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Development Trends and Dynamics of Industrial Specialization in Russian Regions

Relevance. The study of the industrial structure of regional economies has gained relevance amid shifting geopolitics and unprecedented sanctions, prompting the need for economic restructuring, product/sector substitution, and the exploration of new growth opportunities at national and regional levels.
Research objective. This study evaluates the dynamics of industrial specializations in Russian regions and their role in ensuring stable regional economic development. The hypothesis is that there is a direct link between the resilience of the regional economic system and its industrial specializations. Here, resilience refers to the territory's ability to minimize the negative impacts of external shocks and threats and restore its economic level during a specified adaptation period.
Data and method. The focus of this study is industrially developed regions whose economies rely predominantly on manufacturing. The study uses Rosstat data on shipped goods, performed works, and services from 2019 to 2022. Data cleansing involves removing the inflationary component using producer price indices. The Herfindahl-Hirschman Index is used for the sectors in the «C. Manufacturing» category of OKVED2 (All-Russian Classifier of Economic Activities).
Results. The study identifies regional variations in industrial specialization levels and progression, categorizing regions into diversified and specialized. We found the transformation of the economic structure in the majority of the examined regions and identified the «new» and «departed» sectors of industrial specialization. Resilience to crises is analyzed, revealing three groups of regions based on their resilience levels. Key industries driving regional development are also identified.
Conclusions. Analysis of industrially developed regions uncovers unique structural transformations, offering valuable insights for regional policymakers. Future research avenues may involve refining socio-economic profiles based on industrial specialization and formulating government measures to support industrial development.

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Тенденции развития и динамика промышленной специализации в регионах России

Актуальность. Исследования отраслевой структуры экономики регионов актуализированы новыми геополитическими вызовами и беспрецедентным санкционным давлением, обуславливающим необходимость структурной перестройки экономики, импортозамещения ряда продуктов и отраслей, поиска принципиально новых точек роста экономики России и ее отдельных регионов.

Цель исследования. Статья посвящена оценке динамики отраслей специализации индустриально развитых регионов и их роли в обеспечении устойчивого развития региональной экономики. Авторами ставится гипотеза о том, что устойчивое состояние экономической системы непосредственным образом связано с отраслями специализации. При этом под устойчивым состоянием понимается состояние, которое позволяет территории за определенный период адаптации минимизировать негативные воздействия внешних шоков и угроз и восстановить уровень экономики.

Данные и методы. Объектом исследования являются индустриально развиты регионы, основу экономики которых составляет обрабатывающая промышленность. Исследование базируется на использовании данных Росстата об объеме отгрузки товаров собственного производства, выполненных работ и услуг собственными силами, в период с 2019 по 2022 гг. по разделам «Промышленное производство» по ОКВЭД2 до второго знака для четырнадцати индустриально развитых регионов РФ. Произведена очистка данных от инфляционной составляющей за счет их корректировки в соответствии с индексами цен производителей из официальной статистики. Это позволило определить фактическую производственную динамику в региональных экономиках. Проведен анализ отраслевой специализации регионов на основании расчета индекса Херфиндаля-Хиршмана для отраслей, входящих в раздел «С. Обрабатывающие производства».

Результаты. Выявлены региональные различия в уровне и динамике развития промышленной специализации, выделены два типа регионов: диверсифицированные и специализированные. Доказано, что трансформация структуры экономики происходит в большинстве рассматриваемых регионах, определены «новые» и «ушедшие» отрасли промышленной специализации. Устойчивость регионов к кризисам рассмотрена авторами с точки зрения адаптации их экономики к новым условиям и восстановления положительной динамики региональных показателей объемов производства обрабатывающей промышленности, являющейся специализирующей для рассматриваемых регионов. Выделены три группы регионов по уровню их устойчивости. Для каждого региона определены отрасли-драйверы регионального развития.

Выводы. Проведенный анализ динамики отраслей специализации индустриально развитых регионов показал, что трансформация структуры экономики происходит в большинстве рассматриваемых регионах, но при этом отличаются определенной спецификой. Полученные результаты могут использоваться для обоснования приоритетов регионального развития, актуализации региональной и промышленной политики регионов РФ. Развитием исследования может быть дальнейшее уточнение социально-экономических профилей регионов с учетом их промышленной специализации и выработке государственных мер поддержки промышленности.

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工业化地区产业专业化发展趋势及动态

现实性：区域经济部门结构的研究成为趋势，这是因为新的地缘政治挑战和前所未有的制裁压力的影响。经济结构亟待重组，一些产品和行业需要进口替代，俄罗斯经济及其各个地区的新增长点也应从根本上进行寻找。

研究目标：文章专门评估了工业发达地区专业化产业的动态，及其对地区经济可持续发展的作用。作者假设经济体系的稳定状态与专业化产业直接相关。在这种情况下，稳定状态为地区在一定适应期内将外部冲击和威胁的负面影响降至最低并恢复经济水平的状态。

数据与方法：研究对象是以制造业为经济基础的工业发达地区。研究基

于俄罗斯国家统计局提供的数据，这些数据涉及 2019 年至 2022 年期间俄罗斯联邦 14 个工业化地区"工业生产"分部的货物运输量、完成量和服务量，并按照 OKVED2 的数据精确至小数点后二位。文章根据官方统计的生产者价格指数对数据进行了调整，剔除了通货膨胀因素，从而能够确定地区经济的实际生产动态。 另外，文章根据对"C. 制造业"行业的赫芬达尔-赫希曼指数计算，对各地区的工业专业化情况进行了分析。

研究**结果：**文章揭示了工业专业化发展水平的地区差异，确定了两类地区：多样化和专业化。事实证明，大部分地区的经济结构都发生了转变，"新的"和"已消失的"工业专业化分支已被确定。作者分析了各地区经济适应新条件和恢复制造业生产量的动态和指标，并考虑了这些地区抵御危机的能力。根据各地区的稳定程度，文章确定了三组地区。每个地区都确定了地区发展的驱动产业。

结论：对工业发达地区专业化分支动态的分析表明，经济结构的转型在大部分地区都在进行，但它们又有一定的特殊性。研究结果可用于确定地区发展的重点，有助于俄罗斯各地区和产业政策的更新。这项研究还可以进一步明确各地区的社会经济概况，同时有助于其产业专业化以及政府支持产业的措施制定。

Introduction

Analysis of the regional economy's industrial structure is a key research stage, which contributes to productive state regulation, particularly in its territorial aspect. Effective development of the national economy can be ensured through the establishment of a spatial-industrial structure based on highly competitive industrial complexes located in regions with access to specific resources.

In the case of Russia, the «Strategy for Spatial Development of the Russian Federation for the Period until 2025,» adopted in 2019, outlines the principle of strategic consistency for regional policy[1]. Among other things, this strategy specifies that, to reduce interregional disparities, it is essential to identify prospective centers of economic growth and the economic specializations of regions within the main areas of the country's spatial development. According to the Strategy, the «promising economic specialization of a subject of the Russian Federation is a combination of aggregated types of economic activities (industries), determined by a favorable combination of competitive advantages (spatial factors for locating types of economic activities)[2]. The introduction of the terms «promising» and «non-promising» industries into the framework of regional strategic

management — referring to sectors that are potentially supported or unsupported by mechanisms of state policies for regional development in specific territories — has raised a discussion among Russian economists (Bukhvald & Kolchugina, 2019; Lexin, 2019; Minakir, 2019). Blanutz (2020) argues that the disparities among Russian regions are so significant that the goal stated in the Strategy to mitigate interregional differences and shape a new structure of spatial-industrial placement by 2025 is unattainable. Ivanov & Bukhvald (2019) provide a detailed critique of the concept of «promising» industrial specialization introduced in the Strategy. The authors point out that Russian regions differ significantly regarding their economic specialization: some regions have a well-established specialization, while others lack any specialization. Therefore, the strategic aim of introducing this kind of specialization may not consistently contribute to stable regional development. Even though it might be effective to formulate a list of «promising specializations» and thus align sectoral and spatial development tasks in the Russian economy, the current toolkit hinders its efficient implementation in state governance. Additional research is needed to identify the established specializations of Russian regions, analyze their dynamics, and explore potential structural shifts.

The need for further research on the industrial structure of the regional economy arises from emerging geopolitical challenges and unprecedented sanctions. These challenges also underscore the requirement for restructuring of the economy, import substitution across various

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[1] Decree of the Government of the Russian Federation of 13.02.2019 No. 207-r (in the version dated 23.03.2021) «On Approval of the Spatial Development Strategy of the Russian Federation for the Period until 2025».

[2] Decree of the Government of the Russian Federation of 13.02.2019 No. 207-r (in the version dated 23.03.2021) «On Approval of the Spatial Development Strategy of the Russian Federation for the Period until 2025».

products and sectors, and the exploration of fundamentally new growth opportunities. Regional policy should be aligned with the overall trends of the national socio-economic development (Regional Development Trends..., 2023). The USA and Western countries have imposed a wide range of trade and economic sanctions against Russia after the start of the special operation in Ukraine. These restrictive measures affected Russia's exports and imports as well as its monetary and financial system, impacting virtually all sectors of the economy. The effects of these measures were intensified by sanctions affecting logistics, resulting in difficulties with cargo delivery, extended timelines, and increased transportation costs (Lenchuk, 2023).

External sanctions, of different types and varying intensities, impact the performance of regions, particularly those whose primary specializations are associated with manufacturing. Structural changes in the economy are fundamental to stable economic development (Hidalgo & Hausmann, 2011; Boschma, 2017).

President Vladimir Putin emphasized the «need to create conditions for restructuring of the economy, including the implementation of large-scale technological projects, stimulating economic activity, and developing infrastructure in Russian regions.»[3] The need to restructure the Russian economy has been also repeatedly highlighted by the Head of Russia's Central Bank Elvira Nabiullina[4], the Minister of Finance Anton Siluanov[5], and Prime Minister Mikhail Mishustin[6]. In the medi-

um and long term, it is impossible to maintain the previous configuration of the structure of the Russian economy and its individual regions. Therefore, it is necessary to identify the prospects for structural shifts and explore the possible drivers for future regional development.

For steady regional industrial growth and balanced national development, it is essential that the stages of specialization formation effectively tackle current challenges. Contemporary challenges involve diverse processes such as technological and structural changes in the global production and consumption of specific commodities, the disruption of value chains and the formation of new ones, trade protectionism, and various restrictions, including sanctions.

In this study, we hypothesize that the resilience of the economic system is directly linked to its industrial specializations. It should be noted that in this context, «resilience» refers to a condition where a region can, over a defined period of adaptation, minimize the adverse effects of external shocks and threats, ultimately restoring its economic levels. Over the period from 2019 to 2023, the Russian economy experienced two significant external economic shocks: in 2020, it was the COVID-19 restrictions, and since 2022, it has been under sanctions pressure. We intend to verify our hypothesis by examining how well the regional economy copes with external shocks. The research focuses on industrially developed regions whose economies are primarily based on manufacturing (Akberdina, 2020).

There are different approaches to identifying the territories that can be described as industrially developed Russian regions and their number may range from two to three dozen. For instance, the above-mentioned study by V. V. Akberdina identifies 20 such regions. We have selected 14 territories by applying the following principle: these are the regions whose share of industrial production constitutes a significant proportion of the total volume of shipments of local products, completed works, and services, and whose share of manufacturing industries (section 'C' according to OKVED2 (All-Russian Classifier of Economic Activities)) exceeds 60% of the volume of industrial production shipments.

The study aims to analyze the dynamics of industrial specialization and structural changes in the economy of industrially developed regions in the context of today's external constraints. To

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[3] V. V. Putin. President of Russia. Source: http://www.kremlin.ru/events/president/transcripts/deliberations/69336 (accessed date: 15.07.23)

[4] «The economy can temporarily exist by relying on the currently available reserves, but once they are depleted, structural transformation and the search for new business models will commence.» Source: RBC. https://www.rbc.ru/economics/18/04/2022/625d1abd9a7947966eb090a3?ysclid=lmu827klnz329385686 (accessed date: 15.08.23)

[5] «In response to new challenges, Russia is embarking on a long-term restructuring of the economy.» Source: Business Online Business Electronic Newspaper https://m.business-gazeta.ru/news/550951?ysclid=lopfye398n594757491 (accessed date: 16.08.23)

[6] «We will continue the adaptation and restructuring of the Russian economy, supporting the reorientation of exports and expanding our ties with friendly countries and states. We are building production chains in the country and striving to increase the level of our technological and economic sovereignty.» Source: https://regnum.ru/news/3696399?ysclid=lmu89yo5ls17069893 (accessed date: 16.08.23)

achieve this goal, we have set the following tasks: propose a methodological approach to assessing the dynamics of industrial specialization; analyze the dynamics of industrial specialization and structural changes in the economy of Russian regions under the influence of external shocks; assess the resilience of their economies to external shocks; and identify the key drivers of industrial development in these regions.

Theoretical framework

The challenge of sustaining economic growth amidst systemic transformations and changes in foreign economic relations has long been a subject of interest for researchers, in Russia and other countries. Various shocks – geopolitical, economic, pandemic-related, financial, and currency-related — have significantly impacted the development of national economies. This has led to a surge in studies examining the ways socio-economic systems adapt to such challenges.

Nikolaev & Makhotaeva (2021) studied the resilience of regional economies to shocks, focusing on manufacturing industries. They found that the majority of regions with higher growth rates in manufacturing in the post-crisis period exhibited an increase in innovation activity.

N. N. Mikheeva (2021) addresses issues of regional resilience to crisis shocks and methods for their assessment, showing that the resilience of regions does not depend on the nature of the crisis or the size of the region, what is more important is the presence of large agglomerations.

A recent area of study in research on the adaptive aspects of regional socio-economic systems is focused on regional resilience. This field examines the dynamic capabilities of socio-economic systems to withstand diverse external challenges and adapt to new conditions and circumstances (Chernova, 2023).

When we talk about resilient regional development, what we mean is the region's ability to withstand external shocks (resistance) as well as the capacity to restore equilibrium (recovery). One of the founders of this approach, K. Foster (2007), interpreted resilience as the region's ability to anticipate shocks, be ready for them, respond, and recover after disturbances. R. Martin (2012) proposed to connect the concept of «resilience» with the concept of hysteresis in the economy (the transition of the economy from one stable equilibrium to another) and defined resilience as the ability of the economy to adapt its structure (on the level of firms, industries, technologies and institutions) to a new development pattern.

For quite a long period, both Russian and international scholars have explored the connection between regional resilient development and industrial structure, examining how the degree of economic specialization/diversification influences the region's resilience. However, the outcomes of such research are often ambiguous, which can be explained by significant differences in the economic structures of various countries and the connections between them. Dissart (2003) argues that regional economic diversification itself is not a guarantee of resilience; rather it is the interconnections between industries that play a crucial role. Mai et al. (2019), based on Chinese economic data, demonstrated that the industrial sector plays a stabilizing role in regional development, while rapidly growing sectors such as the financial sector, construction, and real estate operations have the most destabilizing influence. In a study based on American data, Min J. et al. (2020) explore how the structure of regional economies in the United States influences the volatility of their economic growth, identifying only four sectors: federal government, construction, manufacturing, and tourism. As a result, they was found that the specialization of different sectors has varying effects on sustainable development: the federal government and industry have a positive impact on resilience, whereas construction, conversely, has a negative influence. Additionally, the conclusion is drawn that the development of innovative technologies in tourism provides an opportunity for the rapid advancement of innovation in the region overall and in the digital economy in particular. Rocchetta & Mina (2019) argue that regions with technologically coordinated, rather than simply diversified, industries are better prepared for unforeseen economic crises and demonstrate adaptive resilience. Moreover, regional economies are generally more resilient when innovations occur in sectors with the highest growth potential.

Malkina (2020) examines the correlation between the resilience of regional economy and the degree of its industrial diversification. Despite the author's conclusion about a correlation between regional economic resilience and diversification rather than specialization, the factual material presented in the article shows the existence of a certain number of resilient regions with

a low-diversified economic structure. This once again emphasizes the need to assess the dynamics of industrial specializations and the role these industries play in ensuring the resilient development of the regional economy.

O. A. Romanova discusses development opportunities for regional industrial complexes in the face of the new reality. Her research not only demonstrates that it is possible to maintain the stability of regional economies but also shows their capacity for adaptive recovery and economic growth under new conditions (Romanova, 2022).

The study by V. V. Akberdina is worthy of special attention: she identifies factors that contribute to the development of adaptive capabilities in socio-economic systems in the face of emerging challenges (Akberdina, 2022). There are studies investigating the resilience of single-industry regions (Ionova, 2022; Danilova & Pravdina, 2022) and Arctic settlements (Filimonova, 2021; Nikulkina, 2021).

The main distinction between economic resilience and economic stability lies in the fact that resilience has a dynamic nature and corresponds to the ability to return to the original or a similar state after being disrupted by some external influence (Baskakova & Slukina, 2021). Dynamic development is sustained by the existence of a certain stability zone, and factors such as industry affiliation, scale, and production structure, along with social and psychological processes, determine the system's degree of stability as leaving this zone renders the system unstable.

Economic recovery forecasts are mainly associated with the activation of economic growth drivers after a period of adaptation to external constraints. These drivers are supposed to ensure the required economic dynamics (Nikolaev, 2023). In the academic literature, there are numerous viewpoints regarding what can serve as a driver of economic growth: lending for small and medium businesses (Orlovsky, 2016); competition[7]; public-private partnerships (Bozharenko, 2012); low-carbon development (Lugovoy et al., 2015); specific industries, resources[8], institutions, infrastructure, megaprojects, innovations, etc.

In our study, we will focus on the dynamics of industrial specialization and structural changes in the economy of industrially developed regions under the influence of emerging external constraints. The analysis of fundamental aspects of industrial specialization is essential for identifying the drivers of regional development.

Method and data

One of the key factors determining the development of regions is their industrial specialization. In modern conditions, the specialization of industrial-territorial complexes is influenced by various multidirectional factors (resource depletion, emergence of new technologies and products, changes in the current production chains and creation of new ones, changing external constraints, etc.).

The transformations of the sectoral structure of regional economies are of great interest to researchers. Much attention is given to the specifics of regional economies and their specializations as a key aspect of economic development (Lexin & Shvetsov, 2012; Lyubimov et al., 2017). By identifying regional specialization and competitive advantages, we can gain a better understanding of the nature of structural changes and formulate a more effective regional policy (Kutsenko & Eferin, 2019). The industrial structure reflects the level of specialization of a region in specific sectors at both national and local levels (Melkov, 2022). Analysis of structural shifts helps us assess the mobility of the economic structure and draw conclusions about the changes in the role and position of individual industries in the region's economy or of the region in the overall national economy.

In the last five years, structural transformations in regional economies in Russia have been influenced by two successive external shocks: the pandemic and sanctions. Under the influence of these shocks, several industries, which previously constituted regional specializations, couldn't withstand the external pressure, resulting in a decrease in their share in the regional economic structure. In contrast, other industries, adapting to the new

[7] Shcherbinina, M. Yu., Stefanova, N. A. (2016). Competition as a driver of economic growth. Modern research and innovation, 6. [Electronic resource]. Access mode: https://web.snauka.ru/issues/2016/06/69360 (accessed date: 03.05.2023).

[8] Kalmykov, N. N., Katsaurova, S. Yu. Drivers and barriers to the growth of the Russian economy: a sociological analysis of the opinions of the expert community [Electronic resource]. Access mode: https://www.ranepa.ru/images/News/2017-07/13-07-2017-ekonomika-issl.pdf (accessed date: 29.05.2023)

economic conditions, occupied the vacated niches and increased their share in the structure. In a single region, it is possible to witness both the concurrent growth in production volumes for certain industries, including the emergence of new sectors, and a decline in production for other industries. This can ultimately result in some industries' complete loss of their special status in a region.

The logical scheme of the proposed approach to assessing the dynamics of industrial specialization and structural changes of industrially developed regions is presented in Figure 1.

Our analysis relies on the following statistical data: the volume of shipments of the region's own produced goods, performed works, and services, during the period from 2017 to 2022 (according to OKVED2). We intentionally use only this indicator as it correlates with GDP, thus enabling us to compare sectoral changes with the dynamics of the region's economic growth. The methodology does not analyze statistical indicators related to the distribution of investments in fixed capital, the number of employees, and wage levels in the industrial structure. This omission is intentional to avoid potential distortions in our conclusions about the region's production structure, given the variations in labor productivity and capital intensity across different sectors.

Stages	Calculated indices	Regional profile
1. Determining the degree of diversification of the regional economy as of the base period in 2019.	1.1. Herfindahl-Hirschman Index for manufacturing industries	Diversified/Specialized
	1.2. Coefficient of specialization for manufacturing industries	Number and list of industrial specializations
2. Analysis of the dynamics of industrial specialization and structural changes in the period of external shocks (2020–2022).	2.1. Dynamics of the Herfindahl-Hirschman Index	Change in the region's type based on its level of specialization (when such a change is detected)
	2.2. Dynamics of the coefficient of specialization for industries	Identification of 'new' specializations
		Identification of 'departed' specializations
3. Studying the resilience of the regional economy to external shocks	3.1. Growth rate of the shipment of own goods for each industrial specialization in the region, adjusted for inflation, year on year	Result of the economy's adaptation to external shocks: 1) decline; 2) return to the previous level; 3) growth
	3.2. Growth rate of the shipment of own goods for each industrial specialization in the region, adjusted for inflation, from the 1st half of 2023 to the 1st half of 2022	Identification of drivers for the development of regional economies

Figure 1. *Methodology for assessing the dynamics of industrial specialization and structural changes in regions*
Source: compiled by the authors

We agree with other researchers that incorporating cost indicators in the analysis creates challenges due to the volatility of data stemming from the inflationary component. To minimize the impact of this factor on the results, we propose adjusting the assessment of the growth dynamics of shipment volumes for each of the analyzed sectors by the level of the producer price index for that sector in the specified region over the given period (year to the previous year). This way we can assess the actual change in shipment volumes, describe the dynamics of sectoral development, and compare regional specializations at the interregional level. The source of data on producer price indices at the industrial and regional levels is the EMISS database (Unified Interdepartmental Statistical Information System).

Since in 2017–2023 the Russian economy experienced two external shocks, the pandemic and sanctions, we have identified the pre-shock baseline level of the regional economic system as that of the year 2019. The dynamic indicators for 2019–2020 characterize the response of regional production systems to the impact of the pandemic restrictions. The indicators for 2020–2021 characterize the economic recovery in the period when these restrictions were lifted. The indicators for 2021–2022 characterize the impact of sanctions on the regional economy. Additionally, we assess the level of adaptation of the regional economy to the impact of sanctions by looking at operational data from territorial statistical services. This assessment involves examining the dynamics of sectoral production indicators by comparing data from the first half of 2023 with data of the first half of 2022.

The analysis of dynamic changes is conducted not across the entire spectrum of industries but only for industries constituting regions' specializations. The choice of this approach is determined by our hypothesis that there is a connection between regional economic growth and the growth of specialized industries. We identified regional specializations by calculating the Herfindahl-Hirschman Index (HHI, ranging from 0 to 1) for industries listed in the «C. Manufacturing Industries» section (OKVED2), up to the second digit. For a more in-depth analysis and detailed examination of the ongoing changes in the region, we recommend considering a broader list of industries, up to the fourth digit. The approach itself will not change since the databases for the indica-

tors of finished product shipments and the producer price index used in this methodology are compiled by statistical authorities to the necessary level of detail. Such deep detailing, however, fell beyond the scope of this article, so the validation of this methodology was carried out by using the data with the depth of two OKVED digits.

An industry is considered to be the region's industrial specialization if it meets the following criteria:

$$C_y = \frac{Y_o}{Y_p} > 1, \qquad (1)$$

where Y_o is the region's share in the country for the given specialization; Y_p is the region's share in the country for the whole industry;

$$Y_o = \frac{V_C^i}{V_{RU}^i}, \qquad (2)$$

where V_C^i is the volume of shipments of own goods for industry i in region y; V_{RU}^i is the volume of shipments of own goods for industry i for the whole country;

$$Y_p = \frac{V_C^{IND}}{V_{RU}^{IND}}, \qquad (3)$$

where V_C^{IND} is the volume of shipments of own goods across all industries in region y; V_{RU}^{IND} is the volume of shipments of own goods across all industries for the whole country.

If we examine coefficients C_y for individual industries within the region's industrial production structure and notice that the coefficient that previously exceeded 1 falls below 1 at a certain point, we can conclude that the respective industry can no longer be considered that region's specialization. Conversely, if in the base year 2019, an industry was not characterized by coefficient $C_y => 1$, and in a later period, this coefficient for the industry exceeded 1, it means that this industry has become a new specialization for this region.

This study aims to identify industries that drive regional development and are characterized by high adaptability to modern economic conditions. Thus, the most significant outcome will be the identification of these «new» industries constituting regional specialization.

Averina & Nikulina (2021) explain the importance of developing new industrial specializations and highlight the need to address the transformation of regional specializations. They argue

that achieving higher levels and superior quality of economic growth partly depends on fostering the growth of emerging and rapidly advancing sectors in the economy.

The conclusion on regional economic structural transformation is drawn from analyzing the dynamics of the Herfindahl-Hirschman Index in manufacturing. Grebenkin (2019) proposed a classification of regions into three groups based on their industrial specialization stability: those with a trend towards de-specialization; those increasing specialization; and those with no evident change.

Following this classification, we also consider three groups of regions:

– regions with a tendency towards industrial de-specialization;

– regions with a tendency to increase industrial specialization;

– and regions whose industrial specialization remains unchanged.

Furthermore, when we consider the transition to the next stage, which involves studying the resilience of the regional economy to the impact of external shocks, regions are grouped based on the trajectory of post-crisis development. Depending on the dynamics of regions' industrial specialization, any industry can be aligned with four development scenarios: «emergence,» «growth,» «decline,» and «disappearance» (Kutsenko & Yeferyin, 2019). Taking into account the number of specializations and the degree of their development, we can distinguish four types of regions: «agglomeration,» «diversification,» «specialization,» and «differentiation» (Ibid). Therefore, the following groups of regions are distinguished based on the type of resilience:

– regions that have returned to the previous (pre-crisis) level of development;

– regions transitioning to a growth trajectory;

– regions transitioning to a declining trajectory.

This approach is based on determining the system's ability to return to its initial state after an exogenous shock — a concept frequently employed in research on the economic resilience of territories[9]. In other words, the faster the economy returns to its previous state, the more resilient it is (Mikheeva, 2021). It should be noted that there is another approach that considers resilience as the system's ability to change in response to a shock (Pendall et al., 2010). While the latter approach provides an understanding of the system's long-term resilience, the former approach is employed to assess short-term development prospects. Since in this study we operate with a relatively short time series of data, our primary focus is on assessing the speed of economic recovery to the previous level and the deviation of the current state from the pre-crisis level. Furthermore, with a more extended time series of observations in the future, it will be possible to expand the methodological framework.

Since we hypothesize that the stability of the regional economic system and its adaptive capabilities are directly linked to industrial specialization, we intend to focus on the dynamic changes in the volume growth indices of shipped products in both «new» specialization sectors and those that have increased their share in the regional economic structure.

Our analysis covers four periods: 1) 2020 - the shock from restrictions related to the coronavirus pandemic; 2) 2021 — the period of recovery from the pandemic shock; 3) 2022 — the shock from restrictions associated with sanctions from Western countries; 4) the first half of 2023 — the period of adaptation to the new economic conditions. For each region, we identify industries showing an increase in production volumes in 2022 compared to the baseline of 2019 and maintaining a growth trend in the first half of 2023. In this process, an assessment is made of the factor impact of these industries on the overall economic recovery of the region after the influence of external shocks and constraints. When this correlation is identified, these industries are defined as drivers of regional development.

Results

Since the focus of this study is on industrial regions of Russia, while testing this methodology, we intentionally narrowed down the number of analyzed regions. We applied the following criteria for selecting regions for our list: 1) the share

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[9] Hill E., Clair T. St., Wial H., Wolman H., Atkins P., Blumenthal P., Ficenec S., Friedhoff A. Economic Shocks and Regional Economic Resilience. Building resilient regions. Institute of Governmental studies. University of California. Working Paper 2011-03. Available at: https://www.researchgate.net/publication/285940047_Economic_shocks_and_regional_economic_resilience (accessed 20.08.2023).

of industrial production constitutes a significant portion of the total volume of shipments of the region's own products, performed works, and services; 2) the share of manufacturing industry (section «C» in OKVED2) constitutes more than 60% of the volume of industrial production shipments. As a result, 14 regions were included in this list (see Table 1 below).

Taking into account the number of industrial specializations and the degree of their development, two types of industrially developed re-

gions have been identified: diversified (D) and specialized (S). Industrially developed regions with the highest number of industrial specializations (diversified type) include Moscow (20 industries), Vladimir (14), Leningrad (13), Yaroslavl (12), Nizhny Novgorod (12), Novgorod (11), Rostov (11), Kaluga (10), and Omsk (8) regions. The smallest number of industrial specializations (specialized type) is characteristic of Vologda (5), Chelyabinsk (5), Lipetsk (6), Sverdlovsk (7) regions, and the Republic of Bashkortostan (6).

Table 1

Characteristics of industrially developed regions, 2019

Regions	Indicators of industrial development		HHI	Number of specializations	Type of specialization	Industrial specializations ***
	Industry share *	Section C share***				
Moscow	57.13	84.36	0.089	20	D	10, 11, 13, 14, 15, 16, 17, 18, 20, 21, 22, 23, 25, 26, 27, 28, 30, 31, 32, 33
Chelyabinsk	85.80	91.14	0.400	5	S	15, 23, 24, 25, 28
Sverdlovsk	74.58	87.21	0.416	7	S	16, 22, 23, 24, 28, 30, 33
Omsk	66.62	84.90	0.134	8	D	10, 11, 19, 20, 22, 26, 30, 33
Yaroslavl	75.81	83.38	0.103	12	D	13, 15, 17, 18, 20, 22, 27, 28, 29, 30, 31, 32
Rostov	73.37	81.58	0.093	11	D	10, 13, 14, 15, 19, 22, 23, 25, 28, 30, 31
Lipetsk	82.57	97.24	0.494	6	S	10, 17, 22, 24, 27, 28
Vladimir	88.55	94.03	0.164	14	D	10, 13, 14, 15, 16, 21, 22, 23, 25, 26, 27, 28, 31, 32
Leningrad	75.26	94.86	0.054	13	D	10, 12, 13, 14, 16, 17, 18, 20, 22, 23, 27, 30, 31
Vologda	86.30	96.67	0.370	5	S	16, 20, 23, 24, 25
Nizhny Novgorod	71.62	89.19	0.151	12	D	11, 13, 14, 15, 17, 19, 20, 22, 24, 25, 26, 29
Novgorod	81.36	93.59	0.229	11	D	10, 16, 17, 18, 20, 23, 26, 27, 28, 31, 33
Kaluga	88.17	97.91	0.255	10	D	10, 17, 21, 22, 23, 25, 26, 27, 29, 32
Republic of Bashkortostan	79.46	81.82	0.422	6	S	14, 19, 20, 28, 30, 32

Source: Compiled by the authors based on Rosstat data

*Share of industry (Sections B, C, D, and E) in the total volume of own shipped goods, performed works, and services across all types of economic activities, %.

**Share of Section C (Manufacturing Industry) in the total volume of industrial goods and services (sum of Sections B, C, D, and E), %.

***The category of MANUFACTURING INDUSTRIES (Section C) encompasses the following: 10. Food product manufacturing; 11. Beverage manufacturing; 12. Tobacco product manufacturing; 13. Textile product manufacturing; 14. Clothing manufacturing; 15. Leather and leather product manufacturing; 16. Wood processing and production of wood and cork products, excluding furniture, production of straw and plaiting materials; 17. Paper and paper product manufacturing; 18. Printing and reproduction of recorded media; 19. Coke and petroleum product manufacturing; 20. Chemical manufacturing; 21. Manufacturing of pharmaceutical and medical products used in medicine and veterinary medicine; 22. Rubber and plastic product manufacturing; 23. Manufacturing of other non-metallic mineral products; 24. Metallurgical manufacturing; 25. Manufacturing of fabricated metal products, except machinery and equipment; 26. Computer, electronic, and optical product manufacturing; 27. Electrical equipment manufacturing; 28. Manufacturing of machinery and equipment not included in other groups; 29. Manufacturing of motor vehicles, trailers, and semi-trailers; 30. Manufacturing of other transport equipment and machinery; 31. Furniture manufacturing; 32. Manufacturing of other finished products; 33. Repair and installation of machinery and equipment.

The most common industrial specializations found in Russian regions include the following: 10. Food product manufacturing; 17. Paper and paper product manufacturing; 20. Chemical manufacturing; 22. Rubber and plastic product manufacturing; 23. Manufacturing of other non-metallic mineral products; 25. Manufacturing of fabricated metal products, except machinery and equipment; 27. Electrical equipment manufacturing; 28. Manufacturing of machinery and equipment, not included in other groups; 30. Manufacturing of other transport equipment and machinery.

The least common industries include: 12. Tobacco product manufacturing; 11. Beverage manufacturing; 21. Manufacturing of pharmaceutical and medical products used in medicine and veterinary medicine (see Table 1).

For the period from 2019 to 2022, we have analyzed the dynamics of industrial specializations in Russian regions and identified «new» specializations that emerged and «departed» sectors that can no longer be considered specialization sectors for each analyzed region. In the given period, in 14 regions there appeared 15 new sectors and 15 sectors ceased to be specialization sectors (Table 2).

13 out of 14 regions experienced structural economic transformations in 2020–2022. Within a single region, we could observe new specializations emerging alongside the loss of others. However, despite the emergence of new specializations or the loss of market share and the shift away from previous specializations, in twelve out of fourteen regions, the level of specialization calculated through the Herfindahl-Hirschman Index has not undergone significant changes. The regions that previously had a diversified or specialized structure have largely retained this characteristic.

Meanwhile, two regions experienced more significant changes during this period. In the case of Novgorod region, there was a decrease in the degree of economic diversification. As of 2019, the region had a sufficiently diversified structure in manufacturing, but by 2021–2022, it had lost three of its industrial specializations («manufacturing of computers, electronic and optical products»; «manufacturing of machinery and equipment not included in other groups»; «repair and installation of machinery and equipment»). The current conditions are conducive to the development of the region's mono-specialization: the share of the sector «manufacturing of chemicals and chemical products» increased from 40 % in 2019 to 59.4 % in 2022. Due to the transformations in recent years, this region can currently be described as a region with a specialized economic structure rather than a diversified one.

On the contrary, the economic structure of Kaluga region has become more diversified. Due to the crisis and the vacant niche left by motor vehicle production amid the sanctions, the region has acquired new specializations – «clothing manufacturing», «wood processing and production of wood and cork products», and «manufacturing of other transport equipment and machinery». This shift contributed to an increased level of industrial diversification in the region. However, when the crisis is overcome and the automotive industry has recovered its production volumes, this process could be mitigated.

We also examined the economic resilience of industrially developed regions to the impact of crises. To assess the impact of external shocks on the dynamics of shipments in the manufacturing industry, the following periods were analyzed: 2020–2019, 2021–2020, 2022–2021, and the first half of 2023 (Figure 2). The figure also includes a curve illustrating the changes in production from 2019 to 2022, indicating whether the economic system has managed to restore its level of development before the impact of external shocks or not. It should be noted that these indices are adjusted for the inflationary component, indicating the net increase or decrease in industrial production.

The year 2020 was characterized by the impact of the coronavirus pandemic (COVID-19), as a result of which the economy experienced an unprecedented crisis. This crisis led to the decline in manufacturing indices in all 14 analyzed regions, although the extent of the decrease in industrial production volumes varied among them. The most significant decline was recorded in Vologda region (the index to 2019 was 56.8 %), where industries such as the production of chemicals and chemical products, as well as metallurgy, were most affected, showing a decline of more than 50 %. In Bashkortostan, printing and related activities experienced a loss of more than 50 % (48.7 %), and the production of coke and petroleum products fell by 45.9 %; in Chelyabinsk region, the printing and related activities sector showed a decline of 34.8 %. A slight decrease in production indices in the manufacturing industry (4.6 %) is observed in Moscow region.

Table 2

Dynamics of industrial specializations of Russian regions in 2019–2022

Regions	HHI (scaled from 0 to 1)				Type of specialization	Tendencies in industrial specialization	«New» sectors	«Departed» sectors
	2019	2020	2021	2022				
Moscow	0.090	0.097	0.088	0.090	D	No change	no	33 Repair and installation of machinery and equipment
Chelyabinsk	0.400	0.374	0.497	0.421	S	No change	29 Manufacturing of motor vehicles, trailers and semi-trailers; 33 Repair and installation of machinery and equipment	15 Manufacturing of leather and leather products
Sverdlovsk	0.416	0.374	0.458	0.420	S	No change	27 Manufacturing of electrical equipment 32 Manufacturing of other finished products	22 Manufacturing of rubber and plastic products
Omsk	0.134	0.054	0.118	0.104	D	No change	25 Manufacturing of finished metal products, except for machinery and equipment	no
Yaroslavl	0.103	0.112	0.102	0.096	D	No change	no	no
Rostov	0.117	0.104	0.118	0.093	D	No change	24 Metallurgical production; 27 Manufacturing of electrical equipment	no
Lipetsk	0.494	0.495	0.571	0.484	S	No change	no	22 Manufacturing of rubber and plastic products
Vladimir	0.164	0.177	0.159	0.187	D	No change	no	14 Clothing manufacturing; 15 Manufacturing of leather and leather products
Leningrad	0.054	0.063	0.054	0.137	D	No change	33 Repair and installation of machinery and equipment	27 Manufacturing of electrical equipment
Vologda	0.370	0.370	0.420	0.363	S	No change	no	23 Production of other non-metallic mineral products 25 Manufacturing of finished metal products, except for machinery and equipment
Nizhny Novgorod	0.151	0.113	0.106	0.110	D	No change	10 Food production; 16 Wood processing and manufacture of wood products;	11 Beverage production; 19 Production of coke and petroleum products
Novgorod	0.229	0.230	0.327	0.403	D	Tendency towards greater specialization	no	26 Manufacturing of computers, electronic and optical products; 28 Manufacturing of machinery and equipment not included in other groups; 33 Repair and installation of machinery and equipment
Kaluga	0.255	0.229	0.204	0.092	D	Tendency towards greater diversification	14 Clothing manufacturing; 16 Wood processing and manufacture of wood products; 28 Production of machinery and equipment not included in other groups; 30 Manufacture of other vehicles and equipment	no
Republic of Bashkortostan	0.422	0.304	0.341	0.348	S	No change	16 Wood processing and manufacture of wood products;	32 Manufacturing of other finished products

Source: developed by the authors using the data retrieved from EMISS (https://fedstat.ru/indicator/57722)
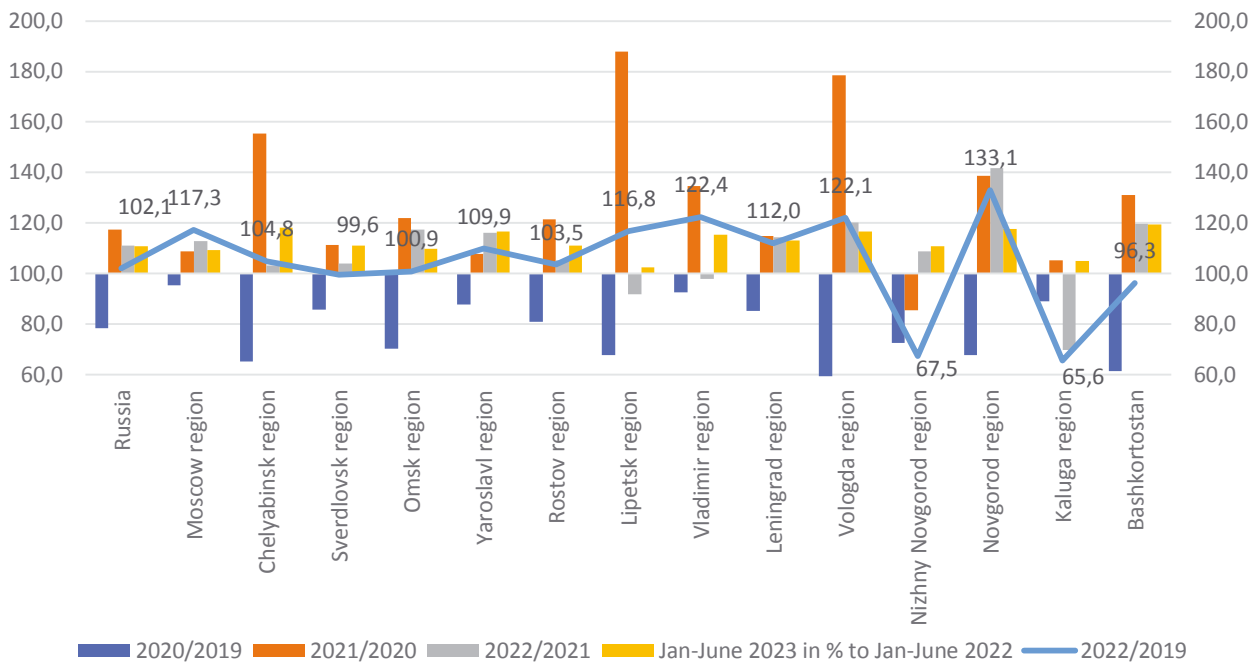
Figure 2. *Indices of the manufacturing industry in Russian regions*
Source: Compiled by the authors based on Rosstat data

The post-pandemic year of 2021 saw recovery processes in Russian regions. Industrial production rebounded to the 2020 level in all the regions under consideration. The positive dynamics of industrial production reflected the low base effect of 2020, especially in the regions with the greatest decline.

When the geopolitical situation aggravated and sanctions against Russia were imposed, the economic recovery in 2021 was disrupted. However, despite the negative impact of sanctions and the exodus of some international companies from the Russian market, in 2022, there was an increase in production volumes in manufacturing in 11 out of the 14 examined regions. Three regions — Lipetsk, Vladimir, and Kaluga regions — showed a decline in industrial production volumes in 2022. In Lipetsk region, the most significant decline compared to 2021 was observed in the production of electrical equipment (49.6 %) and rubber and plastic products (74.2%) in 2022. Vladimir region experienced a notable decline in the production of pharmaceuticals and medical materials (18.8 %) and metallurgical production (59.4 %). In Kaluga region, the most significant decline is observed in the production of motor vehicles, trailers, and semi-trailers (28.7 %), the repair and installation of machinery and equipment (54.3 %), and the production of rubber and plastic products (59 %).

We assess the resilience of regions to crises by examining how well their economies adapt to new conditions and restore positive dynamics in regional indicators. The rates of recovery may not necessarily reach the levels observed in the pre-crisis period. In Table 3, regions are grouped by the type of resilience based on the trajectory of post-crisis development.

The first group of regions that have returned to their pre-crisis development levels (with an index of 95–105 % in 2022 compared to 2019) includes five regions.

In Sverdlovsk region, three specializations have strengthened their positions: «repair and installation of machinery and equipment» showed a significant growth (the production volume increased by 326.6 % from 2019 to 2022), and there was also growth in «wood processing and production of wood and cork products» and «manufacturing of machinery and equipment not included in other groups.» The region also acquired two new specializations, including «manufacturing of electrical equipment», which is identified as a development driver (growth of 138.8 %). The declining industries — those that have not reached the 2019 level — are the production of other transport equipment, other non-metallic products, and metallurgical production. «Manufacturing of rubber and plastic products» has

Table 3

Groups of regions by resilience type and industrial specialization, 2019–2023

Groups of regions by resilience type	Regions	Industrial production index		Industry (OKVED index)*	Industrial production index	
		2022 to 2019, %	first half of 2023 to first half of 2022, %		2022 to 2019, %	first half of 2023 to first half of 2022, %
Regions returning to the pre-crisis level	Sverdlovsk	99.6	111.2	16	124.5	132.5
				27	138.8	111.0
				28	144.6	132.4
				33	326.6	200.6
	Chelyabinsk	105.3	118.3	24	101.1	119.6
				29	100.7	107.7
	Rostov	103.5	111.0	10	195.6	113.7
				13	126.2	118.9
				22	125.9	109.2
				25	122.8	139.1
				27	314.5	107.7
				28	122.7	122.9
	Omsk	100.9	109.8	10	131.0	105.4
				20	117.7	124.8
				26	168.5	131.5
	Republic of Bash-kortostan	96.3	119.4	16	158.6	131.9
				30	117.8	102.7
Regions transitioning to a growth trajectory	Moscow	135.0	109.2	10	112.1	102.9
				13	137.4	125.7
				14	174.8	116.8
				15	140.8	127.7
				16	164.5	131.2
				17	167.3	113.0
				18	167.1	101.8
				20	129.3	121.1
				22	148.9	131.5
				23	112.4	114.9
				25	150.8	108.6
				26	208.4	150.5
				31	144.1	130.3
	Yaroslavl	109.9	116.8	17	182.9	134.5
				22	125.0	217.4
				27	116.8	123.0
				29	104.4	118.2
				31	118.9	108.5
	Lipetsk	116.8	102.6	10	134.0	103.3
				24	102.0	100.2
	Vladimir	122.4	115.5	10	152.8	102.4
				13	128.7	100.9
				16	208.6	118.7
				22	106.5	123.2
				27	156.7	149.6

Table 3

Groups of regions by resilience type	Regions	Industrial production index		Industry (OKVED index)*	Industrial production index	
		2022 to 2019, %	first half of 2023 to first half of 2022, %		2022 to 2019, %	first half of 2023 to first half of 2022, %
Regions transitioning to a growth trajectory	Vladimir	122.4	115.5	28	212.3	101.7
				31	197.3	111.8
				32	120.5	103.2
	Leningrad	112.0	113.1	10	118.2	101.2
				14	168.1	197.2
				18	103.6	113.3
				20	197.3	155.7
	Vologda	122.1	116.8	16	130.2	118.6
				20	109.2	128.8
				24	102.3	110.9
	Novgorod	133.1	117.7	10	115.4	109.2
				20	135.6	135.1
				27	164.7	106.2
Regions transitioning to a declining trajectory	Nizhny Novgorod	67.5	110.8	10	140.3	114.3
				14	101.6	111.8
				16	199.0	104.1
				17	153.6	101.9
				22	124.0	113.2
				26	119.4	110.6
	Kaluga	65.6	105.0	16	206.8	110.9
				17	161.8	116.1
				23	126.8	105.8
				25	134.1	117.2
				27	110.5	127.0

Source: developed by the authors using the data retrieved from EMISS (https://fedstat.ru/indicator/57609?id=57609)

*See the note in Table 1 specifying these industries.

been removed from the list of the region's specializations.

In Chelyabinsk region, its main industry - metallurgy — has returned to the levels of 2019. Two new specializations have emerged, one of which is the production of motor vehicles, which has become a major driver of regional development. Industries with negative dynamics in the given period comprise the production of finished metal products, other non-metallic mineral products, as well as machinery and equipment not included in other groups. Manufacturing of leather and leather goods has ceased to be the region's specialization, primarily due to this industry's dependence on imported raw materials.

In Rostov region, five key industries demonstrated growth: «food production» (2022 production volume increased by 195.6 % compared to 2019), «textile production» (growth of 126.2 %), «production of rubber and plastic products» (growth of 125.9 %), «production of finished metal products, except for machinery and equipment» (growth of 122.8 %), and «production of machinery and equipment not included in other groups» (growth of 122.7 %). The region also acquired a new specialization — «manufacturing of electrical equipment» (threefold growth compared to the 2019 baseline). At the same time, four sectors show negative dynamics, with the greatest decline in the production volumes of the sectors «other non-metallic mineral products» (33.1 %) and «other transport equipment and machinery» (58.7 %). However, despite the significant decline in production volumes, these sectors did not lose their special status.

In Omsk region, there is a growth in production volumes in three key industries: «food production» (2022 production volume increased by 131.0 % compared to 2019), «production of chemical substances» (growth of 117.7 %), and «manufacturing of computers, electronic and optical products» (growth — 168.5 %). The latter industry is crucial to regional development, as its production is significantly linked to import substitution processes. Declining industries include the following: coke and petroleum production; rubber and plastic product manufacturing; other transport equipment and machinery; repair and installation of machinery and equipment.

In Bashkortostan, two industries can be identified as drivers of development: the long-established industry «manufacture of other transport equipment and machinery» (production volume growth from 2019 to 2022 amounted to 117.8 %) and the new specialization «wood processing and production of wood and cork products» (158.6 %). The following industries did not reach the level of 2019: production of coke and petroleum products, chemicals and products, machinery and equipment not included in other groups. There was one departed specialization — «manufacturing of other finished products».

In the second group there are seven regions that have returned to their pre-crisis levels and demonstrate an upward trend (the 2022 index relative to 2019 is over 105 %).

Moscow region, with the highest number of industrial specializations (20), demonstrates robust growth in thirteen of them. The production growth rates in these sectors in 2022–2019 ranged from 112.1 % to 208.4 %. The most significant decline was observed in the following sectors: «electrical equipment manufacturing» (51.1 %), «manufacturing of other vehicles and equipment» (51.3 %), and «manufacturing of other finished products» (61.4 %). The sector «repair and installation of machinery and equipment» saw a threefold reduction in production volumes, and as a result this industry lost its special place in the region's economy.

In Yaroslavl region, five industries have been identified as drivers of regional development, and the production of paper and paper products had the most significant growth, showing a 1.8 times increase. Nine industries, while retaining their special status, did not reach the level of 2019. Additionally, one industry — the production of computers, electronic and optical products — signifi-

cantly reduced its production volumes and ceased to be the region's specialization.

A major driver for the development of Lipetsk region, featuring six key industries, is the primary sector of metallurgy. Another significant driver is the food production sector, which saw a 134 % increase in production volumes from 2019 to 2022. Manufacturing of rubber and plastic products ceased to be a specialized industry due to the significant reduction in its production volumes.

In Vladimir region, over half of its key industries are showing positive dynamics. A two-fold increase in production volumes is observed in the following sectors: «wood processing», «machinery and equipment manufacturing (not included in other groups) «, and «furniture manufacturing». There is, however, a substantial decline in the production of pharmaceuticals (55.3 %). The production of clothing nearly halved during the period under consideration and ceased to be the region's key specialization. Another «departed» sector is the production of leather and leather goods.

In Leningrad region, four industries — food production, clothing, printing, and the production of chemicals — have become drivers of development. Additionally, a new specialization has emerged: the repair and installation of machinery and equipment. Six industries show a negative trend, and the region has lost one specialization — the production of electrical equipment.

In Vologda region, such industries as production of chemicals and products, metallurgy, and wood processing are growing steadily. At the same time, the region has lost two of its industrial specializations — «manufacturing of other non-metallic mineral products» and «manufacturing of finished metal products and repairs».

Despite the highest growth rate in production volumes, Novgorod region shows negative dynamics in three industries. The most significant decline is observed in the production of beverages (14.8 %) and wood processing (58.5 %). The region has lost three of its specializations: the production of computers, electronic and optical products; the production of machinery and equipment not included in other groups; and the repair and installation of machinery and equipment. The drivers of regional development, where production growth offset negative effects, were food production (growth of 115.4 %), the production of chemical substances (135.6 %), and manufacturing of rubber and plastic products (164.7 %).

Two regions, Kaluga and Nizhny Novgorod, belong to the third group of regions transitioning to a declining trajectory. In both regions, the production of motor vehicles significantly decreased. In Nizhny Novgorod region, the 2022 production volume made up 36.3 % of the 2019 level, and in Kaluga region, this figure was 35.3 %. Nizhny Novgorod region lost such specializations as the production of beverages, whose production volume was only at 8 % of the 2019 level, and the production of coke and petroleum products (at 8.5 %). Given this negative trend, the key drivers for the development of Kaluga region are the production of paper and paper products (1.6 times growth); production of other non-metallic mineral products (126.8 % growth); production of finished metal products, except for machinery and equipment (134.1 %); and production of electrical equipment (110.5 %). In Kaluga region, despite a significant decrease in the share of the leading industry — the automotive industry, several industries have become new specialized sectors: wood processing, clothing manufacturing, production of machinery and equipment not included in other groups, and production of other vehicles and equipment. In Nizhny Novgorod region, the main growth drivers were five industries: wood processing (growth of 199.0 %), production of paper and paper products (153.6 %), production of rubber and plastic products (124 %), clothing manufacturing (101.6 %), and production of computers, electronic, and optical products (119.4 %). In addition, the region gained a new industrial specialization - food production (140.3 %). Overall, in these two regions, there was a search for new industries into which resources from the main industry could be redirected during the crisis.

Summarizing the above data on the dynamics of industrial specialization in 2019–2023, the following conclusions can be drawn:

1. The drivers of economic recovery were the industries of domestic consumer demand: food production, textile and clothing manufacturing, furniture production, as well as wood processing and the production of wood, paper, and pulp products.

2. Against the backdrop of import substitution, the key industries driving economic recovery are the production of chemicals and chemical products, as well as the manufacturing of machinery and equipment (except for motor vehicles).

3. The reason why these industries have become drivers of economic development and contributed to the economy's adaptive recovery in the face of external constraints is their technological and organizational readiness to increase production. When major competitors exited the market in the process of import substitution, domestic producers managed to occupy vacated niches left by Western companies. At the same time, the sale of finished products is associated with meeting domestic demand.

4. These industries are set for further growth through expanding domestic markets. Additionally, changes in external policy restrictions could open up opportunities for international exports.

5. Different regions show varying trends in the production volumes of a particular industry. In some, there is significant growth leading to the appearance of a new specialization, while in others, there is a notable decline, causing a departure from specialized sectors. This applies to the following industries: the production of electrical equipment and computers, the production of finished metal products (except for machinery and equipment), and the repair and installation of machinery and equipment. To investigate the reasons behind these trends, a more detailed analysis of the sector up to the fourth digit of OKVED code is required. In general, we can conclude that these industries involve manufacturing of specific types of products that can act as drivers of development. However, the industry's dependence on resource imports imposes limitations on its development.

6. Two industries that are crucial for Russia's economy and act as key industrial specializations in various regions were severely impacted by external restrictions: manufacturing of coke and petroleum products, and motor vehicle production. Trade restrictions have resulted in a decline in their production volumes. In the petrochemical industry, this decline is attributed to a sharp reduction in sales in the Western market for finished Russian goods. Meanwhile, in the automotive manufacturing sector, the decrease is linked to restrictions on the supply of imported components and machine parts. Both of these industries cannot be considered as anti-crisis growth drivers. On the contrary, they require close attention from the government in order to devise and implement temporary support mechanisms. This will help maintain employment levels and, consequently, address potential issues related to layoffs and income loss for a significant portion of workers.

Conclusion

Our analysis has revealed disparities in the level and dynamics of development of Russian regions' industrial specializations. Since we take as a point of departure the understanding that the resilience of the regional economic system is closely tied to industrial specialization, we categorized regions into two types: those with a diversified structure and those with more distinct industrial specializations.

Analysis of the dynamics of industrial specialization levels revealed notable variations in the speed and extent of changes across different regions. In one region, new specializations may emerge alongside the loss of special status by certain industries. In the given period, 14 regions acquired 15 new specializations while 15 sectors ceased to be specialization sectors (Table 2). However, despite the emergence of new specializations or the departure of existing ones, in twelve out of fourteen regions, the level of specialization in the regional economy has not undergone any significant changes. The regions that previously had a diversified or specialized structure have remained as such. In two regions significant transformations were detected. In Novgorod region the level of economic diversification decreased, which means that the current conditions are conducive to the development of the region's mono-specialization: the share of the sector «manufacture of chemicals and chemical products» increased from 40% in 2019 to 59.4% in 2022. On the contrary, the economic structure of Kaluga Region has become more diversified. Due to the crisis and the vacant niche left by motor vehicle production amid the sanctions, the region has acquired new specializations such as clothing manufacturing, wood processing and production of wood and cork products, and manufacture of other transport equipment and machinery. This shift contributed to an increased level of industrial diversification in the region. However, when the crisis is overcome and the automotive industry has recovered its production volumes, this process could be mitigated.

We assessed Russian regions' resilience to crises by analyzing how their economies adapted to new conditions and restored positive dynamics, focusing specifically on the production volumes of the manufacturing industry, identified as a key specialization for the regions in question. We divided the regions into three groups: 1) those that restored their pre-crisis level of development (Sverdlovsk, Chelyabinsk, Rostov and Omsk regions, the Republic of Bashkortostan); 2) those that transitioned to a growth trajectory (Moscow, Yaroslavl, Lipetsk, Vladimir, Leningrad, Vologda, and Novgorod regions); and 3) those that transitioned to a declining trajectory (Nizhny Novgorod and Kaluga regions). For each region in each of the above-mentioned groups we identified the sectors that showed growth in production volumes and maintained their upward trends in the first six months of 2023. Therefore, these sectors can be deemed drivers for the regions' economic development.

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