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Anna A. Fedyunina ✉, *Yuri V. Simachev*, *Igor M. Drapkin*
Ural Federal University, Ekaterinburg, Russian Federation

Intensive and Extensive Margins of Export: Determinants of Economic Growth in Russian Regions under Sanctions[1]

Abstract. The impact of foreign trade on the Russian economy's growth remains debatable. In 2014, the economy faced initial sanctions, leading to export restructuring and affecting growth. In 2022, a second unprecedented wave of sanctions necessitated export restructuring and intensified the challenge of sourcing economic growth. This study evaluates the impact of intensive and extensive export margins on Russian regions' growth from 2015 to 2021 and discusses post-2022 implications. It is hypothesised that new export goods and markets are vital for economic growth in Russian regions. The study shows that both intensive and extensive margins are positively related to the level of development in Russian regions, and developed regions with diversified economic structures had higher values of export margins. The methodology uses panel regression with random and fixed effects. The empirical results show Russian regions' market share in the products they export and in the countries where they export (i. e. intensive product and geographic margin) is important for the economic growth of Russian regions, while the results for extensive margin are ambiguous. The obtained findings have implications for industrial policy, which should prioritise the development of measures aimed at supporting existing exporting companies in expanding their presence in familiar markets. The task of export diversification should primarily be addressed through working with existing exporters and export products, while the export of innovative products should be viewed as a gradual evolutionary process within the framework of long-term planning.

Keywords: extensive margin, intensive margin, Russian regions, economic growth, sanctions

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

А. А. Федюнина ✉, *Ю. В. Симачёв*, *И. М. Драпкин*
Уральский федеральный университет имени первого Президента России Б. Н. Ельцина,
г. Екатеринбург, Российская Федерация

Интенсивная и экстенсивная компоненты экспорта: детерминанты экономического роста в российских регионах в условиях санкций

Аннотация. В существующих работах влияние внешней торговли на экономический рост российской экономики и ее регионов остается дискуссионным вопросом. В 2014 г. российская экономика впервые подверглась санкциям, приведшим к структурной трансформации экспорта и изменениям темпов экономического роста. Введение в 2022 г. беспрецедентных санкций актуализировало задачу поиска источников экономического роста, определило вызов структурной перестройке экспорта. Цель настоящего исследования — оценить влияние интенсивной и экстенсивной компонент роста экспорта на экономический рост в российских регионах в 2015-2021 гг. и обсудить последствия для периода после 2022 г. Выдвинута гипотеза, что введение новых экспортных товаров и вход на новые экспортные рынки (расширение экстенсивной составляющей экспорта) являются важными факторами экономического роста в российских регионах. Исследование показало, что как интенсивная, так и экстенсивная компоненты положительно связаны с уровнем развития в российских регионах, при этом развитые регионы с диверсифицированной структурой экономики имеют более высокие значения выделенных компонент экспорта. Для анализа были построены модели панельных данных со случайными и фиксированными эффектами. Эмпирические результаты показывают, что доля рынка российских регионов по продуктам, которые они экспортируют, и в странах, куда они экспортируют (интенсивные продуктовые и географические компоненты), достаточно существенна для экономического роста российских регионов, в то время как экстенсивная составляющая экспорта не имеет устойчивого статистически значимого эффекта. Полученные выводы могут быть использованы для развития промышленной политики, приоритетом которой должна являться выработка мер по расширению присутствия существующих компаний-экспортеров на тех рынках, где они уже присутствуют. Задачи по диверсификации экспорта следует решать, прежде всего, через работу с существующими экспортерами и экспортными товарами; вывод на экспорт инновационной продукции должен рассматриваться как постепенный эволюционный процесс в рамках долгосрочного планирования.

Ключевые слова: экстенсивная компонента, интенсивная компонента, российские регионы, экономический рост, санкции

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Introduction

The Russian economy encountered difficulties with economic growth in the early 2010s, which became a subject of discussion among experts and academic circles. While in the 2000s, Russia was only outpaced by China and India in terms of growth rate, over the past decade it has fallen to seventh place, lagging behind such countries as Indonesia, Turkey, and others (Akindinova et al., 2020). The reasons for this slowdown are not solely due to the exhaustion of the impact of "one-time" factors that Russia received during the post-Soviet transformation of its economy, such as the growth of retail trade and the banking sector in the 2000s (Akindinova et al., 2020), or the reduction of the impact of temporary or cyclical factors, such as the increase in oil prices and record capital inflows into emerging market countries (Drobushevsky et al., 2018), but also due to the slowdown in the impact of structural factors (Zamulin, 2016). Zamulin and Sonin (2019) argue that Russia has the capacity to achieve annual growth rates of 5–6 % and narrow the gap with developed countries.

In 2014, the Russian economy faced serious sanctions for the first time (excluding earlier sanctions imposed by the EU and the US, aimed at urging Russia to respect human rights). Sanctions and Russia's counter-sanctions have affected the mutual trade of Russia with the EU, US, Korea (Korgun,

2019) and other countries that have joined the sanctions (Belozyorov & Sokolovska, 2020; Korgun, 2019; Bělín & Hanousek, 2021), reduced the inflow of foreign capital, and slowed down the pace of Russia's economic growth by 0.3–0.6 percentage points per year. In addition to these effects, there are more distant but significant effects associated with the weakening of the process of transfer of advanced technologies (in particular, this is manifested in the decline of foreign direct investment) (Gurvich & Prilepsky, 2019).

After 2014, there have been some shifts in the structure of Russian exports (Simachev et al., 2019). In particular, there has been a gradual decrease in the volume of raw material exports (on average by 5 %) and non-raw material energy exports (on average by 8 %), while export shipments of non-raw material goods (on average by 1 %) have increased. Significant for the Russian economy in terms of value-added formation is the growth of exports of non-raw material finished products, including high-tech sectors, the volume of which amounted to $51.14 billion in 2019 compared to $41.89 billion in 2016 (Karachev & Vinogradova, 2020).

The second, much larger wave of sanctions hit the Russian economy in 2022. This has intensified the search for growth factors for the Russian economy in conditions of even greater reduction of mutual trade between Russia and the countries that imposed sanctions, especially considering that, as noted by Drezner (2022), the number of such countries, as well as the scale of sanctions, have increased dramatically, making Russia the country under the heaviest sanctions.Начало формы

Numerous papers have studied the factors of economic growth of Russian regions. For example, Kaneva and Untura (2019) consider the role of research and development (R&D) and external knowledge spillovers on economic growth, while Vasilyeva and Kovshun (2015) and Yushkov (2015) discuss the role of developing regional financial systems. Demidova and Ivanov (2016) analyse the role of spatial effects, while Demidova and Kamalova (2021), as well as Kartaev and Polunin (2019) investigate the role of institutions and investment climate. Izotov (2018a, 2018b) and Kadochnikov and Fedyunina (2013) study the role of international trade.

The interdependence between the export and economic growth of Russian regions is well established. Izotov (2018a) shows that the current fluctuations in exports and imports significantly affect the dynamics of regional economic growth. Indeed, as illustrated in Figure 1, the dynamics of Russian exports and gross domestic product (GDP) are significantly related. This holds true not only for the relationship between gross commodity exports and GDP in the primary and secondary sectors (gross value added (GVA) for sections A, B, C on Figure 1), but also for the relationship between indicators excluding the extractive sector (GVA for sections A and C OKVED on Figure 1).

Kadochnikov and Fedyunina (2013) show that different components of exports have vary-

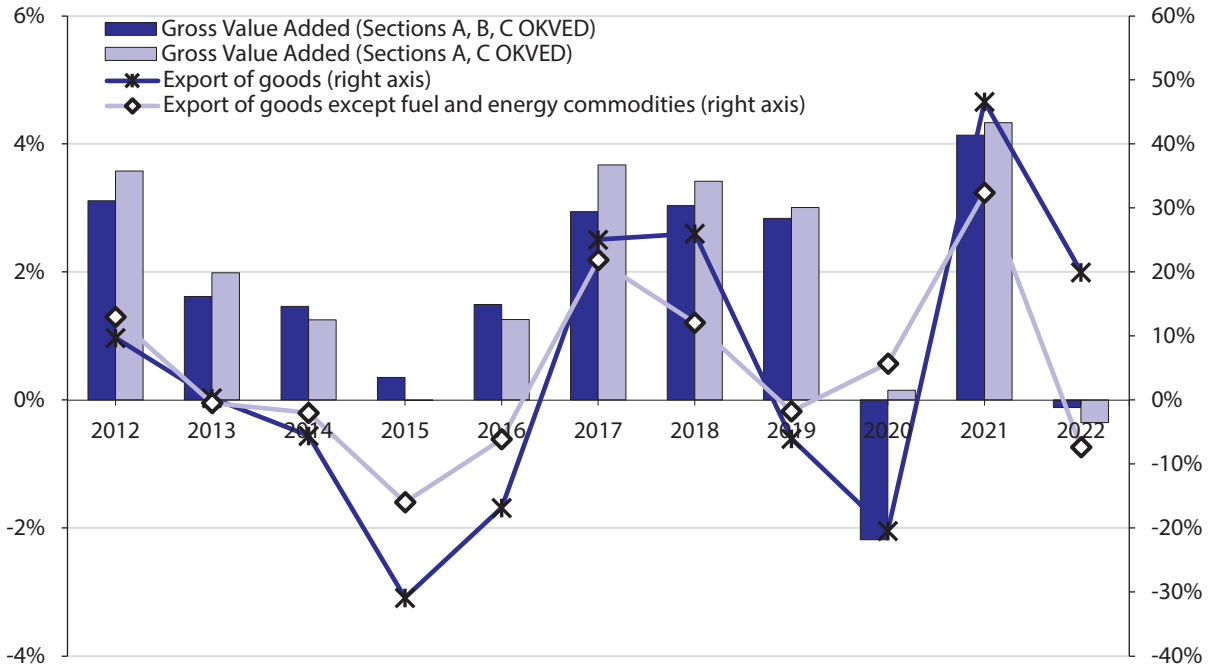

Fig. 1. *Growth of gross value added and export of goods in Russia in 2012–2022, by categories (source: compiled by the authors, data from the Federal State Statistics of Russia (Rosstat), the Federal Customs Service of Russia (Date of access: 09.03.2023))*

ing impacts on economic growth, and argue that the density of the product space around goods with comparative advantage has more influence than gross export. This is in line with the study of Gnidchenko (2014) that accounted for competitive advantage while calculating export margins and showed that export growth is mainly driven by intensive margin.

Sarin et al. (2022) reviewed eighty-eight pertinent research articles published in various scholarly journals and revealed that most studies indicate that export diversification has a positive impact on economic growth, but the impact of export instability is uncertain. Some studies (Turkcan, 2014; Dutt et al., 2008) argue that export growth driven by diversification of risks through the extensive margin can promote sustainable economic growth. Moreover, sustainable growth can also be achieved through an increase in exports driven by the price component of intensive margin, as higher prices can indicate higher quality (Bayar, 2018). Conversely, an increase in exports resulting from the quantity component of intensive margin is the least desirable since it raises demand for resources, including imported ones, and puts pressure on the current account balance (Turkcan, 2014; Dutt et al., 2008).

Given the expected significant changes in the structure and volumes of Russian exports, it is particularly relevant to investigate the role of exports as a factor in economic growth of Russian regions in the modern period, following the first wave of sanctions and in anticipation of the second wave in 2022.

The novelty of this study lies in its examination of the contemporary period of the relationship between export growth and economic growth in Russian regions amidst the 2014 sanctions. Unlike previous studies, this research takes into account the impact of the 2014 sanctions, which led to shifts in the commodity and geographic structure of exports. Additionally, the period from 2014 onwards was characterised by low global economic growth rates and growth rates of international trade. It also encompasses the influence of a significant non-economic shock, namely the COVID-19 pandemic. Taken together, these factors indicate that the results obtained in this study may differ from those obtained prior to 2014, making them most relevant for formulating recommendations for industrial policies aimed at stimulating economic growth in Russian regions and redirecting their trade activities towards friendly nations. In addition to analysing the impact of export growth on economic growth, it is important to note that this study also conducts an analysis of the relationship between export growth characteristics, the level of development, and sectoral specialisation of regions for the first time. Considering these factors is crucial for formulating industrial policy.

The rest of the paper is structured as follows. In Section 2, we present the methodology of export decomposition, the empirical model, and the data used. In Section 3, we discuss the characteristics of exports in Russian regions and present the results of the econometric analysis. In Section 4, we provide the conclusions and discuss implications for policy.

2. Empirical Methodology of the Study

2.1. Methodology of export decomposition

Selecting an appropriate method to calculate export margins is crucial for our analysis (Besedes & Prusa, 2011). The count method is one of the commonly used methods that assigns equal weight to product categories and destination countries (Dennis & Shepherd, 2011; Persson, 2013; Beverelli et al., 2015). The count method calculates bilateral export margins as the number of product categories exported from a source country to a destination country, while bilateral import margins are defined as the value of exports of common products between a source and destination country. Although the count method is easy to implement, it has a limitation of giving equal importance to all observed product categories, resulting in an overestimation or underestimation of the significance of each margin in export growth (Lee & Kim, 2012).

The decomposition method introduced in the study of Hummels and Klenow (2005) is another frequently used approach to explore intensive and extensive export margins (Lee & Kim, 2012; Feenstra & Ma, 2014; Beverelli et al., 2015; Töngür et al., 2015). Unlike the count method, the decomposition method weights each product according to its overall importance as an export to a particular country, thereby preventing a product category from being deemed significant only because a source country exports a substantial amount of it to a specific destination country.

Given the limitations of the count method, we use the decomposition methodology developed by Hummels and Klenow (2005) to estimate the role of EM and IM for economic growth in Russian regions in this paper.

Hummels and Klenow (2005) proposed a variant of their methodology where new export lines are weighted by their share in world trade. This approach takes into account the relative importance of different export products by weighting

them based on their share in world trade. For instance, exporting a million dollars' worth of high-tech products, such as semiconductors, is considered more significant than exporting a million dollars' worth of traditional handicrafts, as high-tech products are in higher demand globally and have greater potential for further technological advancements and innovation. K^i denotes the set of products exported by region i, X_k^i is the dollar value of i's exports of product k to the world, and X_k^W is the dollar value of world exports of product k. Hummels and Klenow (2005) define the intensive product margin (*IPM*) as follows:

$$IPM^i = \frac{\sum_{K^i} X_k^i}{\sum_{K^i} X_k^W}. \quad (1)$$

Stated differently, the numerator in the equation represents the dollar value of region i's exports, while the denominator represents the dollar value of world exports of products that are included in region i's export portfolio. This means that IM^i is a measure of region i's market share in the products it exports.

The extensive product margin (*EPM*) is:

$$EPM^i = \frac{\sum_{K^i} X_k^W}{\sum_{K^W} X_k^W}, \quad (2)$$

where K^W is the set of all traded goods. EM^i measures the share of the products belonging to i's portfolio in world trade.

Next, we define intensive and extensive geographic margins. Let D^i represent the collection of destination markets where region i exports, regardless of the number of products (ranging from one to 5,000). The dollar value of i's complete exports to destination d is denoted as X_d^i, while X_d^W indicates the dollar value of global exports to destination d, representing d's total imports. It is important to note that all dollar values are combined over all goods.

The intensive geographic margin (*IGM*) is then:

$$IGM^i = \frac{\sum_{D^i} X_d^i}{\sum_{D^i} X_d^W}, \quad (3)$$

where the set of all destination countries is represented as D^W. The formula (3) refers to i's share of the market in the countries where it exports, specifically i's portion of their total imports.

The extensive geographic margin (*EGM*) is:

$$EGM^i = \frac{\sum_{D^i} X_d^W}{\sum_{D^W} X_d^W}. \quad (4)$$

That is, expression (4) represents the share of i's destination markets in world trade (their imports as a share of world trade).

2.2. Methodology of econometric estimation

The works evaluating the effects of intensive and extensive margins of export on economic growth are limited. Thus, Rondeau and Roudaut (2014) empirically estimate the contribution of intensive and extensive export margins, calculated according to the methodology (Amurgo-Pacheco & Pierola, 2008; Brenton et al., 2007), to the economic growth rates of 64 countries of the world economy 1990–2009. However, it appears that this work is not free from shortcomings. In particular, it seems that the intensive and extensive margins of exports, considered in the paper as exogenous variables of the model, are not really exogenous, since the growth rate of exports (and probably its components) is related to the dynamics of not only the current but also the future rate of economic growth. In addition, the authors do not pay sufficient attention to explaining the chosen econometric method and the set of explanatory variables of the model.

Economic performance differences across regions and nations have been explained through growth regression studies. The neoclassical growth theory predicts a trend of convergent growth among regions or nations, where poor regions or nations tend to grow faster than rich ones due to diminishing returns to capital (Mankiw et al., 1992).

Let's assume that every region i has a production function as follows:

$$Y_t = F(K_t, L_t, X_t), \quad (5)$$

where Y_t represents the total production at time t, $F(\cdot)$ is a concave production function with homogeneity degree of one, K_t represents the physical capital stock, L_t is the labor force, and X_t is a vector of all other production inputs.

Time differentiation of the labour intensive form of the equation (5) gives:

$$\frac{dy_t}{dt} = f_1 \frac{dk_t}{dt} + \sum_{j=2}^{N} f_j \frac{dx_{j,t}}{dt}. \quad (6)$$

Let y_t^* reflect the stationary level of per capita production in the region, and let y_t reflect the real volume of production at time t, then the rate of convergence of regions will be equal to:

$$\frac{\partial \ln y_t}{\partial t} = \lambda\left(\ln y_t^* - \ln y_t\right), \quad (7)$$

where λ is the speed of convergence. Then for a given $\ln y_t^*$ and $\ln y_{t-1}$ we have:

$$\ln y_t = \left(1 - e^{-\lambda t}\right) \ln y_t^* + e^{-\lambda t} \ln y_{t-1}. \quad (8)$$

Since equation (5) holds at any point in time, it can be rewritten by subtracting from both sides of the equation the per capita output with one lag, $\ln y_{t-1}$:

$$\Delta \ln y_t = \left(1 - e^{-\lambda t}\right) \ln y_t^* + \left(e^{-\lambda t} - 1\right) \ln y_{t-1}. \quad (9)$$

Therefore, equation (6) represents the tendency of regional growth rates to converge towards a stable level over time, while equation (9) is a common characteristic of neoclassical growth models. Specifically, assuming that the stationary growth rates of all regions are the same, their actual growth rates should converge over time.

The panel regression tools proposed by Sala-I-Martin and Barro (1995) and adapted for panel data by Soto (2000) and Laureti and Postiglione (2005) are used to estimate equation (9). This method utilises information on the growth rates of per capita income, physical capital stock, labour resources, and a set of control variables. We assume that a higher GDP per capita reflects a higher accumulated physical capital stock per capita and that a higher initial stock of labour resources is reflected in the lagged level of GDP per capita, in line with the neoclassical growth model. The equation also takes into account the contribution of extensive and intensive margins of export in the previous period to determine the pace of economic growth in the next period. The resulting equation (6) can be expressed in terms of GDP per capita (y_{it}) in region i ($i = 1, \ldots, 85$) in period t ($t = 2015, \ldots, 2021$), the initial value of GDP per capita in the previous period (y_{it-1}), parameters reflecting the speed of convergence (α_1) and the impact of capital intensity on economic growth (α_2), lagged indicators of intensive and extensive margins ($IM_{i,t-1}$ and $IM_{i,t-1}$), and a vector of control variables with corresponding parameters (Δ_{it-1}) with γ parameters:

$$\Delta \ln y_{it} = \alpha_1 \ln y_{i,t-1} + \alpha_2 \ln k_{i,t-1} + \\ + \beta_1 IM_{i,t-1} + \beta_2 EM_{i,t-1} + \gamma' \ln x_{it-1}. \quad (10)$$

2.3. The data and descriptive statistics for econometric estimation

Table 1 presents the definitions and data sources for the variables used in this section. To calculate the extensive and intensive margins, we utilise a four-digit classification of the Commodity Nomenclature of Foreign Economic Activity of the Customs Union (TN VED TS). This four-digit classification corresponds to the four-digit classification of the Harmonised System (HS). Six control variables are employed as important drivers of economic growth in Russian regions.

First, we include the logarithm of per capita fixed investment, which is consistent with economic intuition and empirical research indicating that investment is a crucial driver of economic growth. We use information on annual volumes instead of the cumulative level of capital investment as the latter may not reflect annual dynamics as meaningfully, and the impact of cumulative volume seems to be already reflected in the lagged level of gross regional product (GRP) per capita.

Second, we add the logarithm of net per capita inflows of foreign direct investment (FDI) as a control variable, which is also consistent with economic intuition and theoretical and empirical research indicating that FDI has a strictly positive effect on the host economy. Classical works (Soto, 2000; Li & Liu, 2005), as well as contemporary research (Hanousek et al., 2011; Villar et al., 2020) support this notion.

Third, we include the logarithm of GRP energy intensity in our analysis, following the approach of Ledyaeva and Linden (2008), to account for the high dependence of the Russian economy on energy carriers and their impact on economic growth. Given the short time period under consideration and the specific production function used, we acknowledge that natural resources can have a positive effect on economic growth and should be treated as an additional resource factor.

Fourth, we include the volume of per capita exports and imports in regions to account for economic openness. Empirical literature highlights exports as a factor in economic growth (Hagemejer & Mućk, 2019; Tang et al., 2015), and we can also point to the arguments for the role of imports (as a source of technology, equipment, scarce resources) in economic growth (Awokuse, 2008; Rani & Kumar, 2018).

Finally, we add a dummy variable for 2020 in order to account for the effect of the COVID-19 pandemic that spread to Russian regions in early 2020 and determined the negative dynamics of economic performance at the end of 2020.

Table 2 displays the descriptive statistics of the variables after applying logarithmic transformation to reduce the impact of outliers and smoothen the series. The panel dataset obtained is unbalanced due to the lack of data on certain indicators, especially net FDI inflows, for some small-sized regions of the Russian Federation. (Table 3).

The correlation analysis suggests that there is no significant multicollinearity among the variables included in the model, which ensures the reliability of the results. Furthermore, we observe a high correlation between the intensive product and intensive geographic margins of export,

Table 1

Definitions and data sources for variables

Variable	Definition	Data source
im_i_goods	Intensive product margin	Calculations by the authors, data from the Federal Customs Service of Russia
em_i_goods	Extensive product margin	Calculations by the authors, data from the Federal Customs Service of Russia
im_i_geo	Intensive geographical margin	Calculations by the authors, data from the Federal Customs Service of Russia
em_i_geo	Extensive geographical margin	Calculations by the authors, data from the Federal Customs Service of Russia
lngrp	Logarithm of gross regional product per capita, roubles	Rosstat
growth	Growth rate of gross regional product per capita	Calculations by the authors, data from Rosstat
lninv	Logarithm of fixed capital investment per capita in actual prices, roubles	Rosstat
lnenergo	Logarithm of energy intensity of gross regional product, kg of standard fuel per 10,000 roubles	Rosstat
lnexport	Logarithm of goods exports per capita, million USD	Calculations by the authors, data from Rosstat
lnimport	Logarithm of goods imports per capita, million USD	Calculations by the authors, data from Rosstat
lnnfdi	Logarithm of net foreign direct investment per capita based on the balance of payments data of the Russian Federation, million USD	Calculations by the authors, data from Rosstat
covid	Dummy variable, equals 1 for the year 2020 — the year of the start of the COVID-19 pandemic in Russia	Calculations by the authors

Source: Compiled by the authors.

Table 2

Descriptive Statistics of Variables

Variable	No of obs.	Average	St. Dev.	Min	Max
im_i_ product	504	0.013	0.058	0	0.892
em_i_ product	504	54.956	25.982	0.749	98.402
em_i_geo	504	77.687	24.388	3.310	99.980
im_i_geo	504	1.190	3.493	0	41.669
lngrp	510	12.972	0.676	11.580	15.834
lninv	510	11.435	0.781	9.686	14.781
lnenergo	504	4.865	0.459	3.096	6.108
lnexport	504	–0.508	1.781	–7.285	3.444
lnimport	506	–0.949	1.449	–9.112	3.146
lnnfdi	482	–2.201	2.249	–9.659	2.944
growth	425	0.076	0.078	–0.369	0.571
covid	595	0.143	0.350	0	1

Source: Authors' calculations.

as well as between the extensive product and extensive geographic margins of export. This means that either export growth indicators for goods only (i. e. intensive and extensive by goods) or for markets only (i. e. intensive and extensive by markets) can be simultaneously included in the model. Respectively, the simultaneous inclusion of all four indicators creates a multicollinearity problem, which can lead to an unjustified conclusion about the significance of influence of the corresponding explanatory variable on the dependent variable, as well as to obtaining incorrect regression coefficients.

For the econometric estimation, considering the panel data structure, we will utilise panel regression with fixed and random effects. The selection between fixed and random effects will be made based on the Hausman test.

3. Empirical Results

3.1. Intensive and extensive margins across russian regions

Table 3 presents the calculated average values of intensive and extensive margins of export across Russian regions. According to the established methodology, the Intensive Product Margin (IPM) represents a measurement of a region's market share in exported goods, which explains the relatively small values of this indicator

Table 3

Average indicators of intensive and extensive margins of export across Russian regions for the period 2015–2021, by groups of regions

	IPM	EPM	IGM	EGM
Highly developed	*0.063*	*57.890*	*5.558*	*85.052*
Raw material export-oriented	0.030	37.543	1.152	76.979
Financial and economic centres	0.122	94.062	13.391	99.405
Developed	*0.015*	*71.037*	*1.493*	*93.469*
Diversified economy	0.017	85.660	2.429	97.236
Reliant on extractive industries	0.019	62.604	1.477	90.508
Reliant on manufacturing industries	*0.011*	*67.450*	*0.805*	*93.234*
Moderately developed	0.005	60.247	0.570	85.419
Agro-industrial	0.004	61.147	0.536	83.172
Industrial-agrarian	0.008	58.868	0.621	88.863
Least developed	*0.004*	*18.094*	*0.049*	*37.418*
Less developed agricultural	0.001	19.298	0.013	37.259
Less developed raw material	0.014	15.084	0.138	37.813

Source: Authors' calculations; regions are classified according to Grigoriev et al. (2011).

for Russian regions. However, for developed regions, particularly financial and economic centres such as Moscow and Moscow Region, as well as St. Petersburg and Leningrad Region, IPM exhibits significantly higher values. This is attributable to the diversified product structures and high levels of export intensity in these regions. Moreover, a positive correlation between regional development and IPM has been observed.

IPM is distributed in a similar manner to Intensive Geographic Margin (IGM), which reflects a region's proportion of exported goods in a particular market. This indicator demonstrates higher values for regions with higher levels of development, particularly for financial and economic centres.

Extensive Product Margin (EPM) and Extensive Geographic Margin (EGM) are also key indicators in the analysis of regional economic performance. EPM reflects the scale and importance of goods in the exports of Russian regions relative to global trade, while EGM assesses the significance of markets in these exports. Notably, the most diversified product and market structures are observed in Moscow, St. Petersburg, Moscow and Leningrad regions, and in other developed and diversified regions in Russia, consistent with expectations. Furthermore, the level of diversity is positively correlated with regional development, as higher levels of development are associated with higher levels of product and geographic diversity in exports.

It should be emphasised that the level of development of regions cannot be determined solely by the region's income level. Our classification approach, based on the study by Grigoriev et al. (2011), considers the dynamics of socio-economic indicators in Russian regions from 2003 to 2010. While our calculated intensive and extensive margins vary depending on the region's group, there is no clear correlation between GRP per capita and margins of export at the regional level (as shown in Figure 2). This indicates that the level of development in the regions we are analysing is a more comprehensive parameter that reflects the socio-economic situation beyond GRP per capita.

3.2. Intensive and extensive margins and economic growth across russian regions

Tables 4 and 5 depict the empirical findings of the estimation of intensive and extensive margins of export by goods and markets, respectively, as a determinant of economic growth in various regions of Russia. The Hausman model specification test indicates that individual effects are correlated with the explanatory variables. Consequently, we reject the null hypothesis of nonsystematic (random) effects. However, it should be noted that the Hausman test is not the sole criterion for selecting a model. The test is almost always significant, indicating that models with fixed and random effects significantly differ, albeit insignificantly in some cases. Therefore, we consider it advantageous to examine the estimation results of the model with random effects as well, as a means of testing the robustness of the findings contingent upon the assumption of effect types in the model.

The findings demonstrate that intensive margin of export by goods and markets is statistically significant for economic growth in Russian regions between 2015 and 2021. Specifically, the expansion of regional exports by existing goods categories or markets correlates with higher rates of regional economic growth. However, the results re-

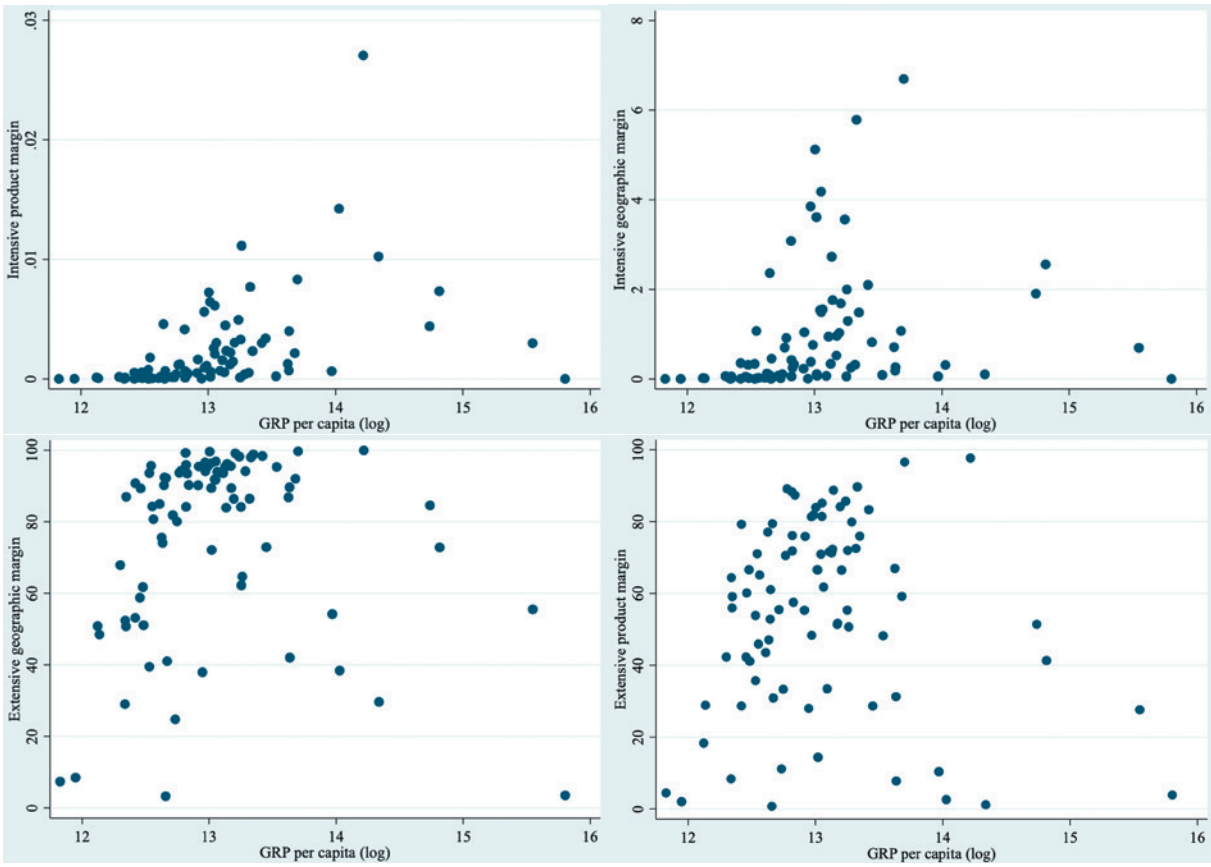

Fig. 2. *Intensive and extensive margins of export and GRP per capita across Russian regions (source: compiled by the authors, data from Rosstat, the Federal Customs Service of Russia (Date of access: 09.03.2023))*

Table 4

Intensive and extensive margins of export and economic growth in Russian regions: panel regression with fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
L.lngrp	–0.188 (0.166)	–0.219 (0.167)	–0.200 (0.167)	–0.225 (0.173)	–0.179 (0.164)	–0.197 (0.172)
L.lninv	0.117*** (0.0311)	0.111*** (0.0311)	0.116*** (0.0306)	0.109*** (0.0326)	0.117*** (0.0316)	0.115*** (0.0324)
L.lnexport	–0.0110 (0.0173)	–0.0121 (0.0181)	–0.0123 (0.0176)	–0.0132 (0.0175)	–0.01000 (0.0178)	–0.0124 (0.0175)
L.lnimport	–0.0104 (0.0222)	–0.0113 (0.0234)	–0.0119 (0.0221)	–0.0124 (0.0229)	–0.00938 (0.0227)	–0.0120 (0.0222)
L.lnenergo	0.0520 (0.135)	0.0330 (0.136)	0.0633 (0.136)	0.0328 (0.132)	0.0497 (0.135)	0.0608 (0.132)
L.lnnfdi	–0.00244 (0.00411)	–0.00281 (0.00403)	–0.00259 (0.00413)	–0.00318 (0.00416)	–0.00223 (0.00401)	–0.00274 (0.00416)
covid	–0.0295*** (0.0111)	–0.0272** (0.0112)	–0.0292** (0.0111)	–0.0274** (0.0111)	–0.0289** (0.0111)	–0.0288** (0.0110)
L.im_i_ product	0.159** (0.0780)				0.159** (0.0784)	
L.em_i_ product		–0.00118 (0.00120)			–0.00118 (0.00116)	
L.im_i_geo			0.00678** (0.00311)			0.00676** (0.00309)
L.em_i_geo				0.000345 (0.00119)		0.000315 (0.00117)
Constant	0.897 (2.631)	1.539 (2.662)	0.998 (2.668)	1.534 (2.722)	0.860 (2.618)	0.962 (2.714)
Observations	312	312	312	312	312	312
R-squared	0.274	0.261	0.277	0.258	0.277	0.277

Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculations, data from Rosstat, the Federal Customs Service of Russia.

Table 5

Intensive and extensive margins of export and economic growth in Russian regions: panel regression with random effects

	(1)	(2)	(3)	(4)	(5)	(6)
L.lngrp	–0.0695**	–0.0758***	–0.0697**	–0.0726***	–0.0761***	–0.0734***
	(0.0272)	(0.0252)	(0.0277)	(0.0243)	(0.0248)	(0.0244)
L.lninv	0.0453***	0.0374***	0.0450***	0.0345***	0.0398***	0.0368***
	(0.0103)	(0.0102)	(0.0106)	(0.00978)	(0.0102)	(0.0100)
L.lnexport	0.00411	0.00827**	0.00530	0.0105***	0.00645	0.00990**
	(0.00494)	(0.00422)	(0.00468)	(0.00406)	(0.00461)	(0.00422)
L.lnimport	0.00166	0.00544	0.000908	0.00556	0.00595	0.00539
	(0.00307)	(0.00397)	(0.00301)	(0.00354)	(0.00404)	(0.00357)
L.lnenergo	0.000555	–0.0121	–0.00225	–0.00496	–0.00449	0.000784
	(0.00927)	(0.00910)	(0.00977)	(0.00839)	(0.00920)	(0.00914)
L.lnnfdi	–0.00103	–0.000465	–0.000820	–0.000638	–0.00107	–0.00111
	(0.00269)	(0.00258)	(0.00275)	(0.00257)	(0.00253)	(0.00261)
covid	–0.0507***	–0.0541***	–0.0545***	–0.0564***	–0.0499***	–0.0560***
	(0.00809)	(0.00865)	(0.00837)	(0.00862)	(0.00830)	(0.00854)
L.im_i_product	0.148**				0.148**	
	(0.0690)				(0.0688)	
L.em_i_product		–0.000467**			–0.000469**	
		(0.000196)			(0.000197)	
L.im_i_geo			0.00117*			0.00140**
			(0.000666)			(0.000625)
L.em_i_geo				–0.000610***		–0.000630***
				(0.000211)		(0.000215)
Constant	0.456	0.725**	0.479	0.707**	0.659**	0.661**
	(0.340)	(0.313)	(0.343)	(0.301)	(0.305)	(0.301)
Observations	312	312	312	312	312	312
Number of id	84	84	84	84	84	84

Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Authors' calculations, data from Rosstat, the Federal Customs Service of Russia.

garding the significance of extensive margin of export proved to be unstable. The extensive growth model produced significant results with random effects, but insignificant results with fixed effects. Therefore, it is not possible to determine the impact of increased commodity/geographic diversity of exports on economic growth in Russian regions between 2015 and 2021.

Regarding the control variables utilised in the model, several noteworthy observations can be made. Firstly, the volume of per capita investment has a positive impact on the rate of economic growth in Russian regions. Specifically, a higher volume of investment corresponds to a subsequent increase in per capita GDP growth rate, with this result attaining statistical significance across both fixed and random-effects models.

Secondly, our analysis indicates that the COVID-19 pandemic had a significant negative impact on the economic growth rates of Russian regions. Our estimations show that, holding all other factors constant, economic growth in 2020 was lower by approximately 2.7–3.0 % in the fixed-effects model and 5.0–5.7 % in the random-effects model. This finding is consistent with the recorded 3.0 % decline in Russian GDP reported by Rosstat.

Thirdly, we observe that alongside intensive margin of export, economic growth in Russian regions is also positively associated with the region's export orientation. Specifically, the greater the specific volume of exports in a region, the higher its subsequent growth rate. However, these results hold only for the random-effects model.

Finally, the study reveals that the effects of imports, foreign direct investment inflows, and energy intensity on economic growth rates in Russian regions from 2015–2021 are statistically insignificant.

We also conducted a robustness check. In the first stage, to address potential heterogeneity across regions and the presence of outliers, we estimated econometric models excluding the top 10 % of regions with the highest and lowest GDP per capita. In the second stage, the sample was divided into four sub-samples based on the level of regional development: highly developed, developed, moderately developed, and least developed. Considering the number of observations in each sub-sample, we performed regressions for

the developed and moderately developed region sub-samples. The results obtained at each stage closely align with the initial findings. Specifically, the statistical significance of the intensive product margin increased, while the statistical significance of the extensive product margin disappeared in the model with random effects. Other results remained unchanged.

4. Conclusion and Policy Implications

This study explores the impact of export on the economic growth of Russian regions in the aftermath of the first wave of sanctions in 2014. The study found a positive correlation between the intensive and extensive margins of export and the level of regional development. We hypothesised that expanding the presence in new markets and accessing new product markets (i. e., the extensive margin) positively affects the pace of economic growth in Russian regions. If confirmed, this would suggest that economic growth requires focusing on large markets that are currently restricted or closed to Russia, such as the EU and North American markets, or expanding the product structure of exports to increase global trade presence.

However, our results do not support the hypothesis. On the contrary, we revealed that higher rates of economic growth are associated with a wider market presence of the region in terms of global products and geographic reach (referred to as the intensive margin). We also demonstrated that the intensive product margin has a larger effect on economic growth than the intensive geographic margin. This means that it is more important for economic growth to increase the region's share of exported products than to increase presence in export markets. In other words, it is more important to export one product to many markets and have a relatively small presence in each than to try to increase supplies of different products to one foreign market.

We believe that our results have important implications for Russia's economic policy after the second wave of sanctions in 2022, which, according to experts, led to significant changes in the structure of the Russian economy and exports. It is important to support domestic companies in expanding their exports to the markets where they already operate and are familiar with. This is a good way to expand the company's presence in existing foreign markets with existing products, given the relatively small costs typically associated with marketing, participating in trade shows, and interacting with local trade representatives and business associations. These countries include, primarily, the BRICS countries, Turkey, as well as the Central Asian and Southeast Asian countries (such as the rapidly developing Vietnam, Thailand), and the Middle East (including Iran, Iraq, Egypt, Saudi Arabia, Turkey, Syria, and Lebanon).

It is also important to support domestic companies in entering new country markets of developing and relatively small countries. However, in conditions of uncertainty and restructuring of global value chains involving Russian companies and potential shortages of certain production inputs and semi-finished products, the priorities should not include a rapid introduction of new innovative products to the market. This should be a gradual evolutionary process, where the company, along with increasing production size and achieving economies of scale, can independently develop new products. It should not be forgotten that improving the quality of existing products can become a self-efficient and less costly way to expand export revenues compared to developing new export products.

Nonetheless, the significance of exploring new markets for Russian exports should not be underestimated. While exports make a positive contribution to GDP, simply increasing exports may not necessarily lead to per capita GDP growth. Rather, increased exports can initially lead to productivity growth and learning effects, which may ultimately drive economic growth with a lag of several years. Therefore, diversifying export flows should be pursued as an objective, and the increase in diversity should be substantiated and supported by state measures to mitigate the risks associated with enterprise activities. This is particularly important for developed regions with a diversified economic structure, as they already exhibit higher values of the extensive margin, which reflects the greater propensity of firms in these regions to discover new product and geographical markets.

Trade costs such as the distance to the importing country and the level of customs burden or availability of preferential agreements have a significant impact on intensive export growth. Although geographical distance cannot be altered, policy measures can be implemented to mitigate these costs. Such measures include facilitating market access, enhancing customs efficiency, and simplifying international trade procedures and costs. It is widely acknowledged that these factors influence export expansion.

In order to facilitate the international industrial cooperation of Russian enterprises, support measures should be tailored to the companies' exit strategies and foreign market types. Drawing on previous experiences of supporting exports of existing products to established markets can en-

hance these measures. For instance, our prior evaluations suggest that Export Support Centres (ESCs) located in the regions of Russia are more effective in expanding exports within existing markets than in exploring new ones or attracting exporters of new products to the region. While this outcome was previously viewed as a drawback of ESC activities, it can now be perceived as an advantage. Additionally, organising exhibitions and emphasising the support of small and medium-sized enterprises, along with providing a high-quality informative website, can significantly contribute to expanding medium- and high-value-added non-resource exports. Therefore, non-financial support measures and tools are just as crucial as financial ones in supporting exporters over the long term.

In conclusion, our study opens up promising avenues for future research in the field. The profound impact of the 2022 sanctions on the structural dynamics of the Russian economy, leading to significant transformations in both the commodity and geographic structure of Russian exports, highlights the need to further develop and refine the conclusions drawn from our findings. Specifically, there is a pressing need to assess the specific contributions of the intensive and extensive margins to the pace of economic growth within individual industries and product categories. Additionally, a crucial task lies in evaluating the adaptive capacity of Russian exporters to the sanctions regime and formulating targeted measures to support them, considering factors such as company size, sectoral specialisation, product diversification, and integration into global value chains. By addressing these research gaps, one can provide valuable insights for policymakers and stakeholders in shaping effective industrial policies and strategies for sustained economic growth in the face of sanctions and changing global dynamics.

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About the Authors

Anna A. Fedyunina — Cand. Sci. (Econ.), Leading Research Associate, Laboratory for GVC Studies, Ural Federal University; Scopus Author ID: 56062931900; http://orcid.org/0000-0002-2405-8106 (19, Mira St., Ekaterinburg, 620002, Russian Federation; e-mail: afedyunina@hse.ru).

Yuri V. Simachev — Cand. Sci. (Eng.), Chief Research Associate, Laboratory for GVC Studies, Ural Federal University; Scopus Author ID: 36126955200; http://orcid.org/0000-0003-3015-3668 (19, Mira St., Ekaterinburg, 620002, Russian Federation; e-mail: yusimachev@hse.ru).

Igor M. Drapkin — Dr. Sci. (Econ.), Professor, Academic Department of International Economics and Management, Ural Federal University; Scopus Author ID: 57191611854; http://orcid.org/0000-0002-5989-8463 (19, Mira St., Ekaterinburg, 620002, Russian Federation; e-mail: i.m.drapkin@mail.ru).

Информация об авторах

Федюнина Анна Андреевна — кандидат экономических наук, ведущий научный сотрудник, лаборатория исследований глобальных цепочек создания стоимости, Уральский федеральный университет имени первого Президента России Б. Н. Ельцина; Scopus Author ID: 56062931900; https://orcid.org/0000-0002-2405-8106 (Российская Федерация, 620002, г. Екатеринбург, ул. Мира, 19; e-mail: afedyunina@hse.ru).

Симачёв Юрий Вячеславович — кандидат технических наук, главный научный сотрудник, лаборатория исследований глобальных цепочек создания стоимости, Уральский федеральный университет имени первого Президента России Б. Н. Ельцина; Scopus Author ID: 36126955200; http://orcid.org/0000-0003-3015-3668 (Российская Федерация, 620002, г. Екатеринбург, ул. Мира, 19; e-mail: yusimachev@hse.ru).

Драпкин Игорь Михайлович — доктор экономических наук, профессор, кафедра международной экономики и менеджмента, Уральский федеральный университет имени первого Президента России Б. Н. Ельцина; Scopus Author ID: 57191611854; http://orcid.org/0000-0002-5989-8463 (Российская Федерация, 620002, г. Екатеринбург, ул. Мира, 19; e-mail: i.m.drapkin@mail.ru).

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