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Economic effects of pandemic-related restrictions in Russia and their spatial heterogeneity

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Relevance. The spatial dimension of economic development is always in the focus of the political and research agenda. Regional disparities, along with different rates of the spread of the coronavirus pandemic and decentralization of restrictive measures, resulted in significant differences in Russian regions' economic responses to the pandemic. The relevance of this study is determined by the need to investigate the reasons behind these regional discrepancies. **Research objective.** This study aims to analyze the economic consequences of the pandemic-related restrictions and the degree of the spatial heterogeneity of these effects in Russia. **Data and methods.** We rely on the Rosstat data to build the indicator of the level of economic activity in Russian regions in April-May 2020. We tested the hypothesis that developed regions, large cities and small businesses will suffer more, and considered the impact of the reduced demand in world markets. The significance of the factors was tested by using regression analysis. **Results.** The results of our analysis have shown that economic activity in the country decreased by almost 25% due to the lockdown measures, and in some regions, the decline in production output was more than twofold. The urban economy proved to be more resilient to the restrictive measures compared to the average business activity in the country. Due to its diversified structure, the urban system has a wider adaptive capacity and survived the first period of the lockdown with less losses. SMEs, due to their flexibility and entrepreneurial initiative, supported the economies of their regions. Larger and more developed regions, all other things being equal, suffered more from the pandemic. This influence, however, was offset by other factors, and the expected trend towards spatial convergence was not observed. **Conclusions.** While all the previous crises that Russia experienced in the post-Soviet period were accompanied by decreasing regional discrepancies, during the COVID-19 pandemic, the spatial differences, on the contrary, increased.

KEYWORDS

COVID-19, restrictions, economic activity, spatial heterogeneity, empirical analysis

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Экономические последствия ограничений, связанных с пандемией, и их пространственная гетерогенность в России

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Актуальность. Пространственный аспект экономического развития всегда находится в центре внимания политиков и исследователей. Региональные различия, наряду с разной скоростью распространения пандемии коронавируса и децентрализацией ограничительных мер, привели к значительным различиям в экономических ответах российских регионов на пандемию. Актуальность данного исследования определяется необходимостью изучения причин этих региональных различий. **Цель исследования.** Это исследование направлено на анализ экономических последствий ограничений, связанных с пандемией, и степени пространственной неоднородности этих эффектов в России. **Данные и методы.** Мы опираемся на данные Росстата для построения индикатора уровня экономической активности

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КЛЮЧЕВЫЕ СЛОВА

COVID-19, ограничительные меры, экономическая деятельность, пространственная неоднородность, эмпирический анализ

в регионах России в апреле-мае 2020 года. Мы проверили гипотезу о том, что развитые регионы, крупные города и малый бизнес пострадают в наибольшей степени, и учли влияние снижения спроса на мировых рынках. Значимость факторов проверялась с помощью регрессионного анализа. **Результаты.** Анализ показал, что экономическая активность в стране снизилась почти на 25% из-за ограничительных мер, а в некоторых регионах падение производства было более чем двукратным. Городская экономика оказалась более устойчивой к ограничительным мерам по сравнению со средней деловой активностью в стране. Благодаря своей диверсифицированной структуре городская система обладает более широкой адаптивной способностью и пережила первый период изоляции с меньшими потерями. МСП, благодаря своей гибкости и предпринимательской инициативе, поддерживали экономику своих регионов. Более крупные и развитые регионы, при прочих равных, больше пострадали от пандемии. Однако это влияние было компенсировано другими факторами, и ожидаемой тенденции к пространственной конвергенции не наблюдалось. **Выводы.** Если все предыдущие кризисы, которые Россия пережила в постсоветский период, сопровождались сокращением региональных различий, то во время пандемии COVID-19 пространственные различия, наоборот, увеличились.

БЛАГОДАРНОСТИ

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Introduction

The pandemic and subsequent decisions by the central and regional governments have created a unique situation in Russia as measures stimulating economic activity have given way to the ban on many businesses and shutdown of many firms. The promotion of various forms of cooperation, international and interregional cooperation has been replaced by restrictions on the movement of goods and on the communication of people. Although in Russia there is a general tendency to concentrate power and resources at the federal level, during the pandemic, the federal government delegated the authority to deal with its consequences to the sub-federal level.

While lockdown restrictions had a disastrous effect on many businesses such as fitness clubs and theatres, they also boosted demand for other industries, such as online retail and delivery. The decline in commodity and raw materials exports due to the falling global demand went hand in hand with a decrease in imports because of the closure of borders and channels of international relations. The latter circumstance significantly enhanced the opportunities for import substitution. In addition to the coronavirus pandemic, the socio-economic processes were affected by a sharp drop in world oil prices and the surge in oil market transactions, following the breakdown of negotiations between the OPEC and Russia.

Regional disparities, along with different rates of the spread of the pandemic and decentralization of restrictive measures, resulted in significant differences in Russian regions' economic responses to the pandemic. The most severe restrictive

measures affected air transportation, hotel and restaurant businesses, and many service industries, including the organization of leisure, entertainment, tourism and everyday life. Since these industries are concentrated in large cities, we can suppose that the urban economy would suffer more from the epidemiological measures. Since there are many SMEs in the service sector, which has been significantly affected by the lockdown, there are well-grounded concerns about the job losses and the overall damage to business activity in this sector. As the post-Soviet crises that Russia went through showed, large and dynamic regional economies tend to suffer more, while depressed and problematic regions experience less shocks and decline in production (Glushenko, 2015). Taking into account the key role of raw materials, oil and gas exports for the economies of some Russian regions as well as the current situation in the global market, it is reasonable to expect that regions with extractive specialization will show a stronger decline in production.

The aim of the paper is to study the spatial dimension of the effects of coronavirus restrictions on economic activity. Our hypothesis is that the key factors that determine the regional response to the COVID-19 pandemic are the urban economy, the abundance of SMEs, a high share of extractive industries and the high level of the region's development. We are going to construct an index of economic activity for Russian regions based on the monitoring statistics, describe an appropriate econometric model and its estimation, and investigate the changes in the spatial heterogeneity of economic activity in the country.

Theoretical framework

The unforeseen, global, and strong influence of the new coronavirus infection allows us to consider the events and their consequences as an external shock with serious macroeconomic and structural consequences, which can lead to changes in the spatial proportions of development. Theoretical studies of the spatial equilibrium change began with the “center-periphery” model (Krugman, 1991; Krugman, 1995), which introduced the idea of its multiplicity and was further developed in the studies on the new economic geography (Combes et al, 2008).

The models demonstrate that the distribution of business activity across space in the market conditions is influenced by such variables as the cost of interaction between economic agents, increasing returns on scale, size and diversity of markets.

In equilibrium, depending on the combination of these factors, a polarized or dispersed spatial structure of production and employment may develop. However, the inertia of social processes, along with the impact of geographical, historical, and cultural factors that shape the structure of business activity impede spatial; and this fact was confirmed in empirical studies.

David Weinstein (2002) tested the spatial equilibrium multiplicity on the real data and studied the impact of the bombing during WWII on the geographical distribution of economic activity in Japan. The consequences of the catastrophic external shock, which included complete destruction of several cities and radioactive contamination of vast territories, were gradually eliminated and the spatial distribution of population, industrial production, and even the output of individual industries returned to the pre-war structure. This research was followed by other studies of the effects of dramatic unexpected events on the spatial model of development: some of them concluded that the spatial equilibrium is unique (Davis, Weinstein, 2008; Brakman et al., 2004; Miguel, Roland, 2001), others argue for its change (Bosker et al., 2006; Redding et al., 2011).

Distances, interaction costs, geographical and resource-related factors, and government regulation have always played a major role in the location of business activity in Russia (Markevich, Mikhailova, 2013). Restrictions introduced to counteract the spread of COVID-19 led to a sharp increase in transaction costs, the closure or significant compression of foreign markets, and an

increase in the costs of interregional cooperation. From the theoretical point of view, all these results are important and can affect the spatial proportions of Russia’s development.

Method and Data

The analysis is based on the data from “Information for Conducting Monitoring of the Socio-Economic Situation in the Regions of the Russian Federation in January-May 2020”, published by the Federal State Statistics Service (Rosstat). This book contains indices of industrial production by types of economic activity, agriculture, construction, transport, retail trade turnover and services to the population for specific periods and by month in comparable prices. The restrictive measures were introduced at the very end of March, so the reaction to them can be assessed by looking at the dynamics of economic indicators for April – May 2020. Table 1 shows the indices of economic performance in different industries on the national level. The largest decline in business activity was observed in the service sector and in trade; manufacturing and construction were less affected, and in the mining industry, a noticeable reduction in production occurred in May with a delay of one month. These data look quite predictable. Stricter restrictions were imposed on the service sector; the restrictions were quickly lifted in construction and manufacturing; bans in trade persisted for a long time, but they were imposed only on certain types of activity.

Table 1

Indices of economic activity in Russia in January-May 2020, percentage of the corresponding month in 2019

	January	February	March	April	May
Industrial production	101,1	103,3	100,3	93,4	90,4
Mining	99,6	102,3	98,3	96,8	86,5
Manufacturing	103,9	105,0	102,6	90,0	92,8
Electric energy, gas and steam; air conditioning	95,3	99,8	97,8	98,1	95,9
Water supply; water disposal, organization of waste collection and disposal, activities to eliminate pollution	101,0	98,6	96,9	88,6	89,1
Construction	101,0	102,3	100,1	97,7	96,9
Retail trade turnover	102,7	104,7	105,7	76,8	80,8
Services	102,1	101,1	94,6	60,1	60,5

Source: Information for Conducting Monitoring of the Socio-Economic Situation in the Regions of the Russian Federation in January-May 2020, Rosstat.

Table 2

The level of economic activity in Russian regions in April-May 2020

	Ratio of economic results for April-May to February-March	Regions with the highest index values	Regions with the lowest index values
Minimum	44.2	Nenets Autonomous District – 103.8	Sevastopol – 44.2
Maximum	103.8	Republic Khakassia – 101.4	Chechen Republic – 46.0
Median	77.7	Novosibirsk region – 93.6	Republic of Dagestan – 47.7
Average	76.3	Republic Adygea – 93.4	Khabarovsk Krai – 51.2
Standard deviation	11.7	Khanty-Mansi Autonomous District – 92.3	Primorsky Krai – 52.0
Coefficient of variation	0.15	Komi Republic – 92.3	Krasnodarsky Krai – 57.0

Source: the author's evaluations.

To evaluate the level of economic activity in Russian regions, gross regional product (GRP) was used as the base indicator; the latest data for this indicator are available for 2017. It was assumed that the change in value added coincides with the dynamics of total output. Based on this hypothesis and on the information about the structure of GRP by types of economic activity as well as the growth rates of production shown by Rosstat data, volumes of output were calculated by types of economic activity: mining; manufacturing; provision of electricity, gas and steam; water supply and sanitation; construction; trade; public services¹. The total volume of output including the sum of output in these types of activities was taken as the level of overall business activity in the regions, and then the growth rate for April-May in relation to February-March 2020 was calculated. The descriptive statistics of the sample for this indicator and the list of regions with the lowest and highest indices are presented in Table 2.

Based on our estimates, we can conclude that the imposed restrictions had a strong negative impact on economic activity in the country; on average, it decreased by almost a quarter. The response to the lockdown was very spatially heterogeneous, there was a more than twofold variation in the scale of production decline in regions. At the same time, the lists of the most affected regions and the most stable ones are remarkably diverse and include territories with different specializations and levels of urbanization, different levels of economic productivity and employment structure. To identify the patterns and test the preliminary hypotheses, we need to make some econometric estimations.

¹ For agriculture and transport, the latest data in Rosstat monitoring are given for the first quarter of 2020, but there is no information for April and May 2020, so these types of economic activity were not taken into account in the calculations of the level of economic activity in the regions.

The spatial consequences of the events caused by the coronavirus pandemic have been widely discussed in the research literature and in the public sphere (Kuznetsova, 2020; Zemtsov, Tsareva, 2020; Zubarevich, Safronov, 2020). First, since significant restrictions were imposed primarily on services and leisure activities concentrated in cities, it was assumed that the urban economy and large cities would suffer more. Second, since SMEs are better represented in trade and service spheres, where more restrictions were adopted, serious concerns were expressed about the survival of small firms. Therefore, another hypothesis is that territories where SMEs are more represented will suffer more. Past crises have shown that more dynamic and successful regions, which rely more on market-based mechanisms and are less dependent on government support, respond more strongly to macroeconomic shocks. In this regard, the next assumption is that more developed and competitive regions should experience a more significant reduction in business activity. The decrease in the demand for raw materials in world markets and the crisis in the energy market, combined with the restrictive measures, negatively affected the economic development of regions specializing in mineral extraction. A widely spread view in the current research on spatial heterogeneity of the costs of the coronavirus-induced economic crisis is that the regions that suffer the most from this crisis are those that were relatively prosperous in the past, the regions with large cities and an abundance of SMEs as well as the regions with a large share of extractive industries. There are, however, alternative points of view (see, for example, Fujita, Thisse, 2002; Duranton, Puga, 2004; Puga, 2010) that large and diverse markets characteristic of urban economies can make these economies more resilient to external shocks and more adaptable. The factors that contribute to these regions' stabi-

Table 3

Correlation matrix

	Level of economic activity, %	Percentage of urban population, %	The region's share in total gross value added, %	Number of SMEs per 10,000 people, units	Region's share in total production of extracting industry, %
Level of economic activity, %	1				
Percentage of urban population, %	0,483	1			
The region's share in total gross value added, %	0,128	0,503	1		
Number of SMEs per 10,000 people, units	0,342	0,659	0,488	1	
Region's share in total production of extracting industry, %	0,381	0,323	0,518	0,116	1

Source: the author's evaluations.

lity are the flexibility of SMEs and entrepreneurial initiative of their owners, inertia of the demand and long-term contracts for the supply of natural resources.

These factors work in different directions, and the result often depends on which of them dominates.

We take the share of urban population in the region as a variable that controls for the urban component of the decline in economic activity. The territory's share in the total value added of the country is the variable controlling for the role of the size and productivity of the regional economy. The latest Rosstat data on this indicator are available for 2017 and these are the data we used in our estimations. To assess the level of small business development, we used the number of SMEs per 10,000 people. The role of the mining sector in economic activity was estimated by using the regional share in the national volume of the extracting industry.

Estimates of the correlation matrix presented in Table 3 confirm the alternative points of view described above. All linear pair relationships between the economic activity index in April-May 2020 and the tested variables were positive.

To identify the combined influence of the selected factors, the following regression equation was estimated:

$$\ln Y_i = \alpha + \beta_1 \ln U_i + \beta_2 \ln VA_i + \beta_3 \ln SB_i + \ln R_i + \varepsilon_i,$$

where:

Y_i is the economic activity index of region i in April-May 2020 in relation to February-March 2020;

U_i is the share of urban population in region i ;

VA_i is the share of region i in total gross value added (sum of GRP) in 2017;

SB_i is the number of SMEs per 10,000 people in region i ;

R_i is the share of region i in total production of the extracting industry in 2017.

The model specification was chosen in logarithms. In this case, firstly, the multiplicative form of the relationship between the tested factors is explicitly set, and, secondly, the estimated coefficients can be interpreted as elasticities.

Results

The results of OLS-estimates of the specified regression are presented in table 4. The regression estimates suggest that the assumption about cities suffering more from restrictions imposed due to the coronavirus was not confirmed. The elasticity coefficient for share of the urban population is positive and statistically significant. Even though leisure, services, and trade, which were banned to a greater extent, are concentrated in cities, a diversified urban economy has created opportunities to reduce and compensate for losses. Distance services, expanding demand for the delivery of goods and products, pharmaceutical and medical services received growth and supported economic activity in cities.

Table 4

Results of regression estimates

Variable	Coefficient
Constant	-1,991*** (0,344)
Share of urban population	0,306*** (0,098)
Share in total value added	-0,065*** (0,019)
Number of SMEs	0,070* (0,038)
Share in production of extracting industry	0,108*** (0,027)
Number of observations	83
R^2_{adj}	0,35

Source: the author's evaluations. Standard errors are given in parentheses. Significance at 90% is indicated by * and at 99%, by ***.

It would be reasonable to expect a more noticeable decline in large and economically successful territories. The weight of the region in total value added has turned out to be a negative and significant factor in the regional activity since the introduction of restrictions. The spatial distribution of the economic downturn repeated the patterns of the previous crises: other things being equal, the larger and more productive regions suffered more.

Despite the fall in prices and in global demand for raw materials and the crisis on the oil market, the resource economy, which avoided the restrictions, supported overall business activity in the regions. Regression estimates revealed a positive impact of the share of the extracting industry on the economic performance of regions during the lockdown. The decline in demand for natural resources, metals, oil, and gas might have had a delayed effect and occurred later.

The results of our analysis show that SMEs have played a positive role in maintaining production in regions; the coefficient for the corresponding variable in the regression is positive, and it can be considered significant for the risk level of 10%. In discussions of the consequences of the anti-pandemic measures in Russia, it was suggested that they would lead to mass closure of private small businesses.² However, the empirical estimates do not confirm these concerns; rather, small businesses, thanks to their flexibility and entrepreneurial initiative, have contributed to their regions' economies.

The post-Soviet crises in Russia led to a slight decrease in inter-regional disparities due to the active state support of the population and business. As a result, spatial inequality was partially compensated. Regional disparities, however, grew due to the increasing influence of market agglomeration forces in periods of economic growth.

Regression estimates revealed a negative impact of the size of the regional economy on its rate of economic development during the lockdown in April-May 2020. This fact may mean that the restrictions, which are certainly non-market in na-

² "Small and medium-sized companies to a much greater extent than large ones are exposed to external shocks, react harder to growing transaction costs and in the wake of economic crisis are first to be hit. The 2020 crisis can force many businesses to terminate their activity... Within pessimistic scenario, we can expect a severe contraction in the sector, exit of active business or final transition into informal sector of half of SMEs and reduction of employment in the sector by several millions of persons." (Zemtsov, Tsareva, 2020).

ture, as well as support measures can also lead to spatial divergence.

A widely used quantitative characteristic of heterogeneity and σ -convergence (Glushenko, 2018) is the coefficient of variation, which is the ratio of the standard deviation to the average value. Rationing to the average value allows to solve the problem of different scales of a variable. A special case of this variable is the influence of prices. Estimates of the coefficient of variation for the constructed indicator of economic activity in Russian regions for the first five months of 2020 are shown in Table 5.

Table 5

Coefficient of variation for the indicator of economic activity in Russian regions in 2020

	January	February	March	April	May
Coefficient of variation	1,87	1,95	1,87	1,99	1,98

Source: the author's evaluations.

The quantitative estimates of the variation indicate that there has been no convergence of regions in terms of business activity since the introduction of bans and restrictions at the end of March 2020. Instead, there is a growth in the disparities, the coefficient of variation increased in April compared to March by 6.4%, in May it remained almost at the same level. The negative impact of the size of the regional economy identified in the regression was offset and outweighed by other factors that had a positive impact on regional economic processes such as the diversified urban economy, entrepreneurial initiative and flexibility of SMEs, and access to mineral resources. As a result, regional imbalances have grown since the introduction of the restrictions.

Conclusions

The new coronavirus pandemic forced the Russian central and sub-federal authorities to impose a number of restrictions on different socio-economic spheres of life. In addition, the pandemic coincided with the crisis in the oil market due to the breakdown of agreements between Russia and the OPEC. These events led to significant economic losses in Russia, and the country's business activity in the first two months after the lockdown was introduced decreased by an average of a quarter. These measures affected Russian regions differently depending on the size and specialization of the latter.

The strictest restrictions were imposed on services and leisure industry, where the share of

SMEs is quite high. Therefore, it was assumed that the urban economy, where most service functions are concentrated as well as small businesses, should suffer particularly heavy losses. It was predicted that more developed regions, which always respond more strongly to crisis events, will show a more significant reduction in economic activity³. In addition, a stronger decline in production was expected in territories specializing in extractive industries, which were under additional pressure due to the falling global demand and the breakdown of negotiations with the OPEC.

The negative impact of the restrictions in regions varied in degree: some regions suffered slightly, while in others, there was more than a twofold decline in economic activity. Nevertheless, the predictions about the spatial distribution

of the impact of restrictive measures were largely unfulfilled.

The urban economy proved to be more resilient to restrictive measures compared to the average business activity indicators for the whole country. Thanks to its diversified structure, the urban system has a greater adaptive capacity, which allowed it to survive the first period of emergency measures with less losses. SMEs, despite serious concerns, turned out to be not the source of problems for Russian regions but, on the contrary, provided support for regional economies due to their flexibility and entrepreneurial initiative. Reliance on mineral resources and mining in some regions has proven to be a positive rather than negative structural element of the economy in the short term.

It was confirmed that larger and better developed regions, all other things being equal, suffered from the pandemic more. However, the impact of this factor was compensated for by other factors acting in favour of regional economies. All the previous crises that Russia experienced in the post-Soviet period were accompanied by a decline in regional discrepancies, however, this was not the case with the economic recession that accompanied the COVID-19 pandemic.

³ “For economically underdeveloped regions, the impact of the coronavirus is mitigated by a higher share of employees who receive wages from the budget system. A lower share of the service sector in agricultural regions means that they are less dependent on coronavirus.” (Kuznetsova, 2020).

“...the April 2020 crisis hit the budgets of resource-export industrial regions and major agglomerations harder. The budgets of highly-subsidized regions suffered the least due to the stable receipt of transfers and a small share of income tax in their income.” (Zubarevich, Safronov, 2020).

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