SCIENTIFIC BASIS OF INNOVATION

https://doi.org/10.15407/scine21.06.049

NEPRAN, A. V. [1] (https://orcid.org/0000-0002-8329-7123),
STEPANENKO, S. V. [2] (https://orcid.org/0000-0002-6132-328X),
DOVGOPOL, N. V. [2] (https://orcid.org/0000-0002-2438-0904),
OVSIUCHENKO, Yu. V. [2] (https://orcid.org/0000-0002-0522-1799),
and BATIH, V. V. [2] (https://orcid.org/0009-0007-3883-3648)

[1] Kharkiv National Automobile and Highway University,
25, Yaroslava Mudryho St., Kharkiv, 61002, Ukraine,
+380 57 700 3864, admin@khadi.kharkov.ua
[2] Kharkiv National University of Radio Electronics,
14, Nauky Ave., Kharkiv, 61166, Ukraine,
+380 57 702 1013, info@nure.ua

MANAGING INDUSTRIAL DEVELOPMENT UNDER SYSTEMIC DISPROPORTIONS: THE STRUCTURAL FACTOR AND MATERIAL INTENSITY IN UKRAINE'S MANUFACTURING SECTOR

Introduction. *The post-war reconstruction of Ukraine's industrial sector shall proceed in line with development priorities that enhance competitiveness, reduce resource and material intensity, and improve labor productivity.*

Problem Statement. *Ukraine's industrial structure has long been dominated by low-technology, resource-oriented enterprises with limited value added, which has largely determined the persistently high material and energy intensity of production.*

Purpose. *This study has examined the impact of structural shifts within the manufacturing sector on material intensity and has substantiated the strategic directions for its recovery.*

Materials and Methods. *The index and coefficient methods have been applied. The analysis has been based on data from the State Statistics Service of Ukraine, including indicators of sales volumes and material costs.*

Results. *The study has assessed the influence of sectoral structural shifts on production efficiency. It has been established that during 2020–2022, the structural factor has contributed to a reduction in the average material intensity of manufactured products — by 15.2% in 2020, by 13.1% in 2021, and only marginally in 2022. The findings have demonstrated that the recovery of the manufacturing sector driven by high- and medium-technology industries ensures the largest decline in average material intensity, equivalent to 13.1 kopecks. Moreover, production growth based on these industries has required approximately 30% less material expenditure compared with traditional low-technology manufacturing.*

Conclusions. *Recovery centered on low- and medium-technology industries has demanded an additional 100 billion units of material resources. The structural restructuring of Ukraine's manufacturing sector shall therefore be grounded in a reorientation of state investment policy toward high- and medium-technology industries to secure sustainable reductions in material intensity and improve long-term competitiveness.*

Keywords: industrial production, processing industry, structural shifts, material intensity of products, sold products.

Citation: Nepran, A. V., Stepanenko, S. V., Dovgopol, N. V., Ovsiuchenko, Yu. V., and Batih, V. V. (2025). Managing Industrial Development under Systemic Disproportions: the Structural Factor and Material Intensity in Ukraine's Manufacturing Sector. *Sci. innov.*, 21(6), 49–59. https://doi.org/10.15407/scine21.06.049

Up to the present, industrial production in Ukraine has remained dominated by low-technology and resource-oriented industries. The sectoral structure of industry has been characterized by a steady increase in the share of energy-intensive, material-intensive, and environmentally hazardous industries. This trend has virtually excluded the possibility of achieving sustainable economic growth without mobilizing substantial additional material and labor resources and has hindered the resolution of key socio-economic challenges facing the state. The transition to an innovation-driven model of economic development has required significant structural transformations in Ukrainian industry. Industrial production shall adapt flexibly and in a timely manner to progressive shifts in science, technology, and both social and individual needs. In this regard, the role of structural policy shallstrengthened as one of the key instruments for enhancing production efficiency and accelerating the socio-economic development of the country.

The problems of structural transformation in Ukrainian industry have been addressed in the works of V. P. Vyshnevskyi [1], L. V. Deineko [2], V. I. Zakharchenko [3], H. V. Kozachenko [4], V. H. Herasymchuk [5], S. O. Ishchuk [6], N. T. Shadura-Nekyporets [7], O. O. Okhten [8], among others. In their research on structural shifts in industry, V. P. Vyshnevskyi, L. O. Zbarazska, and colleagues have concluded that the possibilities for extensive growth based on traditional factors have been exhausted, which has necessitated structural transformation toward neo-industrialization [1]. Neo-industrialization has been grounded in the shift to an innovation-driven model of economic development, which has reduced resource and material intensity, improved product quality, and enhanced environmental safety.

I. Shovkun has concluded [9] that structural shifts in Ukraine following the global financial crisis have been associated with a contraction of the industrial sector, particularly the manufacturing industry. According to studies by economists of the Institute of Industrial Economics, the sharpest declines in industrial production have occurred in metallurgy, chemical, and coke-chemical industries, due to the substantial loss of production capacities [10].

A defining feature of Ukraine's industrial structure has been the persistently high share of low-technology and raw-material-based production. According to research by the National Institute for Strategic Studies (NISS), the share of low-technology industries has increased from 23.9% in 2021 to 26.8% in 2022, while the share of medium-low-technology industries has declined from 27.3% to 17.4% [11]. Analyzing the structure of industrial production, O. V. Sobkevych has noted: *"The value added of the medium- and high-technology sectors in the total value added of manufacturing in Ukraine in 2021 amounted to 28.3%, which is significantly lower than in the countries under review"* [12]. Many scholars have argued that this situation has been largely driven by insufficient investment in industrial modernization, an unsatisfactory sectoral and technological structure of capital investment, low expenditures on research and development, a deterioration of human capital, and the lack of closed production cycles for high-technology goods [1, 12—13].

As a result, L. V. Deineko et al. have noted that Ukraine has been weakly represented in global markets for high-technology products and even in markets for traditional goods requiring a high degree of technological processing. Instead, Ukraine has been positioned internationally primarily as a supplier of raw materials and products with low added value [14, p. 15].

An analysis of economic indicators has enabled experts of the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine to conclude that Ukrainian industry has exhibited significant technological gaps relative to the digital challenges of Industry 4.0. This situation has required urgent managerial actions from the state, business, academia, and society [15, p. 58].

The definition of an industrial development strategy under conditions of uncertainty has therefore acquired particular importance. As D. Fukushima has argued, *"to create a stable long-term strategy in a naturally unstable environment, it is*

necessary to abandon the choice of scenarios built around a single expected future state and to direct strategic thinking toward formulating a strategy that will render industry successful under multiple possible futures" [16].

The main vector of structural change in advanced economies has been determined by the degree of innovativeness. According to studies by many international scholars, a company that has failed to meet technological challenges has found itself excluded from modern value chains [17]. In particular, experts at the Centre for Economic Justice (UK) have regarded the promotion of structural transformation in the economy as the primary objective of Britain's industrial strategy [18].

However, previous studies have not devoted sufficient attention to assessing the impact of structural shifts in the manufacturing sector on the efficiency of its functioning. The recommendations of most authors regarding the directions of structural policy in industry have been of a general nature and have not been based on economic calculations. This has complicated the substantiation of industrial policy priorities and the evaluation of their effectiveness. In particular, in the collective monographs edited by L. V. Deineko [15], H. V. Kozachenko [4], and others, no calculations have been provided concerning the strategic directions for the development of Ukrainian industry or the economic indicators of material and capital intensity of production. Without such assessments, it has been impossible to substantiate an industrial development strategy under current conditions.

The purpose of this article has been to examine the impact of structural shifts in the manufacturing sector on indicators of material intensity of production, as well as to justify the key directions for the recovery of manufacturing.

In analyzing structural shifts and their impact on the performance of manufacturing enterprises, the study has applied the index method and the coefficient method. The initial data for assessing structural shifts have been derived from the State Statistics Service of Ukraine, specifically the indicators characterizing the volume of sold products and the size of material costs of production.

The overall trend in the dynamics of industrial structure in advanced economies during the process of innovative development has consisted in a transition from labor-intensive industries to capital-intensive and knowledge-intensive ones. This shift has been explained by the fact that new industries provide comparatively greater advantages in enhancing the competitiveness of national industry as a whole than traditional industries. Naturally, new industries also embody a higher technological order, while their products and production technologies have reflected increasingly significant achievements of science and technology. These industries have demonstrated faster growth rates of production efficiency compared to traditional sectors, which has directly contributed to strengthening the competitiveness of the national economy. This has been associated both with the rapid growth of newly created value in emerging industries and with the accelerated expansion of markets for their products.

High-technology industries, in the course of their accelerated development, have become a kind of locomotive or "growth poles" for industry as a whole. The faster the industrial structure has shifted from labor-intensive to capital-intensive and subsequently to knowledge-intensive industries, the higher have been the growth rates of industrial efficiency overall, and the stronger the competitiveness of domestic producers in the global market.

The development of new and advanced industries has also contributed indirectly to improving the efficiency of industrial production. The products of modern industries have allowed for the technical modernization of older, traditional industrial branches, leading to greater economic efficiency within them. For example, the development of general mechanical engineering has served as the basis for the technical re-equipment of light and food industries, while the advancement of electronics has enabled modernization not only in light industry but also across various branches of mechanical engineering.

At the turn of the 1970s and 1980s, highly developed countries of the West, Japan, and South Korea embarked on a path of profound structural transformation of industry. This transformation was based on the accelerated development of the knowledge-intensive sector, comprising a complex of high-technology industries such as electronics, instrument engineering, pharmaceuticals, biotechnology, robotics, and automation. The use of products from these industries in itself opened additional opportunities to accelerate the growth rate of industrial efficiency. However, these opportunities were realized only when state regulation at the macro level was aligned with the requirements posed by modern scientific and technological progress.

The 1980s demonstrated this particularly clearly: reliance mainly on market forces and the absence of an industrial policy to stimulate the accelerated intersectoral flow of labor and capital inevitably resulted in technological lag. For instance, between 1973 and 1986, labor productivity in Japan grew nearly six times faster than in the United States [19]. By 1984, Japan had even surpassed the United States in the absolute level of labor productivity in manufacturing. Unfortunately, this conclusion has been fully confirmed in Ukraine, where throughout the entire period of independence there has been no policy aimed at stimulating the innovative development of national industry. As a result, industrial output has remained dominated by low-technology and raw-material products, while advanced industrial sectors have lost competitiveness.

In this regard, two main approaches to industrial restructuring are typically distinguished: the American model (also followed by the United Kingdom), which relies on market forces and economic deregulation, and the Japanese model (adopted for more than 30 years by South Korea and China), which is based on industrial policy, support for high-technology sectors, state planning, and the accelerated reallocation of resources across industries.

As the experience of advanced countries has shown, the second path has proven to be faster, less socially disruptive, and associated with more significant gains in productivity.

Given these circumstances, accelerating the structural transformation of industry along these lines cannot be achieved solely within the framework of market mechanisms. The length of structural changes under purely market conditions prevents countries from rapidly capitalizing on the advantages of new and especially high-technology industries. Insufficient attention to this issue can negatively affect the growth rates of industrial efficiency even in highly developed economies.

The foundation of a progressive industrial structure is capital investment. In the early 2020s, significant shifts in capital allocation were observed in favor of raw-material and low-technology industries. For instance, the share of food processing in the structure of capital investment during 2020—2022 has amounted to 13.4%, while the share of machinery manufacturing has remained within 4.4—6.1%, and pharmaceutical production within 1.7—1.8%.

Structural shifts in industry have influenced the dynamics of production efficiency indicators. One of the key aggregate indicators of production efficiency, which reflects the specific consumption of material resources (including primary and auxiliary materials, semi-finished products, fuel, and energy), has been material intensity. An increase in the share of capital investment directed toward low- and medium-technology sectors of manufacturing has not led to the intended structural changes in output.

The dynamics of material intensity in manufacturing are presented in Table 1.

According to the calculations, from 2019 to 2021, there has been a downward trend in the material intensity of manufacturing output. Despite these positive shifts, the material intensity of manufacturing products has remained relatively high.

The overall reduction in material intensity across the industry (average material intensity) has depended both on the efficiency of material resource utilization and on the change in the relative share of output from individual sectors in the total volume of manufactured products.

To analyze the impact of individual factors, the system of index numbers of averages can be applied. This system includes indices of variable composition, fixed composition, and structural shifts [20, p. 160]. The index of variable composition reflects changes in the average value that result both from changes in the attribute itself and from changes in the structure of the aggregate.

The dynamics of the average level of material intensity across industries, considered both as a result of changes in material intensity within specific sectors and as a result of changes in the industrial composition, can be determined using the index of variable composition for material intensity:

$$J_{m^{var}} = \frac{\sum f_1^e d_1}{\sum f_0^e d_0}, \quad (1)$$

where f_0^e, f_1^e are the material intensity of goods sold in the base and reporting periods; d_0, d_1 are the share of goods sold by a specific industry in the total volume of goods sold in the base and reporting periods.

The variable-composition index, which characterizes the dynamics of material intensity of production, has been decomposed into multiplicative indices: the fixed-composition index and the structural-shift index. The fixed-composition index has been computed with weights fixed at the level of a selected reference period and reflects changes only in the indexed variable. The constant-composition index has been derived using an aggregate formula. The average change in material intensity across industries has been determined by means of the fixed-composition index under the assumption of an unchanged sectoral structure:

$$J_{m^{const}} = \frac{\sum f_1^e d_1}{\sum f_0^e d_1}. \quad (2)$$

The index of structural shifts (index of the impact of structural change) characterizes the variation in the average value attributable solely to structural changes within the aggregate [20, p. 160]. This index makes it possible to determine the effect of the structure of industrial production on changes in the average material intensity of output. The index of structural shifts is calculated as follows:

$$J_{m^s} = \frac{\sum f_0^e d_1}{\sum f_0^e d_0}. \quad (3)$$

In this case, the system of interrelated indices takes the following form:

$$J_{m^{var}} = \frac{\sum f_1^e d_1}{\sum f_0^e d_1} \cdot \frac{\sum f_0^e d_1}{\sum f_0^e d_0} = I_{f^e} \cdot I_d. \quad (4)$$

The assessment of the impact of structural shifts on the average material intensity of output has been conducted on the basis of 68 subsectors of the manufacturing industry. To determine the indicators of material intensity, the indices of material intensity and the sectoral structure of manufactured output have first been established. Table 2 presents the volume of manufactured output and material costs for the main sectors of the manufacturing industry.

The data have shown that manufacturing sectors differ substantially both in terms of output volumes and in material intensity. Industries with a low level of material intensity have included pharmaceutical production, mechanical engineering, as well as light and food industries. For example, the material intensity of pharmaceutical products has been more than three times lower than that of enterprises in the food and light industries.

Table 1. **Dynamics of Average Material Intensity of Manufacturing Output in Ukraine, 2018–2022**

Indicator	Year				
	2018	2019	2020	2021	2022
Material intensity, UAH/UAH	0.695	0.687	0.658	0.638	0.697
Growth rate, % (2018 = 100%)	100	98.9	94.7	91.8	100.3

Source: Volume of Sold Production (Goods, Services) of Business Entities by Types of Economic Activity, 2010–2023; Production Costs of Enterprises by Types of Economic Activity, 2012–2022. State Statistics Service of Ukraine. URL: https:// www.ukrstat.gov.ua/ (Last accessed: 24.04.2025).

In recent years, significant structural changes have occurred in the composition of manufacturing output (Table 3). The industrial structure of manufacturing has been dominated by low-technology sectors, while the share of high- and medium-high-technology industries has simultaneously declined. For instance, the share of enterprises producing computers and peripheral equipment in total manufacturing output has decreased from 0.11% in 2019 to 0.07% in 2022, while the share of basic pharmaceutical products has fallen from 1.88% to 0.12% over the same period. At the same time, the share of meat and meat products has increased from 4.23% in 2019 to 7.01% in 2022, and the share of vegetable oil and animal fats has risen from 10.05% to 12.24%, respectively.

On the basis of the above data, the corresponding indices have been computed.

The index of variable composition (2022/2021) is equal to:

$$J_{m^{var}} = \frac{\sum f_1^e d_1}{\sum f_0^e d_0} =$$

$$= \frac{\begin{array}{c}0.780 \cdot 0.0824 + 0.758 \cdot 0.0461 + \\ + 0.612 \cdot 0.0292 + ... + 0.789 \cdot 0.0064\end{array}}{\begin{array}{c}0.903 \cdot 0.0411 + 0.772 \cdot 0.0283 + \\ + 0.623 \cdot 0.0172 + ... + 0.497 \cdot 0.0055\end{array}} =$$

$$= \frac{0.697}{0.638} = 1.0920.$$

Thus, the level of material intensity of products in manufacturing enterprises has increased by 9.2% in 2022 compared to 2021. The absolute increase in material intensity, driven both by changes in material intensity across individual branches of

Table 2. **Output of Sold Products and Material Costs of Manufacturing Enterprises in 2021–2022**

Industry	KVED-2010 Code	Output of sold products (goods, works, services), UAH million		Material intensity, UAH/UAH	
		2021	2022	2021	2022
Manufacture of meat and meat products	10.1	116 127.8	137810.9	0.903	0.780
Manufacture of dairy products	10.5	79 990.5	77064.0	0.772	0.758
Manufacture of bread, bakery and flour products	10.7	48 713.6	48901.9	0.612	0.653
Manufacture of beverages	11	96 621.6	81720.2	0.586	0.652
Manufacture of wearing apparel, except fur apparel	14.1	18 352.7	18844.8	0.383	0.459
Manufacture of coke and refined petroleum products	19	124 765.0	50649.3	0.562	0.832
Manufacture of chemicals and chemical products	20	129 704.6	77700.7	0.623	0.672
Manufacture of basic pharmaceutical products	21.1	2 236.3	24333.0	0.338	0.380
Manufacture of pig iron, steel and ferroalloys	24.1	554 423.4	208497.2	0.742	0.994
Manufacture of computers and peripheral equipment	26.2	1 355.7	1386.7	0.475	0.420
Manufacture of communication equipment	26.3	5 211.5	8375.8	0.318	0.362
Manufacture of electric motors, generators, transformers, distribution and control apparatus	27.1	13 472.9	9713.8	0.566	0.596
Manufacture of wires, cables and wiring devices	27.3	15 612.4	10651.6	0.821	0.789
Total		2828770.2	1673189.1	0.638	0.697

Source: Output of Sold Products (Goods, Services) of Business Entities by Types of Economic Activity (2010–2023); Production Costs by Types of Economic Activity in 2012–2022. State Statistics Service of Ukraine. URL: https://www.ukrstat.gov.ua/ (Last accessed: 24.04.2025).

the manufacturing sector and by structural shifts, has amounted to:

$$\Delta f^e = \sum f_1^e d_1 - \sum f_0^e d_0 =$$
$$= 0.697 - 0.638 = 0.059 \text{ UAH}$$

To provide a quantitative assessment of the impact of changes in material intensity across individual branches of the manufacturing sector on the dynamics of average material intensity, we calculate the index of constant (fixed) composition:

$$J_{m^{const}} = \frac{\sum f_1^e d_1}{\sum f_0^e d_1} =$$
$$= \frac{\begin{array}{c}0.780 \cdot 0.0824 + 0.758 \cdot 0.0461 + \\ + 0.653 \cdot 0.0292 + ... + 0.789 \cdot 0.0064\end{array}}{\begin{array}{c}0.903 \cdot 0.0824 + 0.772 \cdot 0.0461 + \\ + 0.612 \cdot 0.0292 + ... + 0.821 \cdot 0.0064\end{array}} =$$
$$= \frac{0.697}{0.539} = 1.293.$$

Table 3. **Structure of Sales of Manufacturing Enterprises, 2019–2022, %**

Group	Other industries	Year			
		2019	2020	2021	2022
High-tech	Manufacture of basic pharmaceutical products	1.88	2.02	0.08	0.12
	Manufacture of electronic components and boards	0.06	0.05	0.05	0.07
	Manufacture of computers and peripheral equipment	0.11	0.09	0.05	0.07
Medium-high-tech	Manufacture of communication equipment	0.18	0.19	0.18	0.43
	Manufacture of chemicals and chemical products	5.02	3.82	4.59	3.95
	Manufacture of irradiation, electromedical and electrotherapeutic equipment	0.03	0.05	0.03	0.02
	Manufacture of optical instruments and photographic equipment	0.05	0.03	0.04	0.05
	Manufacture of motor vehicles	0.51	0.46	0.49	0.66
	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	0.10	0.08	0.07	0.13
	Manufacture of parts and accessories for motor vehicles	1.05	0.93	0.81	1.38
Medium-low-tech	Manufacture of coke and refined petroleum products	5.02	3.82	4.41	2.58
	Manufacture of rubber products	0.35	0.33	0.36	0.39
	Manufacture of pig iron, steel and ferroalloys	16.44	15.07	19.60	10.60
	Manufacture of tubes, pipes, hollow profiles and fittings of steel	1.12	1.04	1.25	1.54
	Manufacture of fabricated metal structures and products	1.06	0.88	1.04	1.07
	Manufacture of metal tanks, reservoirs and containers	0.22	0.22	0.25	0.30
Low-tech	Manufacture of meat and meat products	4.23	4.46	4.11	7.01
	Manufacture of oils and animal fats	10.05	11.77	10.92	12.24
	Manufacture of dairy products	3.51	3.62	2.83	3.92
	Manufacture of bread, bakery and flour products	1.68	1.75	1.72	2.49
	Weaving industry	0.06	0.04	0.07	0.12
	Sawmilling and planing of wood	0.72	0.74	0.73	1.05
	Total	100.0	100.0	100.0	100.0

Source: developed by the authors.

Thus, the material intensity of products in the manufacturing sector has increased by 29.3% in 2022 compared to 2021. To assess the impact of the industrial structure on the material intensity of manufacturing output, the structure index is calculated:

$$J_{m^s} = \frac{\sum f_0^e d_1}{\sum f_0^e d_0} = \frac{0.539}{0.638} = 0.845. \quad (5)$$

The results have shown that the material intensity of manufacturing enterprises, as influenced by structural shifts, has decreased by 15.5% in 2022 compared with 2021. However, this decline in material intensity due to structural changes has not fully compensated for the increase in material intensity that has occurred in the majority of manufacturing industries. The most significant growth has been recorded in the production of tobacco products (by 198.7%), pig iron (by 33.9%), knitted apparel (by 27.2%), and paper products (by 11.1%).

Accordingly, the results of our calculations, which characterize both the absolute and relative changes in average material intensity, have been summarized in Table 4.

The analysis of Table 4 has shown that changes in the industrial structure of the manufacturing sector in Ukraine have led to a reduction in the average material intensity of output. The structural factor has been particularly influential in 2020. In that year, material intensity increased by 0.076 UAH; however, due to structural shifts, material intensity decreased by 0.104 UAH. As a result, the average material intensity of output decreased by 0.028 UAH.

In 2022, the structural factor has exerted only a minor effect, and the increase in average material intensity has been driven primarily by growth across all industries. Without structural changes, the material intensity of manufacturing output would have increased not by 9.2% but by 29.3%.

Shifts in the industrial structure of manufacturing have tended toward increasing labor and capital intensity overall. In the long run, this nega-

Table 4. **Impact of Changes in Material Intensity Levels and Structural Shifts on the Absolute and Relative Change of Average Material Intensity of Manufacturing Output for 2020–2022**

Indicator	2020		2021		2022	
	Absolute, UAH	Relative	Absolute, UAH	Relative	Absolute, UAH	Relative
Change in:						
Material intensity in manufacturing sectors	0.076	1.130	0.066	1.115	0.158	1.293
Sectoral structure	–0.104	0.848	–0.086	0.869	–0.099	0.845
Overall change in average material intensity	–0.028	0.958	–0.020	0.969	0.059	1.092

Source: calculated by the authors.

Table 5. **Impact of Structural Shifts on the Sectoral Average Material Intensity of Manufacturing Output**

Indicator	Options		
	I	II	III
Total change in average material intensity, UAH	–0.012	–0.044	–0.02
Including the contribution of industry structure	–0.108	–0.131	–0.007
Additional: increase in material costs compared to 2022, billion UAH	288.4	210.9	313.1

Source: calculated by the authors.

tive structural effect is expected to contribute to a decline in the material intensity of output.

To substantiate directions for restoring the manufacturing sector, we have developed three scenarios of structural change, each differing in the industrial composition of output. In all scenarios, material intensity has been assumed at the 2022 level, while the total volume of output has been fixed at the 2023 level (UAH 2,422.9 billion). The scenarios differ in the distribution of sectoral growth:

- Scenario I — actual distribution of growth according to 2023 data;
- Scenario II — priority development of high- and medium-high-technology industries (chemical production, basic pharmaceutical products, electronic components and boards, computers, and peripheral equipment);
- Scenario III — priority development of low-technology industries (meat and meat products, oils and animal fats, dairy products, textiles, and sawmilling and planing).

The results of these calculations have been presented in Table 5.

The calculations have shown that restoring the manufacturing sector based on high- and medium-high-technology industries (Scenario II) has provided the greatest reduction in the material intensity of output. Compared with Scenario I, the decrease in material intensity in Scenario II has reached 0.044 versus 0.012 in Scenario I, representing an almost three improvement. It should be emphasized that the primary reduction in average material intensity has been achieved through structural shifts. In contrast, restoration based on low-technology industries has produced virtually no change in material intensity, and the influence of structural shifts has been minimal.

The scenarios for structural adjustment differ significantly in terms of the additional material inputs required to achieve the 2023 output levels. The lowest material requirement has been observed under Scenario II, which required an additional UAH 210.9 billion, whereas Scenario III required UAH 313.1 billion — nearly UAH 100 billion more. This indicates that restoring the manufacturing sector based on low-technology industries demands higher material inputs compared with Scenario II, which has prioritized the development of high- and medium-high-technology manufacturing.

The allocation and reallocation of capital investments among industries represent the most active instrument of structural policy. Intensifying structural policy, clearly defining investment priorities, and improving the structure of production capacities and material resources constitute an essential component of economic strategy at the current stage of development. Structural transformation of the manufacturing sector toward reduced material intensity requires the adjustment of investment policy, focusing on the preferential development of high- and medium-high-technology industries, whose output exhibits lower material intensity compared with traditional sectors.

Based on the analysis of 68 sub-industries of the manufacturing sector, it has been demonstrated that the structural factor has contributed to the reduction of product material intensity. In 2020 and 2021, the structural factor has accounted for a decrease in the average material intensity of manufacturing output by 15.2% and 15.5%, respectively. The limited impact of the structural factor has largely been attributed to the predominance of low-technology production in the industrial structure.

In 2022, due to a sharp increase in material intensity in many manufacturing industries, the average material intensity of output has risen by 29.3%. The recovery of Ukraine's manufacturing sector should be guided by a shift in development priorities. Calculations have shown that recovery based on increased output from high- and medium-high-technology industries has provided the greatest reduction in material intensity, largely driven by structural factors. In contrast, increasing output from low-technology manufacturing industries has had virtually no effect on the average material intensity of production.

Restoring manufacturing output on the basis of high- and medium-high-technology sectors has resulted in significant savings in material inputs compared with scenarios focused on low-technology production. These findings indicate the need to adjust state investment policies to prioritize the development of enterprises in the high- and medium-high-technology group, whose product material intensity is substantially lower than the industry average.

FUNDING

The publication of this study has been funded from the authors' own resources.

REFERENCES

1. Vyshnevskyi, V. P., Zbarazska, L. O., Zanizdra, M. Yu., Chekina, V. D. (2016). *National model of neoindustrial development of Ukraine* (monograph.) (Ed. V. P. Vishnevskyi). Kyiv [in Ukrainian].
2. *Strategic planning of post-war industrial development: new determinants and imperatives* (Ed. L.V. Dejneko). (2024). Kyiv [in Ukrainian].
3. Zakharchenko, V. I. (2017). Structural transformations of the national industrial complex in the context of post-industrial development. *Industrial economics*, 2(78), 37—60 [in Ukrainian].
4. Kozachenko, H. V., Pohorelov, Yu. S. (2024). Development of strategic industries of Ukraine in the context of national economic security: theoretical foundations. *Industrial economics,* 3(107), 37—51 [in Ukrainian].
5. Herasymchuk, V. H. (2021). Industrial complex development strategy: intentions, implementation mechanisms, responsibility. *Economic Bulletin of the National Technical University "Kyiv Polytechnic Institute"*, 18, 23—29. https://doi.org/10.20535/2307-5651.18.2021.230058 [in Ukrainian].
6. Ischuk, S. O., Sozans'kyj, L. J. (2024). Optimization of the structure of the processing industry of Ukraine based on the criterion of increasing the technological efficiency of production and reducing their import dependence. *Industrial Economics*, 1(105), 16—38. htpps://doi.org/10.15407/econindustry2024.01.016 [in Ukrainian].
7. Shadura-Nekyporets' N., Minina O., Derij Zh. (2023). Structural transformations of the economy: the impact of the war and the search for a new economic paradigm for Ukraine. *Problems and prospects of economics and management*, 4(36), 49—60 [in Ukrainian].
8. Okhten, O. O., Dasiv, A. F. (2023). Baseline scenario for long-term development of national industry until 2035. *Industrial economics*, 1(101), 56—68. htpps://doi.org/10.15407/econindustry2023.01.056
9. Shovkun, I. A. (2021). Structural shifts: impact on productivity and growth of the Ukrainian economy. *Economics and forecasting*, 3, 59—76; 4, 142—155. https://doi.org/10.15407/eip2021.03.059 [in Ukrainian].
10. Novikova, O. F., Zaloznova, Yu. S., Antoniuk, V. P., Khandiy, O. O., Azmuk, N. A., ..., Maltsev, O. Yu. (2024). *Assessment of problems and opportunities for providing industry with labor force in conditions of martial law and post-war development of Ukraine: scientific report*. Kyiv [in Ukrainian].
11. Sobkevych, O. V., Shevchenko, A. V., Rusan, V. M., Zhurakovs'ka, L. A. (2023). *Priorities for ensuring the sustainability of industry and the agrarian sector of the Ukrainian economy in conditions of full-scale war: analytical supplement*. Kyiv [in Ukrainian].
12. Sobkevych, O. V. (2024). *Assessment of the industrial competitiveness of the economy and the technological potential of the industry of Ukraine*. Kyiv [in Ukrainian].
13. Ishchuk, S. O., Sozanskyi, L. Y. (2021). Modeling the impact of structural parameters of the processing industry on its efficiency (using the example of EU countries). *Industrial Economics,* 1(93), 60—78 [in Ukrainian].
14. Dejneko, L. V., Kushnirenko, O. M., Tsyplitskaya, O. O., Gakhovich, N. G., Sheludko, E. I., Wenger, L. A., Zagorodnya, M. Yu., Zarudna, O. S. (2022). *Future challenges for the industrial development of Ukraine: scientific report*. Kyiv [in Ukrainian].
15. Dejneko, L. V. Kushnirenko, O. M., Tsyplitskaya, O. O., Gakhovich, N. G., Sheludko, E. I., Wenger, L. A., Zagorodnya, M. Yu., Zarudna, O. S. (2022). *Ukrainian industry facing the challenges of the future: in search of answers and solutions: collective monograph*. Kyiv [in Ukrainian].
16. Fukushima, D. (2023). *Strategic Planning in a Highly Uncertain World*. Toffler Associates. May 15.
17. Sanyaolu, P. The impacts of industrial revolution to modern state system. URL: https://www.researchgate.net/publication/331260774_The_impacts_of_industrial_revolution_to_modern_state_system/ citation/download (Last accessed: 20.04.2025).

18. Jacobs, M., Hatfield, I., King, L., Raikes, L., Stirling, A. (2017). Industrial Strategy: Steering structural changes in the UK economy. Discussion Paper of IPPR Commission on Economic Justice. URL: https://www.ippr.org/files/2017-11/1511445722_industrial-strategy-cej-november17.pdf (Last accessed: 20.04.2025).
19. Jackson Grayson, C., O'Dell, C. (1988). *American Bussiness: A Two Warning*. New York.
20. Varenichenko, L. L., Vasechko, O. O., Gonchar, O. V., Danilko, V. K., Danchenko, E. S., Yegorov, I. Yu., Zhuikova, E. M., Zhuk, O. P., ..., Chebanova V. G. (2012). *Statistical dictionary*. Kyiv [in Ukrainian].

Received 31.10.2024
Revised 09.02.2025
Accepted 24.02.2025

А.В. Непран [1] (https://orcid.org/0000-0002-8329-7123),
С.В. Степаненко [2] (https://orcid.org/0000-0002-6132-328X),
Н.В. Довгопол [2] (https://orcid.org/0000-0002-2438-0904),
Ю.В. Овсюченко [2] (https://orcid.org/0000-0002-0522-1799),
В.В. Батіг [2] (https://orcid.org/0009-0007-3883-3648)

[1] Харківський національний автомобільно-дорожній університет,
вул. Ярослава Мудрого, 25, Харків, 61002, Україна,
+380 57 700 3864, admin@khadi.kharkov.ua
[2] Харківський національний університет радіоелектроніки,
просп. Науки, 14, Харків, 61166, Україна,
+380 57 702 1013, info@nure.ua

УПРАВЛІННЯ РОЗВИТКОМ ПРОМИСЛОВОСТІ В УМОВАХ СИСТЕМНИХ ДИСПРОПОРЦІЙ: РОЛЬ СТРУКТУРНОГО ФАКТОРУ У ЗМІНІ МАТЕРІАЛОМІСТКОСТІ ПЕРЕРОБНОЇ ПРОМИСЛОВОСТІ УКРАЇНИ

Вступ. Повоєнна відбудова промисловості України повинна відбуватися з урахуванням пріоритетів розвитку, які забезпечують підвищення конкурентоспроможності, зниження ресурсо- та матеріаломісткості продукції, збільшення продуктивності праці.

Проблематика. В Україні тривалий час у структурі промислового виробництва домінують низькотехнологічні підприємства сировинного спрямування та з низькою доданою вартістю, що значною мірою визначає високу матеріало- та енергомісткість виробництва.

Мета. Дослідження впливу структурних зрушень у переробній промисловості на показники матеріаломісткості її функціонування, а також обґрунтування основних напрямів відновлення переробної промисловості.

Матеріали й методи. Застосовано індексний метод, метод коефіцієнтів. Вихідними даними щодо аналізу структурних зрушень слугували дані Державної служби статистики України щодо показників, які характеризують обсяг реалізованої продукції та розмір матеріальних витрат на виробництво.

Результати. Подано оцінку впливу галузевих структурних зрушень у переробній промисловості на показники ефективності виробництва. Встановлено, що за 2020–2022 рр. структурний фактор сприяв зниженню середньої матеріаломісткості продукції переробної промисловості: у 2020 р. на 15,2 %, у 2021 р. — на 13,1 %, проте у 2022 р. був незначним. Доведено, що відновлення переробної промисловості на базі високотехнологічних та середньотехнологічних галузей забезпечить найбільше зниження середньої матеріаломісткості продукції на 13,1 коп. Відновлення випуску продукції за рахунок високо- та середньотехнологічних виробництв потребує на 30 % менше витрат матеріальних ресурсів порівняно із традиційними галузями переробної промисловості.

Висновки. Відновлення переробної промисловості на базі низько- та середньотехнологічних галузей потребує додатково близько 100 млрд витрат матеріальних ресурсів. Основою структурної перебудови повинна стати зміна пріоритетів інвестиційної політики держави.

Ключові слова: промислове виробництво, переробна промисловість, структурні зрушення, матеріаломісткість продукції, реалізована продукція.