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Structural Changes in the Industrial Production of Ukraine in the Conditions of War

Abstract. The article describes changes in the structure of the Ukrainian industry with a goal of identifying factors that weaken and strengthen the country's industrial potential as well as industry sectors that have undergone the biggest structural changes. The authors indicate causes and consequences of these changes, in particular, the nearly complete destruction of the metallurgical industry, which has had a significant impact on Ukraine's economy. On the other hand, a number of industries have grown in size, including the supply of electricity, gas, steam and air conditioning, the manufacture of wood products, pharmaceutical products and textiles. The authors determine the volume and structure of industrial products sold abroad and their share of in sold production and indicate the most important segments of Ukraine's industrial production along with prospects for the development of industrial potential in the current conditions.

Keywords: industry, processing industry, industrial structure, volume of products sold, volume of products sold abroad

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1. Introduction

Industry is a key sector of the Ukrainian economy. However, in the current conditions of political and economic instability, significant changes have taken place in the structure of industrial production. In particular, as a result of the war, many factories, enterprises and various infrastructural facilities have been destroyed, large segments of the population have been forced to migrate (or leave the country, causing an considerable outflow of qualified personnel), logistics has become more difficult, and the risks associated with the country's financial stability have grown more acute, etc. All these and other factors have had an impact on Ukraine's industrial potential. Therefore, the purpose of the article is to analyze the structural changes that have taken place in the Ukrainian industry in recent years and to identify both the most important and promising directions for the development of Ukraine's industrial potential in the future.

2. Review of the Literature

Considering the instability of the Ukrainian economy, it is necessary to keep monitoring and study ongoing changes in the country's economic situation. There are already a number of publications that have been dedicated to the analysis of Ukraine's industry in the current conditions. For example, Gerasimenko A.V. (2023) has conducted a comprehensive analysis of the financial and economic development of industrial enterprises before the start of the full-scale armed invasion of Ukraine, and in the first year of the war. Antonyuk V.O., Gakhovich N., Venger L. (2023) have analyzed the post-war development and modernization of the Ukrainian industry.

While it is very difficult to make predictions about the development of the Ukrainian industry in the current conditions, a detailed structural analysis will make it possible to identify current problems and propose ways of solving them.

3. Research Results

The following analysis of Ukraine's industrial production across different sectors is based on three sets of data: the value of sold industrial production in million UAH, the percentage share of sold industrial production and the rate of change indicator *i*, representing changes between consecutive years, which is calculated according to the following formula:

$$\mathbf{i} = \frac{y_n}{y_{n-1}} \times 100$$

where is y_n denotes the value in a given year, and y_n — the value in the preceding year.

As a result of the negative impact of the war, in 2022 the volume of industrial products sold in Ukraine decreased by 21.67% (compared to the previous year). While the country's industrial potential generally declined, different segments were affected to a varying degree, with some sectors practically collapsing, while others registering only minor effects of the negative political and economic factors.

Table 1. Value of Ukraine's sold industrial production in 2014–2022 by type of activity (in million UAH)

Industrial production	KVED*	2014	2015	2016	2017	2018	2019	2020	2021	2022
Mining and quarrying	В	153659	181414	229966	313825	380828	394847	354564	576520	398091
Processing industry	С	809453	1011864	1137785	1400214	1636893	1597452	1602974	2200379	1505744
Production of food products, beverages and tobacco products	10-12	254992	340604	381445	451115	504332	530505	571773	679662	595911
Textile production, production of clothes, leather, leather products and other materials	13-15	10070	14882	16883	20944	24109	24714	23834	28261	30714
Production of wood products, paper production and printing activities	16-18	40129	52974	60529	70191	85879	84883	85525	117762	103965
Production of coke and oil refining products	19	44015	51044	58670	82179	97400	71593	57722	103675	56683
Production of chemicals and chemical products	20	46808	61971	56235	59199	68542	72160	70474	105149	60028
Production of basic pharmaceutical products and pharmaceutical preparations	21	14404	19675	25029	28949	34206	36395	40919	48973	41442
Production of rubber and plastic products, other non-metallic mineral products	22, 23	56423	75361	90192	109572	131734	141865	156189	205039	124573
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	227547	266611	302958	391165	463845	395137	371655	640193	291326
Engineering	26-30	94088	103708	116367	150417	182103	188082	173078	204852	152924
Production of furniture and other products; repair and installation of machines and equipment	31–33	20978	25035	29477	36484	44743	52119	51806	66812	48177
Supply of electricity, gas, steam and air conditioning	D	217100	285302	380242	416617	465277	458204	488514	772048	874058
Water supply; sewerage, waste management	Е	15381	17433	19101	22376	25582	30301	35096	40433	33680

 ${\rm ^*KVED-a\ code\ taken\ from\ the\ classification\ of\ types\ of\ economic\ activity\ used\ by\ State\ Statistics\ Service\ of\ Ukraine}$

Table 2. Percentage share of Ukraine's sold industrial production in 2014–2022 by type of activity

											Chang	e (p.p.)
Industrial production	KVED	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022- -2014	2022- -2021
Mining and quarrying	В	12.85	12.13	13.01	14.58	15.18	15.92	14.29	16.06	14.16	1.31	-1.90
Processing industry, including:	С	67.70	67.64	64.39	65.03	65.25	64.39	64.61	61.30	53.56	-14.15	-7.75
Production of food products, beverages and tobacco products	10-12	21.33	22.77	21.59	20.95	20.10	21.38	23.04	18.94	21.19	-0.13	2.26
Textile production, production of clothes, leather, leather products and other materials	13-15	0.84	0.99	0.96	0.97	0.96	1.00	0.96	0.79	1.09	0.25	0.31
Production of wood products, paper production and printing activities	16-18	3.36	3.54	3.43	3.26	3.42	3.42	3.45	3.28	3.70	0.34	0.42
Production of coke and oil refining products	19	3.68	3.41	3.32	3.82	3.88	2.89	2.33	2.89	2.02	-1.67	-0.87
Production of chemicals and chemical products	20	3.92	4.14	3.18	2.75	2.73	2.91	2.84	2.93	2.14	-1.78	-0.79
Production of basic pharmaceutical products and pharmaceutical preparations	21	1.20	1.32	1.42	1.34	1.36	1.47	1.65	1.36	1.47	0.27	0.11
Production of rubber and plastic products, other non-metallic mineral products	22, 23	4.72	5.04	5.10	5.09	5.25	5.72	6.30	5.71	4.43	-0.29	-1.28
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	19.03	17.82	17.14	18.17	18.49	15.93	14.98	17.84	10.36	-8.67	-7.47
Engineering	26-30	7.87	6.93	6.59	6.99	7.26	7.58	6.98	5.71	5.44	-2.43	-0.27
Production of furniture and other products; repair and installation of machines and equipment	31-33	1.75	1.67	1.67	1.69	1.78	2.10	2.09	1.86	1.71	-0.04	-0.15
Supply of electricity, gas, steam and air conditioning	D	18.16	19.07	21.52	19.35	18.55	18.47	19.69	21.51	31.09	12.93	9.58
Water supply; sewerage, waste management	Е	1.29	1.17	1.08	1.04	1.02	1.22	1.41	1.13	1.20	-0.09	0.07

Table 3. Changes in the value of Ukraine's sold industrial production in 2014–2022 by type of activity

Industrial production	KVED	2015/2014	2016/2015	2017/2016	2018/2017	2019/2018	2020/2019	2021/2020	2022/2021
Mining and quarrying	В	118.06	126.76	136.47	121.35	103.68	89.80	162.60	69.05
Processing industry	С	125.01	112.44	123.06	116.90	97.59	100.35	137.27	68.43
Production of food products, beverages and tobacco products	10-12	133.57	111.99	118.26	111.80	105.19	107.78	118.87	87.68
Textile production, production of clothes, leather, leather products and other materials	13-15	147.79	113.45	124.06	115.11	102.51	96.44	118.57	108.68

Industrial production	KVED	2015/2014	2016/2015	2017/2016	2018/2017	2019/2018	2020/2019	2021/2020	2022/2021
Production of wood products, paper production and printing activities	16-18	132.01	114.26	115.96	122.35	98.84	100.76	137.69	88.28
Production of coke and oil refining products	19	115.97	114.94	140.07	118.52	73.50	80.62	179.61	54.67
Production of chemicals and chemical products	20	132.40	90.74	105.27	115.78	105.28	97.66	149.20	57.09
Production of basic pharmaceutical products and pharmaceutical preparations	21	136.60	127.21	115.66	118.16	106.40	112.43	119.68	84.62
Production of rubber and plastic products, other non-metallic mineral products	22, 23	133.56	119.68	121.49	120.23	107.69	110.10	131.28	60.76
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	117.17	113.63	129.12	118.58	85.19	94.06	172.25	45.51
Engineering	26-30	110.22	112.21	129.26	121.07	103.28	92.02	118.36	74.65
Production of furniture and other products; repair and installation of machines and equipment	31–33	119.34	117.74	123.77	122.64	116.49	99.40	128.96	72.11
Supply of electricity, gas, steam and air conditioning	D	131.42	133.28	109.57	111.68	98.48	106.61	158.04	113.21
Water supply; sewerage, waste management	E	113.35	109.56	117.15	114.33	118.45	115.83	115.20	83.30



Figure 1. Changes in the value of Ukraine's sold industrial production in 2014–2022 by type of activity
Source: Calculations based on data from State Statistics Service of Ukraine (2023)

As can be seen, the biggest changes in the structure of sold industrial production in 2014–2022 can be observed in the following industries: the processing industry (down by 14.15 p.p.) and the supply of electricity, gas, steam and air conditioning (up by 12.93 p.p.).

The observed changes were mainly due to the impact of the war on the territory of Ukraine. As a result of military operations, metallurgical production was practically destroyed, in particular, PJSC "Azovstal Metallurgical Plant" and PJSC "Mariupol Metallurgical Plant", both of which contributed about 20% of the country's metallurgical output. In addition, about 80% of metallurgical enterprises in Ukraine are located in the regions where hostilities are still taking place, i.e. in the Dnipropetrovsk, Donetsk, and Zaporizhia regions (Liakhovska, 2023). As a result, the share of the metallurgical industry in the country's entire industry in 2014–2022 decreased by 8.67 p.p. In 2014–2021 the volume of sold metallurgical production fluctuated between 14.98% and 19.03%; however, in 2022 this share decreased to 10.36%. In general, the dynamics of metallurgical production over the last year was negative, causing the volume of sold metallurgical production to decrease by 54.49% in 2022.

In addition, in the period 2014–2022, the share of the following sectors also decreased: machine-building production (by 2.43 percentage points), production of chemicals and chemical products (by 1.78 percentage points), production of coke and oil refining products (by 1.67 percent of the population).

On the other hand, in 2014–2022, the volume of sold production of electricity, gas, steam, and air-conditioning products increased by 302.62%, and in 2022, the growth rate was also positive (13.21%). Consequently, the supply of electricity, gas, steam and air-conditioning turned out to be the country's largest industrial sector: the volume of its sold production in 2022 accounted for 31.09% (against 18.16% in 2014), which means that between 2014 and 2022 the share of the sector's production increased by 12.93 percentage points.

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Industrial production sector	KVED	2014	2015	2016	2017	2018	2019	2020	2021	2022
Mining and quarrying	В	44323	51523	57069	77122	85106	97725	125708	184086	78371
Processing industry	С	278180	366848	408473	517746	594272	549451	582096	831485	480666
Production of food products, beverages and tobacco products	10-12	43073	71133	91383	122003	135343	139315	168521	203732	161084
Textile production, production of clothes, leather, leather products and other materials	13-15	4269	6089	7305	8932	10355	9834	10033	12021	10827
Production of wood products, paper production and printing activities	16-18	13685	18298	21106	24248	31562	30150	31437	44943	41794

Table 4. Value of Ukraine's industrial production sold abroad in 2014–2022 by type of activity (in million UAH)

Industrial production sector	KVED	2014	2015	2016	2017	2018	2019	2020	2021	2022
Production of coke and oil refining products	19	2799	1779	2747	4533	6013	5856	3697	8671	4062
Production of chemicals and chemical products	20	15892	20221	14168	14666	21030	20115	17834	33652	12206
Production of basic pharmaceutical products and pharmaceutical preparations	21	2044	2333	3067	3620	3964	4401	5367	6611	6290
Production of rubber and plastic products, other non-metallic mineral products	22, 23	9224	12043	12379	14706	18779	19480	22377	29119	17972
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	129076	167871	189366	243036	273940	227704	226947	379994	145980
Mechanical engineering	26-30	50861	57609	55125	68810	79213	78409	80519	92233	63603
Production of furniture and other products; repair and installation of machines and equipment	31-33	7257	9473	11829	13192	14074	14188	15363	20509	16848
Supply of electricity, gas, steam and air conditioning	D	449	67	n/a						
Water supply; sewerage, waste management	Е	133	354	n/a						

Table 5. Percentage share of the volume of industrial products sold abroad in total industrial production

		2014									Chang	e (p.p.)
Industrial production sector	KVED	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022- -2014	2022- -2021
Mining and quarrying	В	13.72	12.30	12.23	12.93	12.48	15.05	17.70	18.09	13.88	0.17	-4.20
Processing industry	С	86.10	87.60	87.51	86.82	87.13	84.63	81.96	81.70	85.15	-0.95	3.45
Production of food products, beverages and tobacco products	10-12	13.33	16.99	19.58	20.46	19.84	21.46	23.73	20.02	28.54	15.21	8.52
Textile production, production of clothes, leather, leather products and other materials	13-15	1.32	1.45	1.57	1.50	1.52	1.51	1.41	1.18	1.92	0.60	0.74
Production of wood products, paper production and printing activities	16-18	4.24	4.37	4.52	4.07	4.63	4.64	4.43	4.42	7.40	3.17	2.99
Production of coke and oil refining products	19	0.87	0.42	0.59	0.76	0.88	0.90	0.52	0.85	0.72	-0.15	-0.13
Production of chemicals and chemical products	20	4.92	4.83	3.04	2.46	3.08	3.10	2.51	3.31	2.16	-2.76	-1.14
Production of basic pharmaceutical products and pharmaceutical preparations	21	0.63	0.56	0.66	0.61	0.58	0.68	0.76	0.65	1.11	0.48	0.46
Production of rubber and plastic products, other non-metallic mineral products	22, 23	2.86	2.88	2.65	2.47	2.75	3.00	3.15	2.86	3.18	0.33	0.32
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	39.95	40.08	40.57	40.76	40.17	35.07	31.96	37.34	25.86	-14.09	-11.48

											Chang	e (p.p.)
Industrial production sector	ndustrial production sector KVED 2014	2015	2016	2017	2018	2019	2020	2021	2022	2022- -2014	2022- -2021	
Mechanical engineering	26-30	15.74	13.76	11.81	11.54	11.61	12.08	11.34	9.06	11.27	-4.47	2.20
Production of furniture and other products; repair and installation of machines and equipment	31–33	2.25	2.26	2.53	2.21	2.06	2.19	2.16	2.02	2.98	0.74	0.97
Supply of electricity, gas, steam and air conditioning	D	0.14	0.02	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water supply; sewerage, waste management	Е	0.04	0.08	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

As can be seen, Ukraine's metallurgical industry accounted for the largest percentage of industrial products sold abroad (39.95% in 2014), and recorded the biggest decline in its production volume, falling by 14.09 p.p. to 25.86% in 2022. Similar trends were observed in mechanical engineering, whose share decreased from 15.74% in 2022 to 11.27% in 2022 (by 4.7 percentage points). However, there was a considerable increase in the volume of food products, beverages and tobacco products sold abroad: from 13.33% in 2014 to 28.54% in 2022 (by 15.21 percentage points).

To determine how changes in the production of industrial products affected volumes of export sales, Table 6 presents the share of products sold abroad in the total volume of sold industrial production.

Table 6. Percentage share of products sold abroad in total sold industrial production

											Chang	e (p.p.)
Industrial production sector	Code of CTEA	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022- -2014	2022- -2021
Industry	B+C+D+E	27.02	27.99	26.41	27.70	27.19	26.17	28.62	28.35	20.08	-6.96	-8.28
Mining and quarrying	В	28.85	28.40	24.82	24.57	22.35	24.75	35.45	31.93	19.69	-9.16	-12.24
Processing industry	С	34.37	36.25	35.90	36.98	36.30	34.40	36.31	37.79	31.92	-2.44	-5.87
Production of food products, beverages and tobacco products	10-12	16.89	20.88	23.96	27.04	26.84	26.26	29.47	29.98	27.03	10.14	-2.94
Textile production, production of clothes, leather, leather products and other materials	13-15	42.39	40.91	43.27	42.65	42.95	39.79	42.09	42.54	35.25	-7.14	-7.28
Production of wood products, paper production and printing activities	16-18	34.10	34.54	34.87	34.55	36.75	35.52	36.76	38.16	40.20	6.10	2.04
Production of coke and oil refining products	19	6.36	3.49	4.68	5.52	6.17	8.18	6.40	8.36	7.17	0.81	-1.20
Production of chemicals and chemical products	20	33.95	32.63	25.19	24.77	30.68	27.88	25.31	32.00	20.33	-13.62	-11.67
Production of basic pharmaceutical products and pharmaceutical preparations	21	14.19	11.86	12.25	12.50	11.59	12.09	13.12	13.50	15.18	0.99	1.68

	Code of										Change	e (p.p.)
Industrial production sector	CTEA	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022- -2014	2022- -2021
Production of rubber and plastic products, other non-metallic mineral products	22, 23	16.35	15.98	13.72	13.42	14.25	13.73	14.33	14.20	14.43	-1.92	0.22
Metallurgical production, production of finished metal products, except for machines and equipment	24, 25	56.72	62.96	62.51	62.13	59.06	57.63	61.06	59.36	50.11	-6.62	-9.25
Mechanical engineering	26-30	54.06	55.55	47.37	45.75	43.50	41.69	46.52	45.02	41.59	-12.47	-3.43
Production of furniture and other products; repair and installation of machines and equipment	31–33	34.59	37.84	40.13	36.16	31.46	27.22	29.66	30.70	34.97	0.38	4.27
Supply of electricity, gas, steam and air conditioning	D	0.21	0.02	n/a	n/a							
Water supply; sewerage, waste management	Е	0.86	2.03	n/a	n/a							

More than 20% of Ukraine's industrial production in the reference period was sold abroad: from 27.02% in 2014, 28.62% in 2020 to 28.35% in 2021. Following the start of the full-scale war in Ukraine (2022), the share of industrial products sold abroad decreased by 6.95 percentage points in comparison with 2014 and by 8.28 percentage points compared to 2021.

More than half of all metallurgical products sold in the analyzed period (2014–2022) were exported. At the same time, the share of metallurgical products sold abroad in the total volume of sold metallurgical production decreased over the last year (2021–2022) by 9.25 percentage points.

Likewise, the mechanical engineering industry, with the second largest share of products sold abroad (54.06% in 2014) suffered a decline of during 2014–2022 (45.02% in 2021 and 41.59% in 2022) falling by 12.47 percentage points compared to 2014 and by 3.43 percentage points, compared to 2021.

4. Conclusions

It can be concluded that the impact of the war on Ukraine's industry has been considerable, as evidenced by the dynamics of production over the last year. The metallurgical industry has been hit worst, as a result of an almost complete destruction of plants located in the regions most affected by hostilities. In addition, declines were also recorded in the production of coke and oil refining products, chemicals and chemical products, and the production of rubber and plastic products. In general, over the last year, volumes of sold production declined in all seg-

ments of industry, except for textile production, production of clothing, leather, leather products and other materials.

The reduction in the production volume of different industrial sectors caused structural changes in Ukraine's industry. One major change is the growing role of the supply of electricity, gas, steam and air conditioning. A similar trend can be observed in the processing industry, in particular in the production of food, beverages and tobacco products, manufacture of wood products, paper production and printing activities, textile production, production of clothing, leather, leather products and other materials. Taking into account the fact that Ukraine has rich plentiful resources of raw materials for these areas of processing, the outlook for this segment of industry is positive.

With respect to the dynamics and structure of products sold abroad, it can be concluded they are directly proportional to trends in production.

In conclusion, many of the latest structural changes in Ukraine's industry caused by the war are negative, since Ukraine's has lost many of its strongest industries. On the other hand, despite the difficult political and economic situation, new opportunities for industrial development are emerging. In particular, the efficiency of product processing has been increasing, particularly when it comes to products with a full cycle of processing (food products, clothing production, wood products, etc.)

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Zmiany strukturalne w produkcji przemysłowej Ukrainy w warunkach wojny

Streszczenie. W artykule opisano zmiany w strukturze ukraińskiego przemysłu, aby wskazać czynniki osłabiające i zwiększające potencjał przemysłowy kraju oraz sektory przemysłowe, które przeszły największe zmiany strukturalne. Autorki wskazują przyczyny i konsekwencje tych zmian, w szczególności niemal całkowite zniszczenie przemysłu metalurgicznego, które wywarło istotny wpływ na gospodarkę Ukrainy. Z drugiej strony, rozwinęło się wiele gałęzi przemysłu, w tym produkcja energii elektrycznej, gazu, pary i klimatyzacji, produkcja wyrobów z drewna, produktów farmaceutycznych i tekstyliów. Autorki analizują wielkość i strukturę wyrobów przemysłowych sprzedanych za granicę oraz ich udział w całkowitej produkcji sprzedanej, a także wskazują najważniejsze segmenty produkcji przemysłowej Ukrainy, jak również perspektywy rozwoju potencjału przemysłowego w obecnych warunkach.

Słowa kluczowe: przemysł, przemysł przetwórczy, struktura przemysłowa, wolumen sprzedaży produktów, wolumen sprzedaży produktów za granicę