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Sustainability Analysis of the Chemical Industry in the Period of Transformation Using an Institutional Approach

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ABSTRACT

The **relevance** of the study is related to the need to monitor the sustainability of business and improve the institutions of its regulation during the period of transformation of the national economic model focused on technological sovereignty. In this regard, the **purpose** of the study was to develop a methodology for analyzing the sustainability of business models of behavior of companies in the chemical industry using an institutional approach to assess the influence of institutional aspects on the performance of companies belonging to different institutional groups, as well as assessing the transformation in general. The **scientific novelty** of the study lies in the development of analytical tools for assessing the behavior of companies of various institutional groups, which allows us to identify ongoing trends and acts as a navigator for the structural transformation of the industry. According to the results of the study, the most significant institutional factors of the efficiency and sustainability of business behavior models that influence the effectiveness of transformation are participation in government procurement and the mandatory external audit. The author's approach to the formation of institutional groups of companies based on criteria for assessing their business behavior model from the perspective of operational efficiency, investment activity, and financial stability is of **theoretical significance**. The **practical value** lies in the development of an algorithm for identifying points of promising economic growth and indicators for assessing industry transformation to provide support to companies with the greatest multiplier effect. The results obtained can be used in the implementation of priority projects of technological sovereignty and projects of structural adaptation of the economy, as well as the concept of technological development of the Russian Federation for the period until 2030, as a tool for monitoring their implementation and determining the vector of development of priority sectors of the economy, searching for new potential points of economic growth, attracting public and private investments. The proposed tools may be in demand for selecting effective participating organizations in the system of public procurement and government support for business.

Keywords: sustainable development; chemical industry; institutional approach; business model of behavior; the economic growth; transformation assessment indicators; import substitution; investment activity; risks

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INTRODUCTION

The current geopolitical situation requires a large-scale transformation of the national economic model, the key vectors of which have been defined by the Government of the Russian Federation in the priority areas of technological sovereignty projects and structural adaptation projects of the economy,[1] as well as in the Concept of Technological Development for the period up to 2030.[2] This sets the task of improving financial instruments for attracting public and private investments, forming an adequate system for monitoring and controlling the development of priority sectors using transformation indicators, and assessing company behavior to identify potential points of economic growth.

The choice of the chemical industry for studying the processes of transforming the national economic model is due to the high significance of the industry as a high-tech sector and one of the key drivers of economic growth during the period of active import substitution to ensure Russia's technological sovereignty. The advanced development of the industry is associated with the large-scale "chemicalisation" of the national economy. In particular, the restriction of oil and gas exports requires the development of innovations in the production of high value-added products from these raw materials, with the prospect of forming a circular economy that allows for the rational use of resources and achieving the decoupling effect (growth in production while reducing its resource intensity). Along with the problems (dependence on foreign technologies, high level of wear and tear of production equipment, negative external environmental externalities, low added value of produced goods), the chemical industry has important advantages (resource availability, growing demand, need for innovations, potential for import substitution). The sanctions policy regarding the chemical industry does not include direct sanctions limiting producers, but it manifests through personal sanctions on the owners and executives of the largest enterprises, logistical problems; difficulties in international settlements for exported products; refusal of foreign buyers to purchase Russian products or demands for discounts on supply prices; difficulties in obtaining licenses for the supply of imported materials and equipment. At the same time, the imposed sanctions also open up opportunities for industry development related to the freeing up of market niches and import substitution. Thus, an audit by the Ministry of Industry and Trade showed that "out of 79 chemical products banned for sale in Russia, technical sovereignty has been ensured for 38".[3] Experts note an increase in the performance indicators of innovative activities in 2022, which may be related to the stimulation of demand for innovations due to sanctions [1].

The purpose of the study is to develop a methodology for analyzing the sustainability of business models of companies in the chemical industry using an institutional approach to assess the impact of institutional aspects on the performance of companies belonging to different institutional groups, as well as to evaluate the transformation as a whole, including the development of tools for identifying points of promising industry growth to attract investments and provide state support to companies with the greatest multiplicative effect.

METHODS AND METHODOLOGY OF RESEARCH

The research methodology is based on the results of scientific papers by Russian and

[1] On the approval of priority areas for projects of technological sovereignty and projects of structural adaptation of the economy of the Russian Federation: Resolution of the Government of the Russian Federation from 15.04.2023 No. 603.

[2] On the approval of the Concept for Technological Development for the period up to 2030: Order of the Government of the Russian Federation from 20.05.2023 No. 1315.

[3] URL: https://www.vedomosti.ru/business/articles/2022/09/30/943198-minpromtorg-provel-audit-himicheskoi-promishlennosti (accessed on 06.05.2025).

foreign scholars, arguments, hypotheses, and the professional judgement of the authors of this paper, as well as on the fundamental principles of the theory and practice of industry analysis, the institutional approach, information resources available in the digital environment, and methods of financial and mathematical-statistical analysis. The current geopolitical situation not only poses a threat to Russia's economic growth but also serves as a powerful impetus for large-scale structural changes on a qualitatively new basis. This is indicated in the works of scholars A. G. Aganbegyan [2], V. V. Ivanter, B. N. Porfiyrev, D. E. Sorokin, M. A. Eskindarov, V. V. Maslennikov, A. A. Shirov [3], S. D. Bodrunov [4], M. A. Fedotova, and T. V. Tazihina [5]. The most significant risk factors for the transformation of the Russian economy and its sustainable development, according to scientists, are structural and technological restructuring, accelerated growth of investments in production modernisation, increased spending on research and development, which may not yield positive results (O. V. Efimova [6]), and the reduction of dependence on imports and technological backwardness of the Russian economy [7]. The influence of institutional aspects on the sustainability and efficiency of economic entities has been examined by foreign and Russian scholars who developed the theory of economic growth (C. Ménard [8], G. B. Kleiner [9]), the theory of institutional changes, and the theory of dysfunctions (O. S. Sukharev [10]). Among the scholars studying the problems of institutional transformation of the economic model of the Russian economy, it is worth mentioning V. L. Tambovtsev [11], O. S. Sukharev, and S. Yu. Glazyev. Scientists emphasize the expansion of the institutional approach vector by incorporating microanalysis, which allows for the assessment of the impact of institutional factors on the stability of the economy and its economic growth in the short term. In this context, O. S. Sukharev points out the high need to search for new research methods due to the high complexity and heterogeneity of the research objects, and the dependence of the assessment of the "impact of institutional aspects on the quality of rules, which is difficult to quantify" [12]. According to S. Yu. Glazyev, underestimating such influence leads to limitations in the strategic planning of ecosystem development [13]. Scientists G. B. Kleiner, M. A. Rybachuk, and V. A. Karpinskaya rightly point out that under conditions of high geopolitical risks, industry analysis allows for "foreseeing crises and preventing their consequences, which is impossible if limited to macro analysis alone" [14]. According to scientists Yu. V. Simachev, A. A. Fedyunina, and M. G. Kuzyk [15], the institutional approach allows for the study of real processes in different dimensions, which makes it possible to assess ongoing transformations from the perspective of the effectiveness of state policy in achieving multiplicative effects, particularly through the support of industries and companies that ensure such effects. Thus, the hypothesis of our research aligns with the views of many authoritative scholars and posits that the institutional approach allows for the identification of ongoing trends and can serve as a navigator for the structural transformation of the economy, state support for economic entities with the greatest multiplicative effect, which can contribute to the acceleration of the qualitative restructuring of the sectoral structure of the country's economy.

The *Figure* presents a methodology for analyzing the sustainability of business models of enterprises in the chemical industry during the period of economic transformation using an institutional approach. The analysis of macroeconomic and market factors involves assessing the potential of the chemical industry as a condition for successful transformation. Analysis of the industry structure based on various institutional characteristics allows

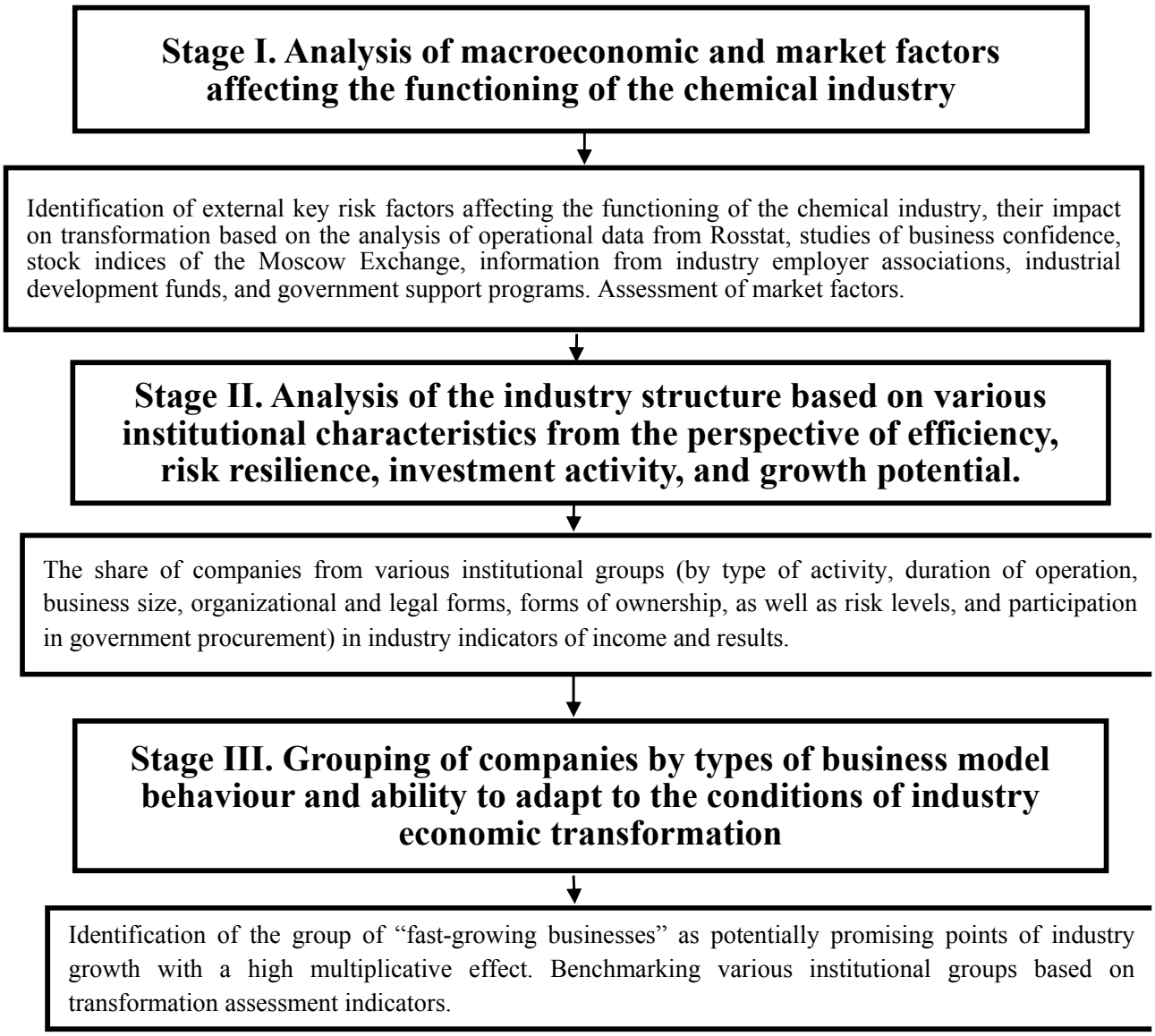

Fig. **Stability Analysis Methodology of Business Models in the Chemical Industry Enterprises During the Economic Transformation Period Using an Institutional Approach**

Source: Compiled by the authors.

for a better understanding of emerging trends from the perspective of the institutional approach. It is based on calculations of the share of aggregated indicators of companies from different institutional groups (by type of activity, duration of operation, size (type), organizational and legal forms, forms of ownership, exposure to risks, participation in public procurement, etc.), as well as the assessment of their share in revenue, assets, and net profit in aggregate indicators across the industry sample.

From the authors' perspective, the business model of company behavior evaluates the overall integrated policy of its sustainable development in accordance with the national strategy for economic transformation, focused on innovation and technological sovereignty. The business model of behavior describes the vector for achieving sustainable development goals through the establishment of indicators of operational efficiency, investment activity, and financial stability as results of the aggregated impact of key risk factors [16].

Table 1

Indicators of Institutional Groups of Companies by Age

Age of companies, years	Share in the number of enterprises, %	Share in equity capital, %	Share in assets, %	Share in revenue, %	Share in net profit, %	Average revenue of the enterprise, million rubles
<4	7.64	0.28	0.91	1.58	0.89	436
4–8	20.79	5.42	7.9	7.13	4.1	723
8–12	18.1	17.83	14.79	11.46	24.51	1 335
12–16	13.46	6.79	6.48	10.05	8.13	1 574
16–20	12.21	5.08	8.42	11.89	7.29	2 053
20–24	10.77	26.90	25.22	21.6	19.54	4 227
24–28	8.14	11.39	10.45	13.77	10.31	3 567
28–32	3.94	6.04	6.13	5.62	4.92	3 001
>32	4.95	20.27	19.69	16.9	20.31	7 200
Total	100	100	100	100	100	2 108

Source: Compiled by the authors.

For the grouping of enterprises by types of business model behavior and their ability to adapt to transformation conditions, the approach of D. Birch [17] was used, which distinguished: gazelle enterprises (high-growth firms, HGFs), which account for a significant portion of production growth in the industry without having a significant share in industry sales; elephant enterprises — large, including state-owned; lion enterprises with an aggressive growth investment strategy aimed at acquiring control over other organizations; mouse enterprises — small enterprises that account for less than half of industry sales.

The author's position is supported by the research of scholars A. Moeuf, R. Pellerin, S. Lamouri, and others [18] on the impact of rapidly growing companies and startups on the qualitative transformation of the economy. Thus, the approach we used, based on the institutional characteristics of companies, allows us to assess the differences in the degree of adaptation to uncertainty risks of companies belonging to different institutional groups during the transformation period, as well as the potential to identify points of promising sectoral growth through companies with the highest multiplicative effect.

RESEARCH RESULTS

The study was conducted using object-level data from the Spark-Interfax information resource on companies in the chemical industry for 2018–2022, aggregated by various institutional criteria, including participation in public procurement, exposure to risks, and others. The sample included 1 597 organizations related to chemical production (OKVED 20 Production of chemical substances and chemical products) with revenue of 120 million rubles or more.

At the first stage, macroeconomic and market factors of the chemical industry were evaluated. The sources included aggregated data from Rosstat on production dynamics, sales, business confidence, reports from the XI Moscow International Chemical Forum,

Table 2

Indicators of Institutional Groups of Companies by Revenue

Revenue, million rubles	Share by number of enterprises, %	Share in equity capital, %	Share in assets, %	Share in revenue, %	Share in net profit, %
<200	25.74	1.03	1.27	1.89	1.05
200–5 200	68.32	16.20	20.39	28.98	14.93
5 200–10 200	2.57	6.89	8.12	8.73	5.66
10 200–15 200	0.81	3.84	3.87	4.76	3.03
15 200–20 200	0.69	13.76	10.96	5.77	5.31
20 200–25 200	0.31	1.43	1.93	3.15	1.64
>25 200	1.57	56.85	53.46	46.74	68.37
Total	100.00	100.00	100.00	100.00	100.00

Source: Compiled by the authors.

indices from the Moscow Exchange, as well as government programs for subsidizing investment projects in priority industrial sectors. According to Rosstat,[4] in June 2022, the business confidence index in the raw materials sector was negative (–1.3); in the manufacturing industry, it was 6.5. However, starting from the IV quarter of 2022, the index has been in the positive zone: in June 2023, it was 4.5 in the manufacturing industry; in the raw materials extraction sector, it was 2.5, primarily due to a 30% reduction in potash fertilizer exports due to the blockage of products in Baltic ports and a decline in ammonia and methanol production due to the closure of the main ammonia pipeline to Europe. In the first half of 2023 compared to 2022, the production of chemical substances and chemical products increased by 2.1%, while for certain types of products, a higher growth was observed: the production of rubber products increased by 15.7%, plastic products by 4.2%, and chemical fibers by 12.7%. The results of the Russian chemical complex's activities in 2022 received a good assessment at the ChemiCos 2023 exhibition: production volume reached 7.7 trillion rubles, which is 13% higher than in 2021, and the export of chemical industry goods in 2022 increased by more than 20%.[5] This was achieved thanks to state support for the chemical industry. The total amount of funding exceeded 34 billion rubles, including loans from the industrial development fund. In 2022, 11 new chemical component production facilities were launched, including for the pharmaceutical, construction, food, and several other industries, and 39 projects were supported through government orders totaling 4 billion rubles from the reserve fund of the Government of the Russian Federation.[6]

The chemical industry has high investment attractiveness, as evidenced by the cumulative

[4] Dynamics of industrial production in June 2023. URL: https://rosstat.gov.ru/folder/313/document/212897 (accessed on 06.05.2025).

[5] In Russia, the export of chemical industry goods has increased by 20%. URL: https://rg.ru/2023/03/21/v-rossii-na-20-vyros-eksport-tovarov-himicheskoj-promyshlennosti.html (accessed on 06.05.2025).

[6] XI Moscow International Chemical Forum. Russian Chemical Society. URL: http://www.ruschemunion.ru/news/lastest_news/id3922.html (accessed on 06.05.2025).

growth of the MOEXMM — Chemistry and Petrochemistry sector index on the Moscow Exchange[7] by 23% in the first half of 2023 (from 30 988.92 on 31.12.2022 to 38 269.94 on 31.06.2023). This, first and foremost, speaks of investors' faith in the strengthening of the financial condition of industry enterprises through state support, as well as the reorientation of major players such as Sibur, EuroChem, UralChem, and PhosAgro towards the domestic consumer and the pivot to the East, as evidenced by the increase in export volumes to China.[8] However, in the structure of the industry's export operations, products of the second processing stage (fertilizers) still dominate, while in imports, products of the third processing stage with high added value (plastics, perfumery, cosmetics, toiletries) prevail.

To understand the conditions of the industry's functioning, we conducted an analysis of entry barriers and economies of scale. The analysis of institutional groups of companies by duration of operation shows that the number of enterprises that managed to enter the industry within 4 years was 7.64%, which means that the administrative barriers of the industry are quite surmountable. However, the penetration rate (the share of industry sales held by new entrants) is low (1.58% of revenue), indicating high economic and behavioral entry barriers that new enterprises will be able to overcome and reach the industry average size (over 2 billion rubles) within 16 years of operation (*Table 1*).

At the same time, it should be noted that the industry is characterized by a significant positive effect of scale, as evidenced by the results of calculations: enterprises with revenues exceeding 25 billion rubles account for 46.74% of the revenue and 68.37% of the net profit (*Table 2*).

Thus, the chemical industry is characterized by relatively high economic and behavioral entry barriers, including the scale effect, which contributes to the formation of concentrated market structures in certain market segments, involving producers with significant market power.

In the second stage, an assessment of the industry structure was conducted based on the grouping of companies according to various institutional characteristics, including performance, stability, investment activity, and growth potential. The industry is divided into 6 sub-industries. A significant share of the industry's revenue (60.4%) is accounted for by the production of basic chemicals, fertilizers, and nitrogen compounds (OKVED 20.1), which is the most investment-attractive (large business with high product margins, accounting for 77.4% of the industry's net profit). The second most significant sub-industry is the production of soap and detergents, cleaning and polishing agents (OKVED 20.4), which accounts for 17.2% of the industry's revenue. The predominant organizational and legal form of business is limited liability companies (57.5% of the industry's revenue), while the most profitable are public joint-stock companies (19% of revenue and 25% of net profit). In the institutional structure of the industry, the private form of ownership dominates: the share of such companies in revenue is 63%, in net profit — 51.93%, which indicates relatively low operational efficiency and the presence of unprofitable enterprises. Companies with joint private and foreign ownership have the highest margin, accounting for 12% of revenue and 28% of net profit.

Grouping of industry companies by business size showed that 80% of revenue comes from large enterprises, which are also the most profitable (90% of industry profit). The business subject to mandatory audit turned out to be more efficient: with 89.3% of

[7] Indices of the Moscow Exchange for Chemistry and Petrochemistry. URL: https://www.moex.com/ru/index/totalreturn/MECHTR (accessed on 06.05.2025).

[8] The government has expanded the program for subsidizing investment projects in priority areas of industry. URL: http://government.ru/docs/47930/ (accessed on 06.05.2025).

Table 3

Indicators of Transformation of the Chemical Industry by Selected Institutional Groups, 2022

Indicators of transformation of selected groups of companies	Institutional groups			
	Fast growing business	Large business	Aggressive growth companies	Other
Average values of indicators by groups				
Operational efficiency				
Revenue growth rate, %	37.76	4.77	19.83	30.7
Share in industry revenue, %	35.79	17.25	12.65	34.32
Share in industry revenue growth, %	58.87	13.89	11.08	16.16
Rate of asset growth, %	29.19	14.07	32.73	23.8
Rate of growth of equity, %	43.59	42.23	37.58	33.77
Rate of growth of net profit, %	87.36	48.78	47.37	53.15
Share of added value, %	24.87	33.8	34.89	26.32
Labour productivity, million rubles per person	19.52	16.85	7. 66	11. 84
Investment activity				
Investment norm	0.13	0.18	0.11	0.12
Ratio of investments to revenue	0.02	0.08	0.04	0.02
Growth rate of non-current assets, %	21.25	0.84	55.65	14.04
Financial stability				
Leverage	0.61	0.08	0.82	0.35
Differential, %	23.69	21.09	15.92	20.99
Return on invested capital, %	27.71	28.56	21.76	25.52

Source: Compiled by the authors.

revenue, it generates 95.43% of the industry's net profit. Grouping companies by risk levels and participation in public procurement allowed us to conclude that 94.5% of industry revenue comes from low-risk enterprises, while public procurement participants (32.4% of the sample) account for 54% of industry revenue.

At the third stage, companies were grouped and classified by types of business model behavior based on their ability to adapt to transformation conditions, using the D. Birch approach adapted to the Russian chemical industry, taking into account the scale of companies that contribute the most to the industry's revenue growth. As a result of the conducted analysis and selection, the following institutional groups were formed:

fast-growing companies with revenue from 1 to 70 billion rubles, an average annual revenue growth rate of over 10% per year from 2019 to 2022, and an increase in long-term financial investments not exceeding 500 million rubles, privately owned, with an age of at least 4 years (LLC "EUROCHEM — UKK"; PJSC "KAZANORGSYNTEZ"; LLC "LAB INDUSTRIES"; PJSC "NIZHNEKAMSKNEFTEKHI" and others — a total of 27 enterprises);

large business — companies with revenue exceeding 70 billion rubles, having an increase in long-term financial investments of no more than 500 million rubles, of any form of ownership and age (PJSC "AKRON"; JSC "AMMONIUM"; LLC "METADINEA"; JSC "SHCHELKOVO AGROCHEM" and others — a total of 7 enterprises);

companies implementing an *aggressive growth* investment strategy, that is, growing through mergers and acquisitions, with an increase in long-term financial investments exceeding 500 million rubles (LLC LITK; LLC STK; LLC TSG — a total of 142 enterprises);

others — companies that are not part of the first three groups and generally represent small and medium-sized businesses (LLC "ATLANT-AZOT"; LLC "AEROSTAR CONTRACT"; LLC "BASF VOSTOK" and others — a total of 1240 enterprises).

The criteria for selecting indicators for assessing transformational processes were based on the goals of transforming priority areas of technological sovereignty projects and structural adaptation projects of the Russian economy, as well as the Methodological Recommendations of the Ministry of Economic Development for preparing sustainability reporting on information disclosure [17]. The indicators we propose include 14 metrics across various areas (calculations are presented in *Table 3*):

- *operational efficiency* as the ability of a business to withstand market risks, accumulate, and effectively utilize resources (assessed by indicators such as revenue growth rates, asset growth, equity growth, net profit, revenue share and revenue growth; share of value added in revenue; labor productivity);
- *investment activity* as the ability of a business to manage production and technological risks and create competitive advantages (investment norm, ratio of investments to revenue, growth rate of non-current assets);
- *financial stability* as the ability to create investment attractiveness (leverage; financial leverage differential; return on invested capital).

The results of the analysis show that the group of *large businesses* stands out significantly with *high values* of business scale, capitalization, and financial stability, but low business activity and declining operational efficiency. The enterprises of the *fast-growing business* group have significantly lower comparable indicators and a smaller share of added value compared to *large and aggressively growing* enterprises with high-tech production. The dynamics of the share of added value are significantly increasing only in the *large business* group (by 15.47% annually), which confirms the conclusion about the presence of development potential.

The growth rate of labor productivity in the industry as a whole is quite high (17.8%), however, the level of labor productivity is highest in the *fast-growing businesses* and has a tendency for further growth. Investment activity is higher among *large businesses*, however, the indicators of investment activity are declining, as the growth in revenue and profit is ensured by price increases, which leads to a decrease in indicators even with stable investments. The dynamics of leverage are also negative, except for *large businesses*, which is due to a sufficient influx of own resources through profit capitalization. At the same time, the efficiency of financial activities (differential, return on invested capital) is quite high. The level of return on capital allows us to conclude that the investment attractiveness of the industry is relatively high, which, unfortunately, did not lead to a significant increase in investments in the industry in 2022, due to high uncertainty, currency fluctuations, and price volatility.

CONCLUSION

The conducted research allowed for the analysis of the impact of institutional aspects on the sustainability of companies belonging to various institutional groups. As a result, a classification of enterprises was identified based on the sustainability of their business model behavior during the transformation period; the most promising enterprises with growth potential and high adaptability to transformation were identified, and a system of transformation evaluation indicators was proposed, which is undoubtedly open, as it is currently limited by the availability of information on enterprises, especially the lack of data on export-import.

The greatest impact on the industry's sustainability was exerted by external risk factors related to country-specific, political, and financial, primarily market and currency risks, as well as operational risks associated with import substitution and the large-scale innovative transformation of industry enterprises, the results of which cannot be achieved in a short period.

At the same time, the introduction of sanctions had a positive impact on the economic growth of the industry, but only in certain segments. Among the institutional factors positively influencing the efficiency and sustainability of businesses, participation in public procurement and the mandatory nature of audits should be highlighted, which proves the significance of these factors in enhancing the effectiveness of the transformation of the economic model towards technological sovereignty. The audited business generates over 95% of the industry's net profit, and the public procurement system creates incentives to enhance its social responsibility. The results and trends of 2023 allow us to conclude a growth in investment attractiveness, but at the same time a decrease in the investment activity of enterprises, which may negatively affect transformation processes in the future. A high growth rate of non-current assets is observed in the group of fast-growing businesses (over 21%) and especially in aggressive growth companies (around 56%). However, for the sustainable development of the industry towards technological sovereignty, due to high innovation risks, enterprises require active government support.

The theoretical significance of the research lies in the author's institutional approach to grouping companies based on criteria of their business model behavior as an ability to adapt to the conditions of economic transformation. The practical value consists in the development of an algorithm for identifying points of prospective economic growth and indicators for assessing industry transformation to provide support to companies with the greatest multiplicative effect. The obtained results can be used in the implementation of priority directions of technological sovereignty projects and structural adaptation projects of the

Russian economy, as well as the Concept of Technological Development for the period up to 2030, as a tool for monitoring implementation and determining the development vector of priority sectors of the economy, as well as for finding new potential points of economic growth and attracting public and private investments.

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