing industry is the lowest among the industrial EU countries. Thus, in 2021, the value of the indicator of the share of GVA in output in Ukraine was 1.43 times lower than the EU-27 average, 1.25 times lower than Poland, and 1.67 times lower than Germany. Relatively low economic efficiency (the share of GVD in output) is characteristic of the vast majority of manufacturing industries in Ukraine, including those that have certain competitive advantages and have significant potential for development. First of all, this applies to the food, woodworking and pharmaceutical industries, and also to the chemical and metallurgical industries, the efficiency of which is relatively low (Table 1). In 2021, 62.8% of the output of the Ukrainian processing industry accounted for the products of the mentioned industries, which explains the generally low efficiency of the latter.

Table 1. The share of VAT in the output of the processing industry, %

Total processing industry	Code NACE Rev.2	Ukraine			Poland		Germany	
		2013	2020	2021	2013	2020*	2013	2020*
Manufacturing	**C**	**18.80**	**20.07**	**20.00**	**24.12**	**27.10**	**31.97**	**34.57**
Manufacture of food products; beverages and tobacco products	C10-12	17.2	19.1	17.9	19.2	20.6	22.0	24.7
Manufacture of textiles, wearing apparel, leather and related products	C13-15	54.9	47.9	48.4	33.7	36.2	32.3	33.5
Manufacture of wood, paper, printing and reproduction	C16-18	21.4	21.0	22.2	26.8	30.8	29.5	34.6
Manufacture of coke and refined petroleum products	C19	10.0	11.6	12.1	10.2	14.0	5.9	5.2
Manufacture of chemicals and chemical products	C20	10.5	10.9	10.4	21.3	25.8	29.3	36.1
Manufacture of basic pharmaceutical products and pharmaceutical preparations	C21	23.4	30.7	30.0	35.9	44.2	49.2	45.5
Manufacture of rubber and plastic products	C22	17.8	13.1	14.4	27.4	32.1	34.6	37.5
Manufacture of other non-metallic mineral products	C23	19.3	16.0	15.9	31.8	32.6	35.4	37.9
Manufacture of basic metals	C24	8.9	15.2	14.3	16.5	17.0	20.5	19.6
Manufacture of fabricated metal products, except machinery and equipment	C25	20.9	19.4	22.0	31.4	36.9	40.8	42.0
Manufacture of computer, electronic and optical products	C26	28.7	25.3	29.8	19.7	21.9	45.0	45.7
Manufacture of electrical equipment	C27	28.9	27.9	28.3	20.6	21.7	40.3	40.4
Manufacture of machinery and equipment n.e.c.	C28	31.0	29.9	30.4	31.3	35.9	37.5	37.9
Manufacture of motor vehicles, trailers and semi-trailers	C29	22.8	21.9	23.5	22.5	20.9	30.3	33.0
Manufacture of other transport equipmen	C30	41.3	34.3	33.8	33.5	21.7	30.2	27.6
Manufacture of furniture; jewellery, musical instruments, toys; repair and installation of machinery and equipment	C31-33	35.1	35.7	36.1	37.9	38.7	41.7	42.9

* The latest available data at the time of the study

Source: Calculated by the authors based on State Statistics Service of Ukraine (2023), State Statistics Service of Eurostat (2023)

During 2014–2020, a radical negative structural transformation took place in the Ukrainian processing industry. Its essence was that the share of low-tech industries increased by 8.5 percentage points. (or by 21.4%), while the share of medium-high-tech industries decreased by 6.7 percentage points. (or by 33.7%). Medium-high-tech industries include the chemical industry, as well as four out of five engineering industries, i.e., this is the segment of industrial activity, which in countries with an industrial type of economy is the center of intersectoral connections and innovations, creates and spreads the highest multiplier effect.

It is also appropriate to note that medium-high-tech industries include industries that produce various types of military weapons or dual-purpose goods. For example, the production of other vehicles (C30) includes the production of ships and boats (30.1), railway locomotives and rolling stock (30.2), air and space aircraft, related equipment (30.3), military vehicles (30.4). In other words, this sector can potentially produce everything that Ukraine most needed and needs today, that is, what could speed up the victory in the war with Russia. However, during 2013–2020, the share of the production of other vehicles (C30) in the output structure of the processing industry of Ukraine decreased by 3.4 percentage points (or by 62.4%).

In 2021, compared to 2020, the output structure of the processing industry of Ukraine underwent significant changes. In particular, by 4.4 percentage points the share of food production decreased; beverages and tobacco products (C10-12) and, at the same time, by 2.4 percentage points the share of metallurgical production increased (C24-25). The mentioned productions together formed more than 50% of the output of the Ukrainian processing industry, however, they are raw materials and export-oriented. Therefore, the dynamics of their production closely correlates with the dynamics of food and metal prices on world markets. This situation may be typical for small developing countries in Asia or Africa, but Ukraine still belongs to industrial countries with high potential and experience in the development of high-tech industries. Accordingly, the identified structural changes are a sign of the high dependence of the development potential of Ukrainian processing industries on the market situation, and therefore the reason for the instability of the functioning of the national economy in general and its industrial sector in particular.

The negative transformations of the structure of Ukrainian industry are based on a number of internal and external factors, largely of a political nature, namely:

1. Perceptible economic dependence on the Russian Federation, which until 2014 was the main supplier of intermediate consumption products and at the same time a consumer of final products of the Ukrainian chemical industry and

engineering. Unfortunately, it was not possible to completely overcome this dependence even after 2014. This is a strategic mistake that has not been corrected since the collapse of the USSR.

2. The conclusion of the FTA agreement with the EU on mostly unfavorable conditions for Ukraine caused a significant increase in domestic raw material exports to the EU countries, and at the same time — an increase in the volume and range of imports of end-use products of high- and medium-high-tech industries (primarily cars and agricultural machinery, which was in use) to Ukraine. Such drastic changes in the vectors of foreign economic activity had an extremely negative impact on the results and prospects of the functioning of the Ukrainian engineering industry, which after 2014 needed to quickly adjust market and assortment benchmarks, become economically self-sufficient (reduce dependence on the import of materials, components, etc.).

3. Absence of an effective protectionist policy of the state regarding the development of domestic mechanical engineering. The Russian military aggression, which began in 2014, should become an impetus for the accelerated innovative development of machine-building industries in Ukraine (primarily the defense-industrial complex) through the introduction of a large-scale import substitution program. However, instead, the financial interests of machine-building TNCs operating under tolling schemes were promoted, as well as the introduction of preferential conditions for the import of worn-out automotive equipment. A clear example of neglect of national economic security was the absence of a ban on the import of engines and other components (especially tractors) from Russia and Belarus.

The described factors deepened the instability of the structure of the Ukrainian processing industry. In countries with a developed market economy, the structural parameters of industry are relatively stable, that is, over a decade, the share of individual industries in the output of the processing industry can change by a maximum of 1–3 percentage points. So, for example, in Poland and Germany during 2014–2020, the share of medium-high-tech industries in the corresponding structure increased by 1.1 percentage points. and 0.8 percent in accordance. On the other hand, in Ukraine over the same period, the value of this indicator decreased by 6.6 percentage points. This confirms both the general instability of the output structure of the Ukrainian processing industry and its negative transformation.

The structural transformation of the industry in the direction of growth in the output of the shares of high- and medium-high-tech industries is economically justified, since their products have a higher content of added value. In addition

(and this is the most important) these productions themselves are centers of intersectoral relations and key producers of technical and technological innovations. In 2020, in Germany, high- and medium-high-tech production accounted for a total of 56.8% (+2.1 percentage points for 2014–2020) of the output of the processing industry, in Poland — 31.6% (+1.1 percentage), while in Ukraine — only 16.2% (−5.9 percentage points). At the same time, it should be noted that the economic efficiency of Ukrainian machine-building industries (with the exception of C28) is greater than that of Polish ones.

The fact that the war and its direct and indirect consequences are radically changing Ukrainian industry is illustrated by current indicators of the dynamics of industrial production. Thus, during 2022, the volume of industrial products sold in Ukraine decreased by 21.6% (Table 2). Production fell in all industry segments, with the exception of the supply of electricity, gas, steam and air conditioning, where the growth was 13.3% overall.

Table 2. Indicators of dynamics and structure of realized industrial products of Ukraine in 2021–2022, %

Type of industrial activity	Code classification of economic activities NACE Rev.2	The rate of increase/ decrease in realized industrial products in Ukraine, %	Structure of sold industrial products, %		The rate of growth/ decrease of industrial products sold outside of Ukraine, %	The share of industrial products sold outside Ukraine, %	
			2021	2022		2021	2022
Industry	**B+C+D+E**	**−21,6**	**100,0**	**100,0**	**−44,6**	**28,4**	**20,0**
Mining and quarrying	***B***	***−31,0***	***16,1***	***14,1***	***−57,4***	***31,9***	***19,7***
Manufacturing	***C***	***−31,5***	***61,3***	***53,6***	***−42,2***	***37,8***	***31,9***
Manufacture of food products; beverages and tobacco products	10–12	−11,9	18,9	21,3	−20,9	30,0	26,9
Manufacture of textiles, wearing apparel, leather and related products	13–15	8,5	0,8	1,1	−9,5	42,5	35,5
Manufacture of wood, paper, printing and reproduction	16–18	−11,8	3,3	3,7	−6,9	38,2	40,3
Manufacture of coke and refined petroleum products	19	−45,3	2,9	2,0	−53,2	8,4	7,2
Manufacture of chemicals and chemical products	20	−43,0	2,9	2,1	−64,0	32,0	20,2
Manufacture of basic pharmaceutical products and pharmaceutical preparations	21	−15,3	1,4	1,5	−4,8	13,5	15,2
Manufacture of rubber and plastic products	22	−18,6	1,9	2,0	−41,3	20,0	14,4

Type of industrial activity	Code classification of economic activities NACE Rev.2	The rate of increase/ decrease in realized industrial products in Ukraine, %	Structure of sold industrial products, %		The rate of growth/ decrease of industrial products sold outside of Ukraine, %	The share of industrial products sold outside Ukraine, %	
			2021	2022		2021	2022
Manufacture of other non-metallic mineral products	23	–49,6	3,8	2,4	–35,6	11,3	14,4
Manufacture of basic metals	24	–57,9	16,0	8,6	–63,4	63,2	55,0
Manufacture of fabricated metal products, except machinery and equipment	25	–24,0	1,8	1,8	–25,1	25,6	25,2
Manufacture of computer, electronic and optical products	26	–35,2	0,4	0,3	–24,6	24,6	28,6
Manufacture of electrical equipment	27	–31,7	1,1	1,0	–27,8	35,6	37,6
Manufacture of machinery and equipment n.e.c.	28	–47,1	2,0	1,3	–52,3	42,2	38,0
Manufacture of motor vehicles, trailers and semi-trailers	29	9,2	0,9	1,3	10,5	64,5	65,2
Manufacture of other transport equipmen	30	–10,4	1,3	1,4	–44,3	50,8	31,6
Manufacture of furniture	31	–22,1	0,8	0,8	–13,1	55,3	61,7
Manufacture other products	32	–9,6	0,2	0,2	–11,6	38,7	37,9
Repair and installation of machinery and equipment	33	–36,6	0,9	0,7	–52,0	8,0	6,0
Electricity, gas, steam and air conditioning supply	***D***	***13,3***	***21,5***	***31,1***	***…***	***…***	***…***
Manufacture, transmission and distribution of electricity	35.1	31,5	13,9	23,2	…	…	…
Gas production; distribution of gaseous fuel through local (local) pipelines	35.2	–23,9	5,9	5,7	…	…	…
Supply of steam, hot water and air conditioning	35.3	–5,3	1,7	2,1	…	…	…
Water supply; sewerage, waste management and remediation activities	***E***	***–16,8***	***1,1***	***1,2***	***…***	***…***	***…***

Source: Calculated by the authors based State Statistics Service of Ukraine (2023)

The volume of sold products of the processing industry decreased most significantly — by 31.5%. The largest decline (by more than 40%) was experienced by: metallurgical production (C24), production of other non-metallic mineral products (C23), production of machines and equipment not classified in other groups (C28), production of coke and oil refining products (C19) and production of chemicals substances and chemical products (C20). In general, in the processing industry,

there was a fall in the volume of sold products in all industries, except for textiles (C13-15) and the production of motor vehicles, trailers and semi-trailers (C29). The result of the described dynamics was negative changes in the structure of the industrial sector of the national economy in the direction of a noticeable decrease in the share of the processing industry in it — by 7.7 percentage points. (or by 12.6%), in particular, metallurgical production — by 7.4 percentage points. (or by 46.3%).

Full-scale military operations on the territory of Ukraine also caused a 44.6% decrease in the volume of industrial products sold outside the country. At the same time, the export orientation of the industrial sector of the national economy, i.e. the share of products sold outside the country, decreased by 8.4 percentage points during the specified period. (or by 29.6%). However, this reduction primarily concerned the extractive industry (by 12.2 percentage points or by 38.2%), while individual processing industries, on the contrary, increased the share of products sold outside the country. These included high-tech industries (C21 and C26), woodworking industries (C16-18) and furniture industry (C31), as well as some machine-building industries (C27 and C29). The most export-oriented (65%) segment of Ukrainian industry is the production of motor vehicles, trailers and semi-trailers (C29), which was the only one that demonstrated an increase in product exports in 2022 (+10.5%). Its basis (~80%) is the production of components, parts and accessories for motor vehicles (C29.3). In 2022, 89.9% of the products of this production were sold outside Ukraine, however, these products are made from raw materials. This means that the production of C29.3 is not economically self-sufficient.

4. Conclusions

Summarizing the results of the assessments, it can be stated that the actual (according to the latest available data) output structure of the processing industry of Ukraine is very unstable and irrational, based, in particular, on the standpoint of economic efficiency. It is obvious that during the period of war and post-war reconstruction, the instability of the structure of the processing industry and, in general, of the entire industry of Ukraine will increase even more, as the dependence on logistics, the situation on the world markets of raw materials, the pace and volume of financial and investment flows into the national economy, the speed of recovery of production capacities, formation of a new industrial policy and many other factors.

The functioning of the processing industry in Ukraine in the post-war period should ensure: stable and significant budget revenues; competitive (compared

to neighboring countries) wages and new jobs in the industrial sector and the economy in general; filling the domestic market with competitive (in terms of quality and price parameters) products of intermediate and final consumption, in particular, high- and medium-high-tech industries, and ultimately (most importantly) high technical and technological defense capability of the country. All this can be achieved provided that the central place in the structure of the industrial sector of the national economy will be occupied by mechanical engineering, the chemical and pharmaceutical industry, and the production processes will have high technology, innovation, focus on domestic science and the IT sector, and low dependence on the import of intermediate consumption products. Therefore, post-war reconstruction should include not only the restoration of destroyed enterprises, but also efforts to return to domestic companies lost positions in the domestic market, since the reduction of many industries caused the mass replacement of Ukrainian products with foreign goods. In addition, the process of restoration of the national economy should take place already at a new technological level, based on long-term development prospects, which involves the creation of enterprises of a higher level in terms of technology, production organization, quality of management, etc. Also, Ukraine needs to move to new forms and principles of organization and placement of enterprises, in particular, the formation of industrial clusters that will ensure a competitive cost of production.

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Sektor przemysłowy gospodarki Ukrainy w warunkach globalnych wyzwań: ocena zmian strukturalnych

Streszczenie. W artykule dokonano porównawczej (w stosunku do krajów UE) oceny efektywności ekonomicznej funkcjonowania przemysłu przetwórczego Ukrainy w ramach 16 branż według wskaźnika udziału wartości dodanej brutto w produkcji globalnej. Badano strukturę technologiczną produkcji krajowego przemysłu w latach 2013–2022. Określono główne przyczyny negatywnych przemian strukturalnych w sektorze przemysłowym gospodarki narodowej we wskazanym okresie. Analizie poddano wpływ agresji militarnej Rosji na pełną skalę na wskaźniki dynamiki i strukturę wyrobów przemysłowych sprzedawanych na Ukrainie i za granicą. Pożądane kierunki zmian strukturalnych w produkcji przemysłu przetwórczego uzasadniono analitycznie, w oparciu o znaczenie jego strategicznych segmentów, przede wszystkim inżynierii mechanicznej.

Słowa kluczowe: przemysł, produkcja, efektywność, przemiany strukturalne, rozwój