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The Ural Federal University named after the First President of Russia B. N. Yeltsin

Contact information

19 Mira St., 620002 Ekaterinburg, Russia

phone: +7 (343) 375-95-23

e-mail: r-economy@ya.ru

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Институт экономики Уральского отделения Российской академии наук

Уральский федеральный университет имени первого Президента России Б. Н. Ельцина

Контакты

Россия, 620002, г. Екатеринбург,
ул. Мира, д. 19,
телефон: +7 (343) 375-95-23,
e-mail: r-economy@ya.ru

Миссия журнала «R-Economy» – обеспечить публикацию исследований в области региональной экономики. Мы считаем сотрудничество с экономистами из стран БРИКС нашим главным приоритетом. «R» в названии журнала ссылается на три его базовых направления – Region (региональное развитие), Regulation (сравнительное изучение региональной политики) и Reconfiguration (пространственные социально-экономические и политические преобразования).

Журнал зарегистрирован Федеральной службой по надзору в сфере связи, информационных технологий и массовых коммуникаций (Свидетельство о регистрации средства массовой информации ЭЛ № ФС77-80764 от 28 апреля 2021 г.)

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Журнал включен в перечень рецензируемых научных изданий, в которых должны быть опубликованы основные научные результаты диссертаций на соискание ученой степени кандидата наук, на соискание ученой степени доктора наук (научные специальности 08.00.05 Экономика и управление народным хозяйством и 08.00.14 Мировая экономика).

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Socio-economic consequences of the first and second waves of the pandemic in Russian regions

A.A. Pobedin[1] ✉, **N.R. Balynskaya**[2], **D. Williams**[3]
[1] *Ural Institute of Management, Branch of RANEPA, Yekaterinburg, Russia; pobedin-aa@ranepa.ru*
[2] *Nosov Magnitogorsk State Technical University, Magnitogorsk, Russia*
[3] *Open University, Milton Keynes, United Kingdom*

ABSTRACT
Relevance. The spread of the coronavirus infection and the ensuing economic restrictions significantly influenced the main parameters of the socio-economic development of Russia and its territories, affecting the growth rate, production structure, territorial differentiation and competitiveness of Russian regions.
Purpose of the study. The key goal of the study was to identify the socio-economic changes in the development of the country and its regions during the pandemic.
Data and Methods. The analysis relies on open data on the socio-economic development of Russian regions for 2019–2021 (monthly, quarterly and annual periods), posted on the official website of Rosstat. Methodologically, the study is based on the comparative analysis of the data for the federal districts and their regions.
Results. The study describes the main trends in the development of industry, trade, paid services, and investment potential and in the dynamics of unemployment and income in federal districts and regions. The first wave hit Russian regions the hardest due to the rigorous restrictions. Although no sharp recession was detected during the second wave, the stagnation in the key sectors persisted. The third wave is expected to have the same impact as the second.
Conclusions. After the second wave subsided, there was a revival of economic activity in the spring of 2021. However, this has not turned into a steady trend yet. The coronavirus pandemic affected the competitiveness of regions. The importance of certain factors (including those related to resource potential) decreased during the pandemic, while the role of the competitive position of regions in the distribution of federal budget transfers increased.

KEYWORDS
regions, federal districts of Russia, pandemic, coronavirus crisis, territorial differentiation, socio-economic development, regional development, dynamics of industrial production, investments of real incomes of the population, paid services to the population, regional policy

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Социально-экономические последствия первых двух волн пандемии для российских регионов

А.А. Побединн[1] ✉, **Н.Р. Балынская**[2], **Д. Уильямс**[3]
[1] *Уральский институт управления – филиал РАНХиГС при Президенте РФ, Екатеринбург, Россия; pobedin-aa@ranepa.ru*
[2] *Магнитогорский государственный технический университет им. Г.И. Носова, Магнитогорск, Россия*
[3] *Открытый университет, Милтон-Кинс, Великобритания*

АННОТАЦИЯ
Актуальность. Распространение коронавирусной инфекции и последовавшие экономические ограничения существенно повлияли на основные параметры социально-экономичного развития как России в целом, так и отдельных территорий, затронув темпы роста, структуру производства, территориальную дифференциацию и конкурентоспособность регионов России.
Цель исследования. Ключевой целью проведенного исследования являлось выявление особенностей деформации социально-экономического развития страны и регионов в условиях пандемии.
Данные и методы. Для анализа использованы открытые данные по социально-экономическому развития регионов России за 2019–2021 годы (помесячные, квартальные и годовые периоды), размещенные на официальном сайте Росстата. Автором проведено кросс-территориальное сравнение по федеральным округам Российской Федерации.
Результаты. Выявлены основные тенденции развития промышленности, торговли, платных услуг, инвестиционного потенциала, охарактеризована

КЛЮЧЕВЫЕ СЛОВА
регионы, федеральные округа России, пандемия, коронавирусный кризис, территориальная дифференциация, социально-экономическое развитие, региональное развитие, динамика промышленного производства, инвестиций реальных доходов населения, платных услуг населению, региональная политика

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динамика уровня безработицы и доходов населения в разрезе федеральных округов и регионов Российской Федерации. Наиболее болезненным для экономического и социального развития оказалось влияние первой волны пандемии, когда действовали максимальные ограничения для субъектов экономики. Вторая волна, не вызвав резкого спада, закрепила стагнацию в ключевых секторах экономики, третья волна, как ожидается, будет иметь схожее воздействие.

Выводы. Оживление экономической активности весной 2021 года, на спаде второй волны, пока не приобрело характер устойчивой тенденции. Пандемия коронавируса повлияла на конкурентоспособность регионов, значимость отдельных факторов конкурентоспособности (в том числе связанных с ресурсным потенциалом) во время пандемии снизилась, одновременно усилилась роль конкурентной позиции регионов при распределении трансфертов федерального бюджета.

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Pobedin, A.A., Balynskaya, N.R., & Williams, D. (2021). Socio-economic consequences of the first and second waves of the pandemic in Russian regions. *R-economy*, *7*(3), 146–157. doi: 10.15826/recon.2021.7.3.013

Introduction

The COVID-19 pandemic has significantly affected the socio-economic development of both Russia as a whole and its individual territories. The impact was produced by the restrictions aimed at reducing the incidence (these measures were primarily mobility restrictions), which caused a drop in domestic demand for the products of several industries, and as a result, a decrease in the incomes of people and enterprises. Since the problem is global in nature, external factors have been added to internal factors – a decrease in demand for Russian export products combined with a decrease in the world prices for Russian exports, the instability of the Russian currency exchange rate, which increased currency risks. To all this it is worth adding the problems of sluggish income growth and sluggish economic growth in recent years.

The development trends of the country as a whole shown by the analysis of macroeconomic data do not always reflect the processes at lower territorial levels, that is, the levels of federal districts and subjects of the Russian Federation. However, without understanding the territorial characteristics, the regulation of socio-economic development, especially during crises, such as the impact of the pandemic, cannot be effective, especially for countries with a large territory and high territorial differentiation such as Russia.

The main goal of this study was to identify the impact of the pandemic on the socio-economic development of the country and its regions. To achieve this goal, the following research tasks were set:

– identify and characterize the main areas of the pandemic's impact on the socio-economic development of Russia;

– select the key indicators of the pandemic's impact on regional development;

– to describe the key trends in the socio-economic development of the federal districts of Russia during the first and second waves of the pandemic.

Theoretical framework

The pandemic and its socio-economic consequences have become the focus of attention for many studies revealing various aspects of the problems faced on the national and regional levels.

The problem of organizing regional public administration during the pandemic is considered by Vladislavleva and Kerov (2020), who demonstrate the need to strengthen economic cooperation between Russian regions in emergencies, such as the coronavirus pandemic as well as in the conditions of radical changes and risks. In addition to federal authorities and state organizations, interregional coordination agencies should play an important role in the implementation of regional policies. The previous experience of interregional associations shows that the coronavirus problem can only be solved through mechanisms of interregional cooperation. After the pandemic, to restore the regional economy, the authors recommend to specify measures in the national plan related to the search for highly effective interregional economic ties. The study emphasizes the need to reboot the state policy in the field of regional development management.

Chisadza et al. (2021) discuss the effectiveness of public administration during the pandemic and assess the efficiency of the tools for limiting the spread of the disease in different countries and regions. It was found that the correlation between the severity of anti-COVID measures and the decrease in the incidence rate is not al-

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ways visible, however, as far as the economic consequences are concerned, such a relationship can be traced quite well. Therefore, the toolkit used in various countries is based on balancing between the restrictions and possible negative consequences for the economy.

Gordeev (2020) discusses the social aspect of the pandemic in the context of regional development. The situation of the crisis caused by the pandemic is becoming decisive for regulating the prospects for socio-economic development. This study examines the social aspects of the pandemic in the context of social heterogeneity in Russian regions. The study analyzes the dynamics of the pandemic in the regions, the specifics and effectiveness of social restrictions that transform the social space.

Tarasova and Tarasov (2020) deal with the labour relations during the pandemic, in particular the effects of restrictive measures on the labour market, both in the short and mid-term. In particular, they predicted the unemployment rate for 2021 at the level of 20%. The authors pay special attention to the crisis processes in Rostov region, although the trends they describe are typical of many other Russian territories.

The socio-spatial effects of the pandemic are investigated by Kuebart and Stabler (2020) using the example of Germany. This study analyzes the key routes of movement of the population around the country, as well as the points of mass gathering of people, contributing to the incidence.

Kuchler et al. (2020) in their study pursue similar goals but study the possible directions of the spread of the coronavirus through the analysis of social connections in social networks.

Sleptsov and Potravnaya (2020) focus on the social changes in the northern regions of Russia in connection with the pandemic.

Morita et al. (2020) analyze the social activity of urban residents and conduct a comparative assessment of changing behaviour patterns of urban residents due to quarantine restrictions.

The financial and budgetary consequences of the coronavirus are discussed by Stepanova (2020), who analyzes the reasons for the increase in the deficit of regional budgets in Russia in 2020, the dynamics of income and expenditures, budget constraints caused by global problems, focusing on the aspect of the budget crisis in the context of the pandemic. She forecasts the development of the situation regarding regional budgets, discusses scenarios for further development of events. Similar problems are considered by Ermakova (2020), who also assesses the budgetary effects associated with the implementation of the package of anti-crisis measures, including those aimed at supporting small and medium-sized businesses.

Milchakov (2021) discusses the priorities for regional development in the context of the pandemic and quarantine restrictions. His analysis focuses on the program for socio-economic development of struggling regions and cities with a population of one million during the pandemic. As a result, proposals for improving certain areas of the Spatial Development Strategy are formulated.

Banai (2020) focuses on the areas of urban development, changes in the components of the urban environment in the context of the pandemic, noting that even though pandemics reveal vulnerabilities in the development of urban systems, they can be a driving force for positive trends in planning sustainable urban environment in the future.

A fairly large array of works is aimed at studying the impact of the pandemic on the structure of regional economies and their separate elements. Andrea et al. (2021) investigate the impact of the pandemic on the structure of the regional economy using the example of Italian provinces. The authors note that the territorial concentration of economic activity in certain areas of the country acts as a means of transmission, thus creating a core-periphery model in the geography of COVID-19, which can follow the key directions of interregional economic ties.

Abramova (2021) studies the impact of the pandemic on the development of small and medium-sized businesses. Tsukhlo (2021) analyzes how the spread of the coronavirus affected industrial development. Martinez-Azua et al. (2021) discuss the activities of agricultural producers. Turgel et al. (2020) focus on the differentiation of agrarian regions. Coke-Hamilton examines the impact of the pandemic on the development of the tourism sector, which was one of the industries that was hit the hardest[1]. Gössling et al. (2020) consider the impact on tourism of the current pandemic on a local and global scale. Investment processes are studied by Rodionov at al. (2021). A separate group of studies consider the transformation of spatial structures under the influence of the pandemic (Adler et al., 2020; Matheson

[1] Coke-Hamilton, P. (2020). Impact of COVID-19 on tourism in small island developing states. UNCTAD. Retrieved from: https://unctad.org/en/pages/newsdetails.aspx?OriginalVersionID=2341

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et al., 2020). Ivanov and Dolgui (2020) investigate changes in interregional trade influenced by the pandemic.

In addition to focusing on certain aspects of the impact of the pandemic, attempts are being made to gain a more in-depth understanding of its impact on regional development (Bailey et al., 2020; Zotikov, 2020; Kulova, 2020). The study by Zubarevich (2020, 2021) is of special interest in this respect. She analyzes the impact of the pandemic on the development of industry, trade, services and other elements of the regional socio-economic system. The paper makes interregional comparisons and discusses the reasons for the diverse impact of coronavirus restrictions on different territories.

This study seeks to continue the line of research based on the systemic comparison of the parameters of regional socio-economic development in the context of the pandemic. The emphasis is made on differentiating the consequences of the current crisis for different federal districts and thus provide a more comprehensive view of the entire territory of the country.

Data and methods

The research methodology is based on comparative cross-territorial analysis; traditional statistical methods, including time series analysis, indexes, grouping as well as graphical methods.

The information base of the study consists of indicators of regional socio-economic development published on the official website of the Federal State Statistics Service (Rosstat)[2].

The following indicators were selected for the analysis: industrial production index, retail trade turnover, the volume of paid services to the population, the volume of investment in fixed assets, the unemployment rate according to the methodology of the International Labor Organization (ILO), the real income of the population, the cost of the fixed set of consumer goods and services for interregional comparisons of the purchasing power of the population. When constructing the time series, the data were used for 2019, 2020 and 2021 (depending on the indicators – from January to May or the first quarter).

The research comprised the following steps. At the first stage, the main development trends were identified during the first and second waves of the pandemic at the national level. For the periodization of coronavirus waves, the official data on the incidence of COVID-19 posted on the Stopcoronavirus resource[3] were used. For the analysis of the national dynamics, the following areas of interest were chosen – industrial production, retail trade, the service sector and the labour market. At the second stage, the analysis of socio-economic dynamics at the level of federal districts and constituent entities was carried out. The federal districts were selected as the main level of analysis, the statistics on the smaller units were considered in the form of additional examples to explain the situation in a certain district. For each of the selected indicators, a comparison was made between the pre-crisis state, changes in the situation in 2020 and dynamics in January-May (or the first quarter) of 2021. At the third stage, the assessment of inter-territorial differences was carried out, highlighting the most significant features for individual federal districts and subjects of the Russian Federation. Territories sharing similar trends were united into groups. Upon completion of the third stage of the study, the main conclusions were drawn on the problems and dynamics of the country's development in the territorial context.

For calculations, construction of graphs and diagrams, Excel software package was used.

For federal districts, the following abbreviations are used: CFD – Central Federal District, NWFD – North-Western Federal District, SFD – Southern Federal District, NCFD – North Caucasian Federal District, VFD – Volga Federal District, UFD – Ural Federal District, SFD – Siberian Federal District, FEFD – Far Eastern Federal District.

Results

There were several waves in the pandemic, followed by measures on different levels and responses of the economic system as a whole. The first wave – from April to August 2020 – had a peak phase in mid-May, when the number of new cases was over 11.5 thousand per day; the second wave – from September 2020 to May 2021 – with a peak at the end of December, when the number of new cases amounted to over 29.9 thousand a day, and, finally, the third wave since June 2021, with a peak in mid-July, when the number of new cases was over 25.7 thousand a day. The first wave turned out to be the hardest for the socio-econo-

[2] https://rosstat.gov.ru/

[3] Stopcoronavirus resource. Available at: https://stopcoronavirus.rf/info/ofdoc/reports/

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mic system of the country since it was then that the quarantine restrictions were maximum (Fig. 1).

In April-May 2020, there was a sharp change in socio-economic indicators, primarily affecting the types of activities related to the services sectors (trade, public catering, transport and several others), primarily affected by quarantine restrictions. The volume of paid services reached its minimum in May, at the peak of the first wave, then, with the weakening of restrictive measures, the volume of paid services grew until September, without reaching the levels of the beginning of the year, stagnation was observed until January 2021, and only from February, there was a positive trend. The situation concerning retail developed very similarly – with minimum values in April 2020, growth resumed already from May, continuing through July inclusive, then there was stagnation until March 2021, and from April 2021 the growth resumed. The development of industry was more inert – on the one hand, the decline in production was not so sharp in the first wave – by May, the industrial production index reached 92% compared to the same month in 2019 (at that time, the indicators for paid services and retail trade were much worse – 62.4% and 82.5%, respectively), after that there was stagnation until February 2021, and from March there was resumption of growth, but at a very moderate pace (in May, the industrial production index was 111.8% by May 2020). There was an increase in unemployment, which reached its maximum by August 2020 (6.4%); later, the unemployment rate decreased, and by May 2021 it amounted to 4.9%. Thus, the second wave of the pandemic, even though the incidence rate showed peak values (almost three times higher than during the first wave), for the economic system turned out to be not as catastrophic as the first, which, of course, is due to less severe restrictive measures. During the second wave, at the national level, economic stagnation was observed, without sharp jumps. The second wave ended with a noticeable revival in the economy, which, unfortunately, has not yet acquired a stable character.

The above-described tendencies observed at the macro-level acquire additional features on the regional level. Industrial growth in the pre-crisis year of 2019 was observed in all federal districts (Fig. 2), and in three districts the growth rates were higher than the average for Russia – in the Central (107.4), Far Eastern (106.6) and Ural (106.4) federal district. In the North Caucasian, Volga and Siberian districts, industrial growth rates were lower than the national ones, while remaining positive. In 2020, the industrial production index for the Russian Federation as a whole, after the two waves of the pandemic, amounted to 97.4%. However, there were two federal districts – the Central and North Caucasus districts – which showed industrial growth. Manufacturing indus-

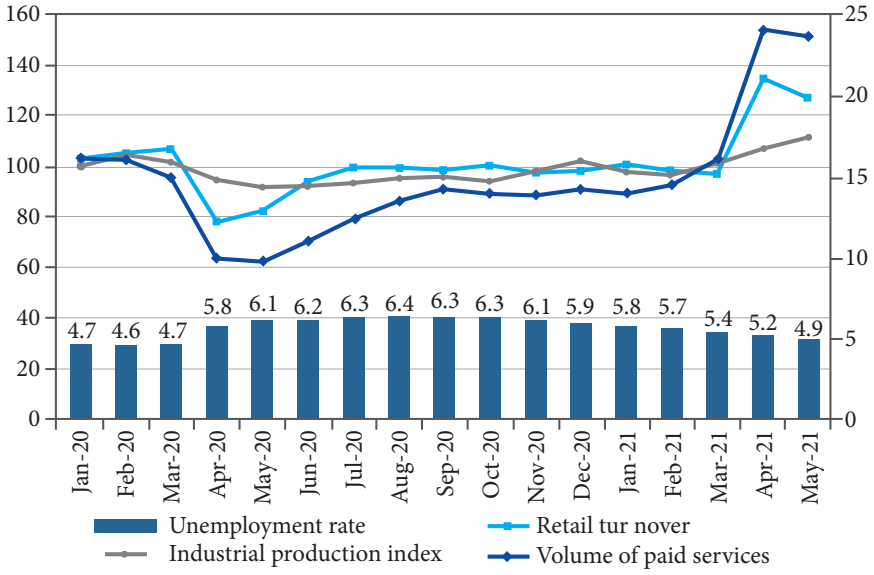

Figure 1. *Dynamics of the industrial production index, retail trade turnover, the volume of paid services to the population (in % of the same month of the previous year) and the unemployment rate according to the ILO methodology (in%) from January 2020 to May 2021 in Russia*

Source: the authors' calculations were based on the official data from Rosstat.
Retrieved from: https://rosstat.gov.ru/folder/10705 (Accessed data: 10.07.2021)

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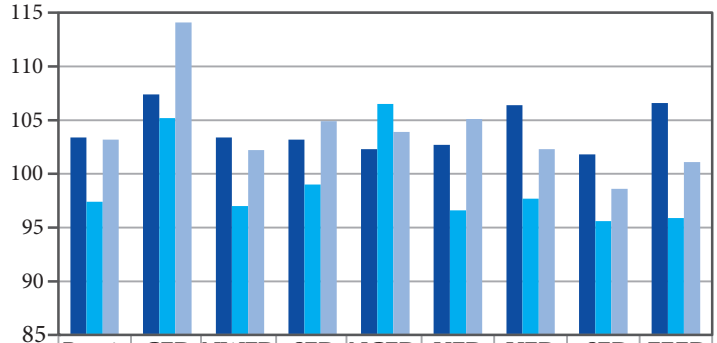
tries were less affected by the pandemic and were able, after the first wave, to significantly restore their production volumes – in the manufacturing industry, which partly explains the rapid recovery of the industry in the Central, North-Western, South and North Caucasian districts. In the Urals, Siberian and Far Eastern districts, industrial recovery was slower due to the high share of the extractive industry in the structure of the economy. The Volga and Siberian districts, with a similar ratio of processing and extractive industries, showed different dynamics – in the Volga district by May 2021, industrial production increased, in comparison with May of the previous year, by 5.1 %, which is higher than the national level. The Siberian District was unable to restore its production levels. The most problematic part of the Siberian Federal District was the Krasnoyarsk Territory, where the May volume of industrial production is still 10% lower than the previous year's figure.

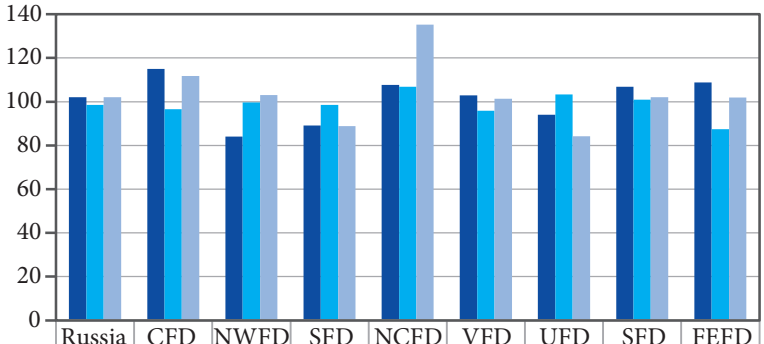
At the national level, there was an investment decline in 2020 (98.6% by 2019). However, during the first quarter of 2021, it was possible to achieve investment growth comparable to the rate of 2019 (102%). But the investment dynamics at the level of individual federal districts was not linear (Fig. 3). First of all, different federal districts performed differently in the pre-crisis year of 2019 – the highest rates of investment were observed in the Central Federal District (115%), more modest, but exceeding the national average rates of investment growth were observed in the Far East, North



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	103.4	107.4	103.4	103.2	102.3	102.7	106.4	101.8	106.6
2020	97.4	105.2	97.0	99.0	106.5	96.6	97.7	95.6	95.9
2021 (Jan-May)	103.2	114.1	102.2	104.9	103.9	105.1	102.3	98.6	101.1

Figure 2. *Index of industrial production on the national level and on the level of federal districts (in% to the corresponding period of the previous year)*

Source: the authors' calculations were based on the official data from Rosstat. Retrieved from: https://rosstat.gov.ru/folder/10705 (Accessed data: 10.07.2021)



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	102.1	115.0	84.1	89.1	107.7	102.9	94.1	106.8	108.8
2020	98.6	96.6	99.7	98.5	106.8	95.9	103.3	100.9	87.4
2021 (Q1)	102.0	111.7	103.0	88.8	135.2	101.3	84.1	102.0	102.0

Figure 3. *Dynamics of investment in fixed assets on the national level and on the level of federal districts (in comparable prices in% to the corresponding period of the previous year)*

Source: the authors' calculations were based on the official data from Rosstat. Retrieved from: https://rosstat.gov.ru/folder/10705 (Accessed data: 10.07.2021)

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Caucasus and Siberian Districts. The Volga Federal District showed investment dynamics close to the data for the Russian Federation, and in the remaining three federal districts (NWFD, Southern Federal District and Ural Federal District), investment growth rates were not only lower than the national value but also showed negative dynamics, the lowest level was in the North-Western District, where there was a decrease in the volume of investment by 15.9%, that is, even before the onset of the consequences of the pandemic, significant problems related to investment were observed in the economy, with significant differentiation between the territories of the country (at the level of individual regions, the differences are even more significant). During the crisis year of 2020, a slowdown in investment processes was observed in 6 out of 8 federal districts, while the North Caucasian Federal District and the Siberian Federal District were able to maintain positive values of investment growth, on the contrary, the sharpest decrease in the volume of investment was characteristic of the Central Federal District, where the decline was by 18.4%. The lowest value of the indicator was observed in the Far Eastern Federal District, where the volume of investment was only 87.4% of the value of the pre-crisis year. Surprisingly, for the North-Western Federal District and the Ural Federal District, the situation has improved, and in the Ural District, the volume of investment in fixed assets even increased by 3.3%. With the end of the second wave, according to the results of the 1st quarter of 2021, in some federal districts, as well as on the national level, the growth in the volume of investment resumed – this picture is typical of the Central, North Caucasian, Volga, Siberian and Far Eastern districts. In the North-Western District, investment indicators continued to improve, investment growth in the 1st quarter of 2021 was 3%. However, in the Southern and Ural Federal Districts, a decrease in the volume of investment was observed, despite the positive dynamics in 2020, and in the Ural Federal District, the volume of investment in the first quarter of 2021 amounted to only 84.1% of the same period in 2020, which is the lowest value. among the federal districts. Record-high investment growth was observed in the North Caucasian Federal District – 135.2%. Thus, during the pandemic, the differentiation between the country's territories in terms of investment attractiveness only increased, while leaders and outsiders changed very quickly, which indicates the instability of investment processes in the current environment.

In contrast to the dynamics of investment, in the development of retail trade, the dynamics in most territories are similar and correspond to the changes observed on the national level (Fig. 4). All federal districts ended the pre-crisis year 2019 with a positive increase in retail trade turnover (from 1 to 3.3%, depending on the territory). A similar situation was observed in the context of the constituent entities – the only exceptions were Arkhangelsk Region and the Nenets Autonomous Okrug, where there was a slight decrease, which, however, did not exceed 0.5%. In 2020, almost all federal districts, as well as on the national level (as noted above), faced a decrease in retail turnover, except the North-Western Federal District, which managed to restore its retail turnover to the level of 2019. At the level of individual regions, a similar result was achieved only in 13 regions (4 of which are part of the North-Western Federal District): in Moscow, Ryazan, Vologda, Leningrad, Pskov, Saratov, Chelyabinsk regions, in Tyumen region (if we exclude the indicators of the Khanty-Mansi Autonomous Okrug and Yamalo-Nenets Autonomous Okrug), in the republics of Karelia, Adygea, Chechnya, Khabarovsk Territory and Chukotka Autonomous Okrug. As the second wave was over, the retail trade turnover in all federal districts increased, demonstrating the highest growth in the Central, North-Western, Southern and North-Caucasian districts. In projection to the level of the constituent entities of the Russian Federation, this trend was observed in most territories, except the Nenets Autonomous Okrug, Murmansk, Samara, Sverdlovsk, Omsk and Tomsk regions.

The dynamics of the volume of paid services is largely shaped by the trends similar to retail trade, albeit with some peculiarities. First of all, 3 out of 8 federal districts finished the pre-crisis year 2019 with a decline in this indicator – the Southern Federal District, the North Caucasian Federal District and the Far Eastern Federal District (Fig. 5). On the regional level, the volume of paid services in 2019 decreased in 34 regions, which were struggling even before the onset of the pandemic. During 2020, in all federal districts, there was a sharp decrease in the volume of paid services, which corresponds to the general federal dynamics (Fig. 1), and in the Central, North-Western, Ural and Far Eastern districts, the decline exceeded the national level. A similar

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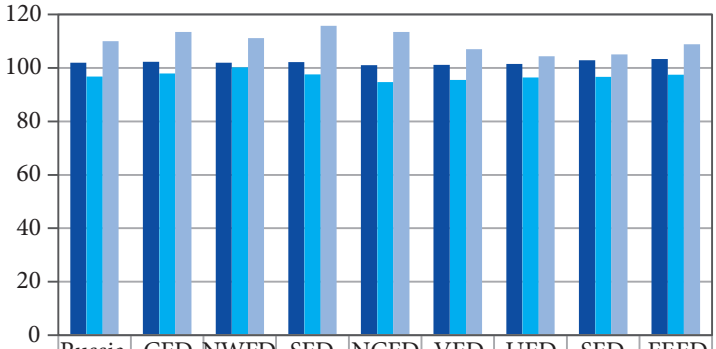
picture was observed on the regional level. From January to May 2021, the volume of paid services, compared to the same period of the previous year, increased in all federal districts. The Southern, North Caucasian and Ural federal districts exceeded the national level. The Southern Federal District reached the record high of 121.6%; the North Caucasus Federal District, 122.4%. This growth is easy to explain for the Southern Federal District which saw a high demand for resort services due to the restrictions on outbound tourism.

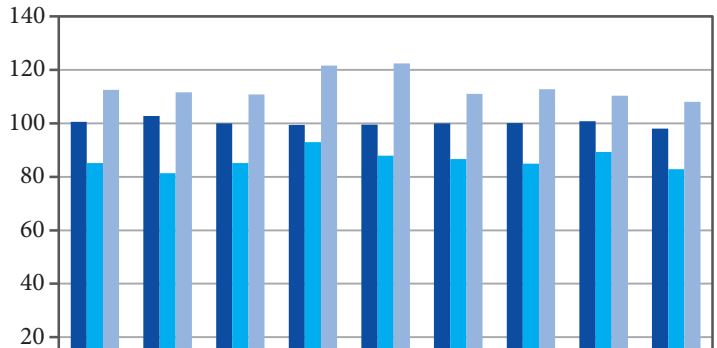
As already noted, the pandemic was accompanied by an increase in the unemployment rate (Fig. 6) at the level of federal districts. This corresponded to the national dynamics illustrated by Fig. 6: in 2020, unemployment increased in all federal districts, but in January-May 2021 the unemployment rate declined in almost all districts, except the Far East, where the number of unemployed continued to grow, and the unemployment rate reached 7%. On the regional level, in 2020 unemployment increased in all regions; by May 2021 in most territories the unemployment rate decreased (although it still exceeded the level of 2019). In some regions, the unemployment continued to grow in 2021: Lipetsk, Astrakhan, Tomsk regions, the republics of Ingushetia, Tyva, Yakutia, Buryatia, the Jewish Autonomous Region and in



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	101.9	102.3	102.0	102.2	101.0	101.2	101.5	102.9	103.3
2020	96.8	97.9	100.2	97.6	94.7	95.5	96.4	96.6	97.5
2021 (Jan-May)	110.0	113.5	111.2	115.8	113.5	107.0	104.4	105.0	108.9

Figure 4. *Dynamics of retail trade turnover on the national level and on the level of federal districts (in comparable prices in% to the corresponding period of the previous year)*

Source: the authors' calculations were based on the official data from Rosstat.
Retrieved from: https://rosstat.gov.ru/folder/10705 (Accessed data: 10.07.2021)



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	100.6	102.7	100.0	99.4	99.5	100.0	100.1	100.8	98.0
2020	85.2	81.4	85.1	93.0	87.9	86.6	84.9	89.3	82.8
2021 (Jan-May)	112.5	111.6	110.8	121.6	122.4	111.0	112.8	110.4	108.0

Figure 5. Dynamics of paid services to the population in the Russian Federation and federal districts (in comparable prices in% to the corresponding period of the previous year)

Source: authors' calculations were based on the official data from Rosstat.
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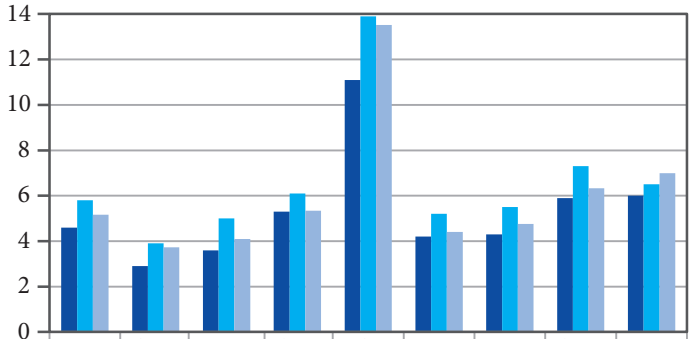
Moscow region. In Smolensk, Moscow, Kirov, and Nizhny Novgorod regions, the unemployment rate by May 2021 remained at the level of 2020, which means that the situation in the labour market remained tense, despite some improvements.

The North Caucasian Federal District, which generally follows the national trend, had the unemployment rate of 11.1% in 2019 (the maximum value for federal districts), and in 2020 it rose to 11.9%. Of the seven constituent entities of the Russian Federation that are part of the North Caucasus Federal District, in six (excluding the Stavropol Territory), the unemployment rate has not dropped below 10% since 2017, and in 2020 it was more than 14%. The record high unemployment rates were observed in Ingushetia (30%) and Chechnya (18.5%). In Ingushetia, unemployment continued to rise in 2021, reaching 31.9% by May. The structure of employment in the North Caucasus differs significantly from the rest of the regions. Outside the North Caucasus Federal District, a high level of unemployment (over 7%), even after the situation improved in March-May 2021, persists in Karelia, the Nenets Autonomous Okrug, Adygea, Kalmykia, Kurgan region, the republics of Altai, Tyva and Khakassia, Omsk, Tomsk regions, Buryatia and the Trans-Baikal Territory, and in Tyva, the figure was 18.4%, showing a worse situation even compared to 2020.

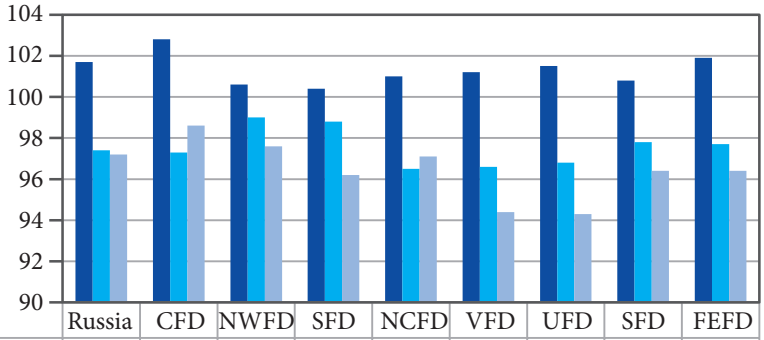
Real income levels in the pre-crisis 2019 increased in all federal districts (from 0.4 to 2.8%), which is close to the indicator for the Russian Federation as a whole (Fig. 7). During 2020, on average in Russia, real incomes of the population



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	4.6	2.9	3.6	5.3	11.1	4.2	4.3	5.9	6.0
2020	5.8	3.9	5.0	6.1	13.9	5.2	5.5	7.3	6.5
2021 (March-May)	5.2	3.7	4.1	5.3	13.5	4.4	4.8	6.3	7.0

Figure 6. *Dynamics of the unemployment rate on the national level and on the level of federal districts (in% of the labor force)*

Source: the authors' calculations were based on the official data from Rosstat.
Retrieved from: https://rosstat.gov.ru/folder/10705 (Accessed data: 10.07.2021)



	Russia	CFD	NWFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2019	101.7	102.8	100.6	100.4	101.0	101.2	101.5	100.8	101.9
2020	97.4	97.3	99.0	98.8	96.5	96.6	96.8	97.8	97.7
2021 (Q1)	97.2	98.6	97.6	96.2	97.1	94.4	94.3	96.4	96.4

Figure 7. *Dynamics of real money incomes of the population on the national level and on the level of federal districts (in% to the corresponding period of the previous year)*

Source: the authors' calculations were based on the official data from Rosstat.
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decreased by 2.6%, at the end of the 1st quarter of 2021, the downward trend in incomes continued, for most federal districts the same trend is characteristic, except the North-Western and North Caucasian federal districts, wherein the 1st quarter of 2021, where the rate of decline in real incomes decreased, but even their incomes of the population decreased. Of the constituent entities of the Russian Federation, growth in real incomes of the population was recorded in 14 regions: Nenets Autonomous District, Leningrad Region, Kalmykia, Volgograd Region, Sevastopol, Mordovia, Chuvashia, the Yamal-Nenets Autonomous Okrug, the republics of Altai, Tyva and Khakassia, Magadan Region and the Chukotka Autonomous District. However, according to the results of the 1st quarter of 2021, there was only one constituent entity of the Russian Federation where real incomes were growing – Moscow. At the same time, the cost of the fixed set of goods and services calculated by Rosstat for interregional comparisons was growing. In 2019, the increase was 4.9%; in 2020, 6.1%; and in the first quarter of 2021, 5%, which is significantly ahead of the inflation rate. Among federal districts, the maximum growth in this indicator in the first quarter of 2021 was recorded in the Ural Federal District – 6.5%. In general, the negative dynamics of real incomes impedes the country's overcoming the economic consequences of the pandemic and is a significant factor that affects the growing social tension.

Conclusions

The country's economic system and regional economies adapted to the conditions of the first and second waves of the pandemic. The sharp decline in indicators characteristic of the first wave as well as on the national level gave way to stagnation, and after the end of the second wave, even to some revival. However, the economic changes in federal districts and regions did not proceed linearly; there was a tendency towards increased interregional. Not all territories that had previously shown relatively positive dynamics were able to adapt to the new conditions to the same extent – some regions (such as the Krasnoyarsk Territory) faced significant problems, others – primarily large agglomerations – were able to quickly limit their negative dynamics, and in some cases show positive changes.

One of the striking features of the current crisis is the change in the role of the key factors of interregional competitiveness: previously one of the main dominants of success was the production of hydrocarbons, while in the current conditions this factor ceases to be decisive, as illustrates the example of the Ural Federal District and its regions. On the other hand, the factor of agglomeration development in combination with the metropolitan position remains highly significant and provides considerable advantages (for example, the Central and North-Western Federal Districts). Finally, as their own sources of income declined, both on the microlevel and on the regional level, the competition of territories for funds from the federal budget became a more decisive factor. In some cases, regions even managed to compensate for their economic losses and show high economic results – a striking example can be the North Caucasian Federal District and its constituent entities.

The third wave of the pandemic is unlikely to cause significant negative dynamics in most parts of the country, unless drastic restrictive measures are introduced by the state (so far such measures have been used only within Moscow). However, even without significant negative effects of the third wave, the country's socio-economic development is not stable, the recovery observed in the spring of 2021 is not sufficiently supported by long-term factors of economic growth, one of which should be an increase in domestic demand. The negative dynamics of real incomes of the population, observed in most territories of the Russian Federation, significantly slows down the country's recovery from the economic consequences of the pandemic and requires attention from the government.

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Information about the authors

Alexander A. Pobedin – Ph.D. Economics, Associate Professor, Head of the Department of Economics and Management, The Russian Presidential Academy of National Economy and Public Administration (The Presidential Academy, RANEPA) (66 8 Marta St., Yekaterinburg, 620144, Russia); e-mail: pobedin-aa@ranepa.ru

Natalya R. Balynskaya – Doctor of Political Sciences, Professor, Director of the Institute of Economics and Management, Head of the Department of State Municipal Administration and Personnel Management, Nosov Magnitogorsk State Technical University (38 Lenina av., Magnitogorsk, 455000, Russia); e-mail: balynskaya@list.ru

Dina Williams – PhD, Associated Lecturer, Open University (Walton Hall, Kents Hill, Milton Keynes MK7 6AA, United Kingdom); e-mail: dina.williams10@gmail.com

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Информация об авторах

Победин Александр Александрович – кандидат экономических наук, доцент, заведующий кафедрой экономики и управления, Уральский институт управления – филиал Российской академии народного хозяйства и государственной службы при Президенте РФ (620144, Россия, Екатеринбург, ул. 8 Марта, 66); e-mail: pobedin-aa@ranepa.ru

Балынская Наталья Ринатовна – доктор политических наук, профессор, директор института экономики и управления, заведующая кафедрой государственного муниципального управления и управления персоналом, Магнитогорский государственный технический университет им. Г.И. Носова (455000, Россия, Магнитогорск, пр. Ленина, 38); e-mail: balynskaya@list.ru

Уильямс Дина – PhD, преподаватель, Открытый университет (MK7 6AA, Великобритания, Милтон Кейнс, Уолтон Холл, Кентс Хилл); e-mail: dina.williams10@gmail.com

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The structural factor of regional economic stability in Russia during the coronacrisis period

O.A. Romanova ✉, **A.O. Ponomareva**
Institute of Economics of the Ural Branch of the Russian Academy of Science, Ekaterinburg, Russia; romanova.oa@uiec.ru

ABSTRACT
Relevance. The coronavirus pandemic has lead to one of the most serious crises in the global economy. The significant disparities between Russian regions influenced the levels of morbidity and their strategies of containing the crisis.
Research objective. The aim of this paper is to identify the factors of regional development which, during the pandemic and in the post-pandemic period, affected and will affect the economic stability of Russian regions.
Materials and Methods. The research is based on the Rosstat data, industry reviews, materials from analytical and consulting firms, Russian and international research literature. The research methodology is based on the structuralist approach and the provisions of the new structural economics put forward by J. Lin. The methods of comparative, statistical, and structural analysis were also used.
Results. The most significant factors in regional economic development are the structure of the economy and the quality of public administration at the national and regional levels. The high-tech sector in the structure of a regional economy plays a pivotal role in ensuring its stability in the times of crisis. The study shows the need for a transition to independent national value chains. It is also necessary to develop a long-term national strategy aimed at stimulating the structural transformation of regional economies.
Conclusions. The study has demonstrated the importance of the two key factors in shaping the regions' responses to the pandemic and the speed of their recovery – the structure of regional economy and the role of the government. These factors should be taken into account by the Strategy of the State Regional Industrial Policy.

KEYWORDS
economic structure, factors of territorial development, economic sustainability, coronavirus, high-tech manufacturing, value chain, regional industrial policy

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Структурный вектор повышения экономической устойчивости региона в период коронакризиса

О.А. Романова ✉, **А.О. Пономарёва**
Институт экономики Уральского отделения Российской академии наук, Екатеринбург, Россия; romanova.oa@uiec.ru

АННОТАЦИЯ
Актуальность. Пандемия коронавируса спровоцировала один из самых сложных и глубоких кризисов мировой экономики. Высокий уровень дифференциации субъектов РФ по последствиям его влияния на глубину экономического спада, на уровень заболеваемости населения, предопределяет актуальность выявления факторов, оказавшихся наиболее значимыми в кризисный период.
Цель исследования. Целью статьи является выявление факторов регионального развития, которые в условиях коронакризиса и в постпандемийный период определяющим образом будут влиять на экономическую устойчивость регионов России.
Данные и методы. Основой исследования явились данные Росстата, отраслевые обзоры, материалы аналитических и консалтинговых фирм, работы отечественных и зарубежных специалистов в области предварительной оценки последствий влияния кризиса на мировую, отечественную и региональную экономику. Методология исследования основана на структура-

КЛЮЧЕВЫЕ СЛОВА
структура экономики, факторы территориального развития, экономическая устойчивость, коронакризис, высокотехнологичное производство, цепочка создания ценностей, региональная промышленная политика

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листком подходе, на использовании положений новой структурной экономики Дж. Линя. Использованы методы компаративного, статистического и структурного анализа.
Результаты. Установлено, что наиболее значимыми факторами развития региональной экономики являются структура экономики и качество государственного управления на национальном и региональном уровнях. Рассмотрена роль высокотехнологичного производства в структуре экономики как фактора повышения ее устойчивости. Показана необходимость перехода к независимым национальным цепочкам создания ценности, что повышает возможность их локализации и значимость региональных участников. Обоснована значимость государственной региональной промышленной политики как системы мер, формирующих долгосрочную стратегию структурной трансформации экономики.
Выводы. Подтверждена правомерность выделения структуры экономики и возрастающей роли государства в экономической жизни общества как важнейших факторов, влияющих на экономическую устойчивость региона и скорость его выхода из кризиса. Обоснована необходимость учета данных факторов в рамках Стратегии государственной региональной промышленной политики, реализующей структурный вектор развития региональной экономики.

БЛАГОДАРНОСТИ
Статья подготовлена в соответствии с планом НИР для ФГБУН Институт экономики УрО РАН на 2021 год

ДЛЯ ЦИТИРОВАНИЯ
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Introduction

The COVID-19 pandemic has caused a severe global crisis, which is fundamentally different from all previous crises. It is not economic in nature, since it was determined not by socio-economic factors but by the factors of an exogenous, in this case biological, nature. The planetary scale of the crisis had a devastating effect on the world economy as a whole, on the economy of all national states, on all industries and spheres of economic activity without exception. The COVID Action Platform was created at the World Economic Forum in Davos, stating: "The dramatic spread of COVID-19 has disrupted lives, livelihoods, communities and businesses worldwide"[1].

The above-described circumstances prevented national governments from resorting to standard anti-crisis measures. In addition, the significant disparities between the countries (the level of socio-economic development, the structure of the economy, the volume and quality of public services) resulted in the differences in the anti-crisis measures taken by each state. The effectiveness of the measures also depended on the governments' competence and their capacity for efficient decision-making in this situation. A special role in such conditions was played by the public attitudes, opinions and beliefs, which shaped people's responses to restrictive measures. The combination of all these factors had a decisive influence on the depth of the economic recession in individual countries, on the possibility of maintaining economic stability.

Russia has demonstrated a relatively high level of resilience to the coronavirus crisis. The rate of decline in GDP was 3.0% in Russia; in Germany, 4.8%; in France, 8.0%; Italy, 8.9%, and in the UK, 9.8%[2]. In general, the rate of decline in Russia's GDP in 2020 turned out to be almost 2% lower than the average level for all G20 countries.

The system of anti-crisis measures taken in almost all countries helped to some extent to mitigate the consequences of the negative shocks. However, in order to increase the effectiveness of these measures in the face of the new waves of COVID-19, coordinated efforts are needed not only by the governments of different countries but also of regional authorities within each country.

In the light of the different socio-economic consequences of the pandemic faced by Russian regions, it is necessary to identify the factors that are the most significant for maintaining economic stability. The economic stability of a region as a socio-economic system in this context is understood as its ability to maintain a certain level of performance despite the negative changes in the external environment. The aim of the study is to identify the factors of regional development, which, during the pandemic and in the post-pan-

[1] The COVID Action Platform. Davos, the World Economic Forum. 2020. URL: https://www.weforum.org/platforms/covid-action-platform (accessed 28.06.2021).

[2] World Economic Outlook Database, April / International Monetary Fund. 2021. URL: https://www.imf.org/en/Publications/WE0/weo-database/2021/April/ (accessed: 15.07.2021); World Economic Outlook, October / International Monetary Fund, 2019. URL: https://www.imf.org/en/Publications/WEO/weo-database/2019/October/ (accessed: 15.07.2021).

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demic period, will decisively affect the economic stability of Russian regions. This research objective determines the following goals:

– to systematize and analyze Russian and international research on the factors of regional development;

– to identify the characteristics of regional economies and the most significant factors of their development in the pandemic;

– to show the importance of high-tech and value chains as structural factors of regional economy;

– to demonstrate the growing importance of government regulation in the economy and to show the role of regional industrial policies in balanced development of regional economies.

Despite the existing research literature on the consequences of the crisis (Seliverstov et al., 2021; Polidi and Gershovich, 2021; Kuznetsova, 2020; Miles et al., 2021), the topic of the structural characteristics of regional economies that determined their responses to the crisis still remains largely underexplored.

Conceptual framework and methodology

There is a body of research seeking to systematize and analyze the factors of regional development (see, for example, Zubarevich, 2010; Melnikov, 2007; Kuznetsova, 2014; Yakishin, 2019; Rodrik, 2003; Rodrik, 2013). The studies of the World Bank are widely known, where the three key factors of territorial development have been identified – density, distance, and division[3]. The interpretation by Zubarevich of the latter term as "institutional barriers" seems important for this study (Zubarevich, 2020). Equally well-known are the two groups of factors identified by Krugman: "first nature causes", which include resource availability and geographic location, and "second nature causes", including the agglomeration effect, institutional environment, and human capital (Krugman, 1991). These factors, according to Krugman, depend on the activities of the state and society.

A somewhat different approach to the typology of factors of regional development was proposed by Rodrik, who distinguishes between "direct" and "deep" factors (Rodrik, 2003). The former include endogenous factors of production – productivity and accumulation of physical and human capital. The deep factors are interpreted as exogenous and include institutions, geography, and foreign trade. The approach to the systematization of factors of regional development proposed by Kuznetsova is different. Her hierarchical five-level model developed is presented in the form of a pyramid of factors (Kuznetsova, 2014). At the bottom, there are three levels comprising the basic factors: resources and natural and climatic conditions, settlement patterns and demographic characteristics, infrastructure availability. The fourth level characterizes the level of development and structure of the regional economy, and the highest fifth level includes subjective factors, including primarily the socio-economic policy of the state. Importantly, the structure of the economy as considered as an independent factor influencing regional socio-economic development. The importance of this factor was substantiated in detail by Lin, who proposed the theory of the new structural economics (Lin, 2011).

The importance of institutional factors was emphasized in the above-mentioned works by Krugman, Rodrik, and in the studies of the World Bank. The socio-economic disparities between Russian regions was pointed out by Kuznetsova in her analysis of the general spectrum of institutional factors. In the pyramid she puts this factor at the highest, fifth level. It means that the policy pursued by the federal center in relation to the regions. This policy is the factor which can contribute to the development of regions even in the situations of crisis. The general policy set by the federal government should be turned into regional-level policies taking into account the specific characteristics and needs of the regions.

The structure of regional economies and regional policies are the key factors that determine regions' responses to the crisis and the speed of their recovery. This conclusion is confirmed by the idea of Keynes about the crucial role of the state in national economic development (Keynes, 1998, 2000). His idea of the priority of budgetary rather than monetary policy in economic regulation rings especially true in the reality of the pandemic. The following principles of state regulation developed by Perroux are also relevant in the modern world: the selective impact on economy; the possibility of uneven growth, and the active transformation of the sectoral structure (Perroux 1961)). These areas which form the basis of modern structural (industrial) policy should be

[3] World Development Report (2009). Reshaping Economic Geography. The World Bank. Washington.

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used in full measure when adjusting regional economic policies to meet the challenges of the post-COVID-19 era.

The research literature highlights the main factors that can help countries fight the pandemic and ensure a fast recovery in the post-pandemic period. According to Seliverstov et al. (2011), these include the following:

– the quality of public administration at the national and regional levels;

– the development of R&D, in particular in the pharmaceutical sphere, to create vaccines and drugs;

– the development of the high-tech sector, including the pharmaceutical industry;

– people's willingness to adhere to the restrictive measures (Seliverstov et al., 2011).

Several other factors that determine regional economic development during the pandemic are identified by Nikolaev *et al.* (2021):

– epidemiological situation;

– readiness and efficiency of the healthcare system;

– structural features of the economy;

– effectiveness of the anti-crisis policy.

Thus, the research literature describes numerous factors that affect the development of regions and determine the gravity of economic recession. In addition to the level and quality of regional healthcare systems, the availability of high-tech, primarily pharmaceutical production, both Russian and international experts pointed out the structural features of the economy as well as the quality and efficiency of the public administration system. These factors, as shown by the theoretical review, are the most significant for economic growth and the development of the regional economy as a whole.

Due to the lack of information on the socio-economic situation in the regions during the pandemic, we chose the methods of comparative and structural analysis and the method of dynamic statistical analysis. Statistical methods are used to analyze the structure of the regional economy and its development. The study uses such well-established methods as the classification of Russian regions according to the prevalence of specific types of activity in the structure of their economies. To identify the factors that have a significant impact on regional economy and determine both the depth of the economic crisis and the possibility of faster recovery, the method of systematic literature review was applied.

Results

As we have discussed above, although the economic aspects of the COVID-19 pandemic in Russia were analyzed in research literature (Kuznetsova, 2020; Mau et al., 2020; Nigmatulin et al., 2020), the regional aspect is still underexplored.

1. Structure of regional economies

Russian regions vary significantly in terms of their socio-economic development, specialization, and the COVID-19 incidence rates (Zubarevich, 2020b). An analysis of the available statistics showed that the industrial specialization of regions and cities, that is, the structural factor, had a significant impact. The structure of the economy both on the national and regional level had a decisive impact on how hard countries and regions were hit by the pandemic. At the same time, the structure of the Russian economy, not optimal by world standards, played a positive role in the second, most dramatic, quarter of 2020 and Russia had lower rates of economic decline in comparison with the USA, France, Germany, the UK, and Japan. Russia's GDP decreased by 8% compared to the same period in 2019 while in the UK, by 21.7%, in France, by 19%, in Italy, by 17.3%, and in Germany, by 11.7% (Nikolaev et al., 2021). It should be noted that the share of gross value added (GVA) of the industry in total GVA of the Russian economy during this period was 25.1%, while in the UK it was 12.2%, in France, 12.3%, and in Italy, 17.6%. Only in Germany, this figure (21.6%) is comparable to Russia (Nikolaev et al., 2021).

However, other structural components of the German economy differ significantly from the structure of the Russian economy. In Germany, the share of the service sector in GVA is about 70%, and in Russia 60% (Kuznetsova, 2020). It should be noted that in Russia, the share of simple services in the total volume of services, in particular, trade, is 1.4 times higher than in Germany. However, in Germany, the share of complex services, such as ICT, professional, scientific, and engineering activities, healthcare and social services is higher than in the sectoral structure of the Russian economy (share of GVA) by 1.9, 1.4, and 2.3 times, respectively.

We believe that the Russian economy enjoyed greater advantages during the lockdown period in comparison with its Western counterparts for the following reasons: GVA of the industry accounts for a larger share in the country's total GVA and less restrictions were imposed on the industrial

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sector, moreover, a relatively low share of services was subjected to harsh restrictions. The same factors determine the differences in the structure of GRP and economic stability in Russian regions. Significant structural components of regional economies include the share of manufacturing and wholesale and retail trade in the GRP structure. According to these two parameters, we can identify two groups of regions – industrial regions (with the share of manufacturing over 27%) and regions where the total share of services is more than 31%, and the share of trade in their GRP exceeds 17% – regions reliant on trade and services (Fig. 1, 2).

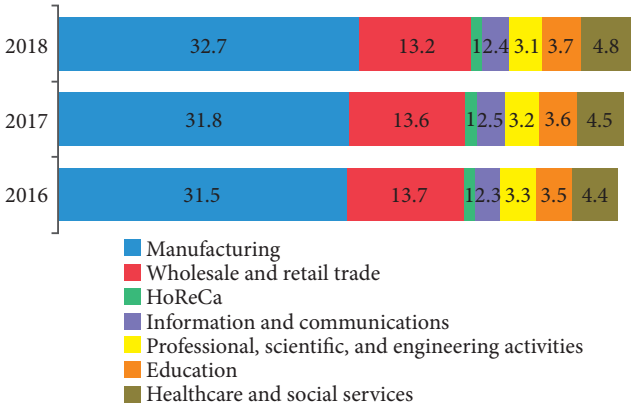

Figure 1. *Change in the structure of GRP in industrial regions, %*

Source: the authors' calculations are based on "Regions of Russia. Main Characteristics of the Constituent Entities of the Russian Federation 2020". Retrieved from: https://rosstat.gov.ru/folder/210/document/13205

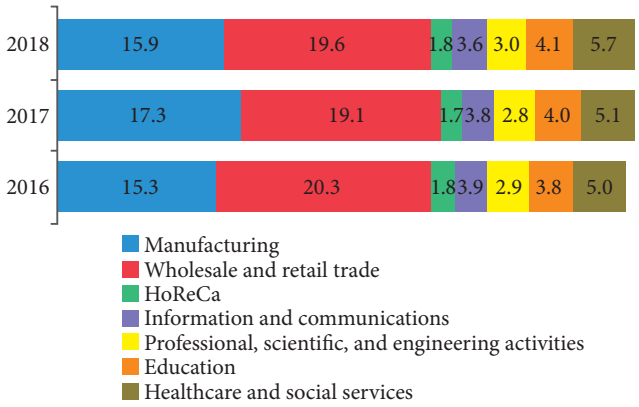

Figure 2. *Change in the structure of GRP in Russian regions reliant on trade and services, %*

Source: the authors' calculations are based on "Regions of Russia. Main Characteristics of the Constituent Entities of the Russian Federation 2020". Retrieved from: https://rosstat.gov.ru/folder/210/document/13205

An insignificant change in the structure of GRP for the two groups of Russian regions in 2016–2018 (Fig. 1, 2) shows that there have been no serious changes in the structure of regional economies. Fig. 3 shows the groups of regions depending on their incidence rates and specialization (industrial regions or regions reliant on the service sector).

The average number of detected cases of the coronavirus infection in regions reliant on the service sector is 1.4 times higher than in industrial regions. Thus, the former were hit the hardest by the pandemic.

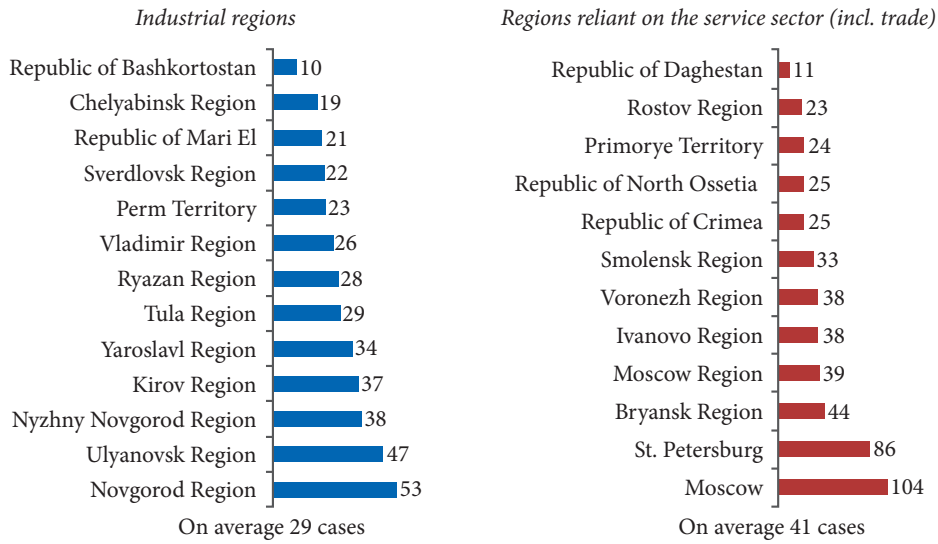

Figure 3*. The number of detected cases of the coronavirus infection in Russian regions as of June 2021, cases/1,000 people*

Source: the authors' calculations are based on COVID-19 statistics in Russia. The cumulative total as of June 26, 2021. Retrieved from: https://coronavirus-monitor.info/country/russia/ (accessed 26.06.2021)

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2. Economic structure of urban agglomerations

The structure of regional economies in Russia partially depend on the structure of the largest urban agglomerations located in these territories. An analysis of changes in the gross urban product (GUP) for 17 million-plus urban agglomerations at the end of 2020 showed that in most of them, the economic losses did not exceed the national average (Polidi et al., 2021). The decline in Russia's GDP in 2020 was 3.1%, which exceeds the decline in real GUP (within 3%) in such major agglomerations as Chelyabinsk, Ufa, Samara-Tolyatti, Perm, and Yekaterinburg. For six agglomerations, this decrease was less than 1%; for five, less than 2%; and one agglomeration (Krasnodar) showed an increase in real GUP by 2%.

Let us look at the structure of the economy of the four largest industrial cities, by the number of people employed in the most important spheres of the service sector (Table 1).

The largest share of employees in healthcare and social services (18%) at the end of 2020 was observed in Chelyabinsk. Interestingly, in comparison with other industrial regions, Chelyabinsk region had the smallest number of cases (Fig. 3).

The dynamics of the average number of employees for the most popular types of services in the current period is also worthy of interest (see Fig. 4).

Yekaterinburg has the largest number of employees in wholesale and retail trade and Chelyabinsk, the smallest. At the same time, the growth in the number of employees in this area from 2017 to the first quarter of 2021 was the largest in comparison with the change in employment for all the cities and types of services. Leaders in the field of

Table 1

Structure of employment by types of services in the largest industrial cities in 2020, %

Indicators	Yekaterinburg		Chelyabinsk		Nizhny Novgorod		Novosibirsk	
	Total	%	Total	%	Total	%	Total	%
Population by types of services, people	342,837	100%	209,845	100%	293,263	100%	315,533	100%
Including:								
Wholesale and retail trade	64,594	19%	27,814	13%	44,734	15%	44,660	14%
ICT	20,311	6%	8,046	4%	22,789	8%	17,697	6%
Professional, scientific, and engineering activities	24,554	7%	4,964	2%	26,396	9%	27,622	9%
Healthcare and social services	44,505	13%	37,130	18%	37,701	13%	46,393	15%

Source: the authors' calculations are based on the database "Indicators of Municipalities". Retrieved from: https://gks.ru/dbscripts/munst/munst.htm

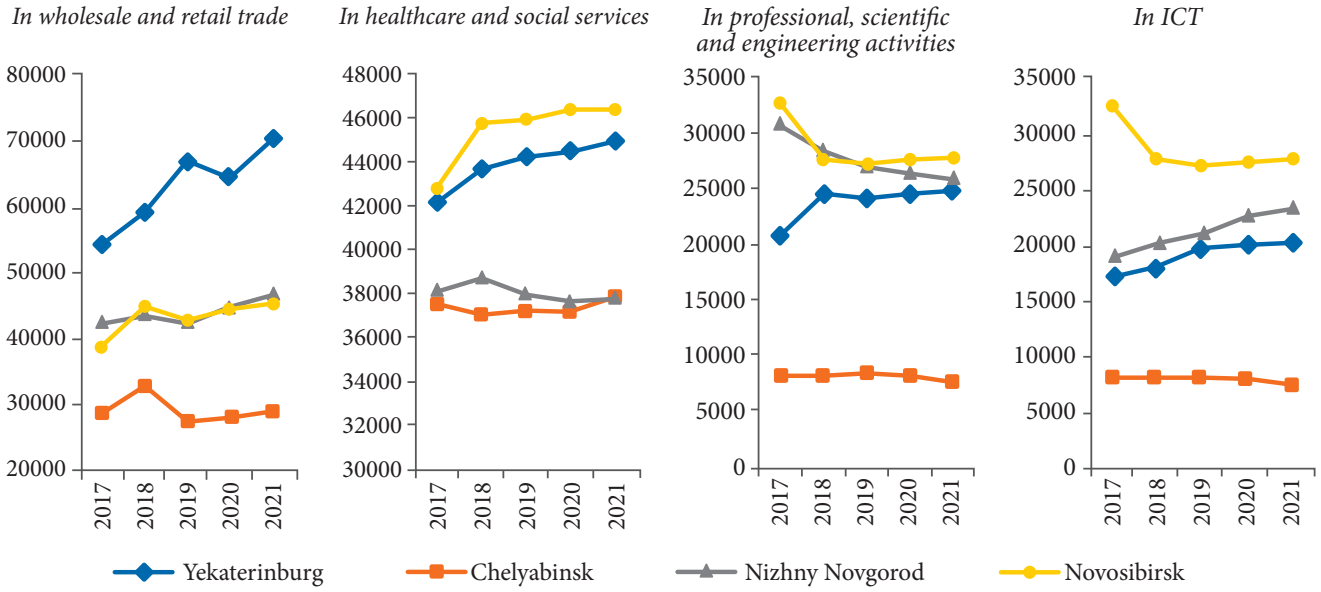

Figure 4. *Dynamics of the average number of employees by types of services, people*
Source: the authors' calculations are based on the database "Indicators of Municipalities".
Retrieved from: https://gks.ru/dbscripts/munst/munst.htm

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such complex services as professional, scientific, engineering activities and ICT are Novosibirsk, Nizhny Novgorod, and Yekaterinburg. Novosibirsk and Yekaterinburg are also the leaders in the sphere of medical and social services. The only city where there was a decrease in the number of healthcare employees is Nizhny Novgorod. This city also saw a decrease in the number of people employed in professional, scientific, and engineering activities, but, unlike other cities, the number of employees in ICT is increasing.

It is also important to look at the COVID-19 statistics and the restriction measures implemented in the regions where the above-mentioned cities are the administrative and economic centers (Table 2).

Table 2

COVID-19 statistics and restriction levels in Russian regions

Regions	Restriction levels*	Number of cases per 100 thousand people as of June 2021
Novosibirsk region	Severe	1,679
Chelyabinsk region	Very severe	1,860
Sverdlovsk region	Moderate	2,173
Nizhny Novgorod region	Mild	3,859

Note: * The level of restrictions is determined by the number of suspended activities. Source: Foundation "Institute for Urban Economics". Differentiation of regions in terms of the severity of restrictive measures in the pandemic. Moscow. 2020. Retrieved from: http://www.urbaneconomics.ru/centr-obshchestvennyh-svyazey/news/differenciaciya-regionov-po-zhestkostiogranichitelnyh-mer-v

Source: the authors' calculations are based on the COVID-19 statistics in Russia. The cumulative total as of June 26, 2021. Retrieved from: https://coronavirus-monitor.info/country/russia/ (accessed 26.06.2021)

We believe that only a qualitative assessment of the relationship between the structure of the economy, the level of restrictions, and the number of cases is possible. However, interestingly enough, in Novosibirsk region, where the restrictions were rather rigorous, the number of cases per 100 thousand people as compared to other regions was minimal, while in Nizhny Novgorod region the restrictions were milder but also the number of cases was higher. In Sverdlovsk region, which has the highest number of employees in wholesale and retail trade, the restrictions were moderate and this could have contributed to the high level of morbidity. Thus, in large urban agglomerations, the prevalence of the share of services in the structure of the economy is one of the factors affecting these cities' vulnerability during the pandemic.

3. The role of the high-tech sector in the economic stability of regions

The pandemic has increased the importance of the high-tech sector and R&D both in overcoming the crisis and solving he current problems of socio-economic development. The term "transformational research" reflects the global trends of prioritizing exploratory research focused on practical results. Transformational research is understood as the process which re-orients fundamental research towards solving practical goals dealing with the transformation of the socio-economic system (Dezhina et al., 2020). A special role in such research in Russia can be played by medium-sized, mainly private, technology companies, which demonstrate not only high growth rates and labor productivity but also spend a lot on R&D (9–14% of their revenue) (Dezhina et al., 2020). The operation of these companies and their support by regional authorities can contribute to progressive structural changes in the economy of the regions where these business structures are located. Today they are not the main beneficiaries of the government's investments in R&D, but this situation may change.

Policy-making aimed at ensuring long-term structural transformations in Russian regions and in the country as a whole should prioritize the development of the IT sector and an increase in the share of high-tech services in all sectors of the economy. There is evidence that companies that remain innovative during crises gain significant advantages over their competitors during the period of economic recovery (Bar, 2020).

The analysis of the problems faced by Russian enterprises in the high-tech sector in connection with the COVID-19 pandemic carried out by the Institute for Statistical Studies and Economics of Knowledge (ISSEK) of the Higher School of Economics (Vlasova, 2021) shows that the most affected type of innovative activity was scientific and industrial cooperation. About half of the high-tech industrial enterprises have reduced or completely stopped interactions with Russian universities and research organizations (Simachev, 2021). Interactions with other counterparties have also significantly decreased. At the same time, over 80% of high-tech companies announced that they expected to intensify and improve their production processes in 2021. Almost two-thirds of enterprises in the high-tech sectors are planning to innovate and intensify their own R&D. However, less than a half of the companies (47%) are planning to establish new partnerships

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with research organizations and universities. In these conditions, it becomes problematic to conduct "transformational research" aimed at transforming, primarily in the structural aspect, regional socio-economic systems.

4. Value chains during the coronacrisis

The coronavirus pandemic has raised structural problems not only in regional and municipal economies; it also exacerbated the problems related to value chains. Due to the strong interconnections between the industries and the length of these chains, they were especially vulnerable to pandemic shocks: there were some serious disruptions in value chains and in supply chains. In this regard, an urgent task to be addressed is to help the chains adapt to the crises of the world economy and to get a better understanding of the role played by regional participants (2020; Varnavsky, 2021)[4].

The limitations of globalization associated with the increasing political and economic risks and the growing share of services in developed and developing countries reduce the importance of cooperative supplies and value chains, the latter being needed more in the production of goods, rather than services. In addition, the length of production chains tends to decrease as production sites are getting closer to end-users.

Thus, in the changing world, a new approach to assessing the efficiency of production location is gaining currency as independent national supply chains are strengthened and the significance of regional participants is growing. The real transformation of value chains creates incentives not only for business entities and regional authorities but also for governments to develop possible options for the creation of more stable structures. Regionalization of chains can increase the stability of value chains and their adaptability to various kinds of shocks. In turn, the localization of value chains will help to increase the resilience of regional economies to external risks, making them more dynamic and responsive to the constantly changing consumer preferences.

5. Regional economic policy

The coronavirus pandemic has resulted in a tremendous increase in the importance of digital technologies and stimulated digital transformation in various sectors of economy. However, it also exacerbated regional disparities. All of the above increases the importance of the role played by the government in the national economy (Romanova, 2020). In addition, the extreme polarization of socio-economic development in Russian regions complicated the situation for the regional governments struggling to ensure the sustainable development of their territories.

Center and regions. At the federal level, in April-May 2020, the Russian government developed three packages of measures to combat the pandemic, which also included measures to support the economy and people. The first package of measures was aimed to provide significant support for SMEs (halving the rates of social insurance payments, credit holidays); it also included a program of preferential loans for paying wages, and financial support for affected industries. The total volume of this package was 0.3–0.4% of GDP. The second package of measures, which included some support for regional budgets, strategic enterprises, and additional payments to healthcare staff, amounted to about 1% of GDP. A specific feature of the third and largest package was direct payments to the population. However, according to a number of experts, the volume of resources allocated for combatting the pandemic in Russia was clearly insufficient, because the National Wealth Fund and the country's foreign exchange reserves made it possible to strengthen support for both the people and business (Aganbegyan, 2020).

The alarming situation resulting from the rapid spread of the coronavirus caused serious changes in the distribution of powers between the center and the regions. Since April 2020, in accordance with the Decree of the President of the Russian Federation No. 239, regional governors have been made responsible for the development and implementation of measures aimed at ensuring public health and combating the coronacrisis as well as maintaining economic activity[5]. Despite the obvious expediency of such solution, in Russian regions, it created serious economic problems, because the regional authorities applied measures to combat the pandemic based not so much on the significance of the problems but the availability of

[4] COVID Action Platform (2020). Davos, World Economic Forum. Retrieved from: https://www.weforum.org/platforms/covid-action-platform (accessed 12.10.2020).

[5] Decree of the President of the Russian Federation of April 2020 No. 239 "On measures to ensure the sanitary and epidemiological well-being of the population in the territory of the Russian Federation in connection with the spread of the new coronavirus infection (COVID-19)". Retrieved from: http://www.consultant.ru/document/cons_doc_LAW_349217/ (accessed: 22.06.2021).

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resources. Since Russia, unlike many other countries, did not declare a state of emergency in the country as a whole, the regions made independent decisions on the introduction of various restriction options. Forty-five regions introduced a high alert, the rest, depending on their incidence rates, introduced restrictions of other levels[6].

The introduction of restrictive measures by regional governments has gradually reduced the number of cases. However, at the same time, there was a sharp decline in demand and in the income of households, the activity of a significant part of the service sector all but ceased, and so on. In order to support business, all 85 Russian regions introduced various economic measures: tax incentives, postponement or reduction of rental rates for small businesses as well as for the most affected industries. In total, 839 economic measures were used in the regions, 45% of which were tax and 55% non-tax (Seliverstov et al., 2021).

The consequences of the transfer of the responsibility for combating the pandemic to regional governments led to a significant increase in their expenditures. More than a half of Russian regions are experiencing an increase in their budget deficit. The discrepancies between the responsibility of regional authorities and the real resources they have at their disposal have grown significantly.

The opinion of a group of Russian experts about the changes in the sustem of regional government during the pandemic was best summarized by Pertsev, who described the asymmetrical 'center-regions' relationship as 'a vertical with no obligations that works mainly in one direction – [the centre] takes a lot but gives little in return' (Pertsev, 2020). At the same time, it seems reasonable to decentralize decision-making to combat the coronavirus, to transfer responsibility and authority to the regional level, which helped to reduce the rate of the COVID-19 spread nationwide.

6. Regional industrial policy

The importance of the regional industrial policy during the pandemic is increasing not only because it is a tool that helps solve the current economic tasks but mainly because it is a tool for building a long-term policy of structural transformations in line with the modern technological trends (Romanova, 2018a; Romanova, 2018b; Tambovtsev, 2017). More attention is now paid to the development of strategic rather than tactical measures to ensure the long-term sustainability of economic development, increase the resilience of SMEs and other types of enterprises. The governments of 33 developed and developing countries implemented measures to support the digitalization of their economies, and the government of 30 countries supported innovation in the manufacturing and service sectors (Gafurova and Kovaleva, 2021).

The most important goal of a regional industrial policy in the modern period is not only ensure economic stability but also to build a strategy for the economy's structural transformation. The development of interregional cooperation, the use of opportunities for horizontal cooperation between regional authorities should find an important place in such a strategy (Turgel and Usoltseva, 2020). The institution of the plenipotentiaries of the President in federal districts mostly worked as a control body, which, of course, is an important function in the times of crisis. As for the organizational functions, however, the plenipotentiaries' performance left much to be desired, especially in terms of their contribution to the development of horizontal cooperation, mobilization of the regions' resources, which were extremely limited, and joint action to combat the pandemic.

An important task is to ensure the balance of these functions because the already existing interregional socio-economic disparities together with the possibilities of attracting highly qualified personnel can lead in the post-pandemic period to an even greater inequality of regions, primarily to digital inequality. Therefore, in regional strategies, an important place should be given to priorities related to the digitalization of the real and service sectors. It is also important to invest in the development of ICT and in medical and pharmaceutical research.

Conclusion

The study identifies two factors that affect the economic stability of regions and the speed of their recovery from the crisis – the structure of the economy and the increasing role of the state in the economy. The combination of these two factors makes regional socio-economic systems more stable in the face of the pandemic shocks, that is, an optimal balance is maintained between the level of economic activity in regions and public health protection. Other tasks include diversi-

[6] Information on the introduction of passes or restrictions on movement in the regions (some municipalities) of the Russian Federation based on the regulations published as of July 15, 2020. Retrieved from: http://base.garant.ru/77398959/ (accessed: 20.06.2021).

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fication of the economy, maintaining and developing the industrial potential; and optimization of the service sector.

A special role in this process is played by the government's industrial policy. Its implementation is regulated by the Federal Act "On Industrial Policy in the Russian Federation". However, this regulation does not actually take into account the territorial factor, which was the reason for the development of the "Strategy for the Regional Industrial Policy of the Russian Federation until 2024 and for the Period until 2035"[7] by the Ministry of Industry and Trade of Russia. The draft Strategy describes measures for targeted support of individual regions and macro-regions, taking into account not only their industrial specialization but also the interests of national security. Importantly, the Strategy highlights the need for advanced industrial development of struggling regions. The priority is to build value chains by strengthening industrial cooperation and by localizing value chains within Russia. The implementation of the Strategy can help not only increase the economic stability of regions, but also stimulate the struggling regions to make the most of their resources, to benefit from interregional cooperation, primarily within their federal districts, and receive real support from the federal center.

[7] Draft Strategy for the regional industrial policy of the Russian Federation until 2024 and for the period until 2035. Retrieved from: https://minpromtorg.gov.ru/docs/#!strategiya_regionalnoy_promyshlennoy_politiki_rossiyskoy_federacii_do_2024_goda_i_na_period_do_2035_goda (accessed: 20.06.2021).

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Information about the authors

Olga A. Romanova – Chief Researcher**,** Doctor of Economics, Professor, Institute of Economics, the Ural Branch of the Russian Academy of Sciences (29, Moskovskaya Street, Yekaterinburg, 620014, Russian Federation); e-mail: romanova.oa@uiec.ru

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Alena O. Ponomareva – Junior Researcher, postgraduate student, Institute of Economics, the Ural Branch of the Russian Academy of Sciences(29, Moskovskaya Street, Yekaterinburg, 620014, Russian Federation); e-mail: ponomareva.ao@uiec.ru

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Информация об авторах

Романова Ольга Александровна – ведущий исследователь, доктор экономических наук, профессор, Институт экономики Уральского отделения Российской академии наук (620014, г. Екатеринбург, ул. Московская, 29); e-mail: romanova.oa@uiec.ru

Пономарёва Алёна Олеговна – младший научный сотрудник, аспирант, Институт экономики Уральского отделения Российской академии наук (620014, г. Екатеринбург, ул. Московская, 29); e-mail: ponomareva.ao@uiec.ru

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The economic and organizational model of the international admission campaign during the COVID-19 pandemic (the case of the Moscow Institute of Physics and Technology)

A.D. Oykher
Moscow Institute of Physics and Technology, Moscow, Russia; anna.oykher@gmail.com

ABSTRACT
Relevance. In the face of the COVID-19 pandemic, universities all over the world had to deal with a major challenge – transition from face-to-face to online learning. It was necessary to make this transition without damaging the quality of education and the transparency of examinations, especially entrance examinations taken by international students. The number of the latter fell significantly because of the pandemic and the competition for overseas students became especially fierce. One of the optimal solutions to the problem of conducting entrance exams during the pandemic was the online proctoring system.
Research objective. This research aims to assess the economic efficiency of the online proctoring system by looking at the case of the Moscow Institute of Physics and Technology (MIPT).
Data and methods. The article compares the most popular online proctoring systems on the market and used by universities in Russia and other country. Furthermore, it analyzes the results of the international admission campaign in 2020 and the economic effect of the in-house proctoring system in comparison with other readymade solutions.
Results. The research results showed that the MIPT's in-house proctoring system is no less efficient than the most popular readymade systems used by the majority of universities in Russia and worldwide, yet the costs of developing and operating the university's own system are significantly lower.
Conclusion. The development of an in-house online proctoring system can increase the economic efficiency of universities in terms of international admission in the forthcoming years.

KEYWORDS
online-proctoring, international admission, international students, admission campaign, economic efficiency, cost effectiveness, education abroad, blended-learning, higher education

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Экономическая и организационная модель международной приёмной кампании во время пандемии COVID-19 (на примере МФТИ)

А.Д. Ойхер
Московский физико-технический институт, Москва, Россия; anna.oykher@gmail.com

АННОТАЦИЯ
Актуальность. В условиях пандемии, начавшейся в 2020 г. в разгар кампании по приему иностранных студентов, вузы по всему миру столкнулись с серьезным вызовом – необходимостью перевода обучения и различных видов экзаменов в дистанционный формат. При этом было необходимо осуществить этот переход без ущерба для качества обучения и прозрачности проведения экзаменов. Кроме того, это было критично для вступительных и отборочных мероприятий для абитуриентов из-за рубежа, – так как их количество, ввиду существенного снижения спроса на обучение за рубежом, было существенно ниже вследствие пандемии, и, соответственно, конкуренция вузов за них была крайне высокой. Одним из наиболее оптимальных решений этой задачи является использование системы онлайн-прокторинга.

КЛЮЧЕВЫЕ СЛОВА
онлайн-прокторинг, набор иностранных студентов, иностранные студенты, приемная кампания, экономическая эффективность, рентабельность, образование за рубежом, смешанное обучение, высшее образование

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Цель исследования. Целью данного исследования было оценить экономическую эффективность использования системы прокторинга для университета при наборе иностранных студентов на примере Московского физико-технического университета (МФТИ).
Данные и методы. В статье был проанализирован опыт использования в вузах системы онлайн-прокторинга, проведено сравнение наиболее популярных систем, предлагаемых на рынке и используемых зарубежными и российскими университетами. Проанализированы итоги кампании по набору иностранных студентов в 2020 году и экономический эффект применения собственной системы прокторинга в сравнении с использованием готовых решений, предлагаемых на рынке.
Результаты. Результаты исследования показали, что применение собственной системы не уступает по функционалу наиболее популярным готовым решениям, услугам которых сегодня пользуется большинство университетов за рубежом и в РФ, при этом затраты на разработку и эксплуатацию собственной системы – существенно ниже и, что немаловажно, в основном не являются постоянными.
Заключение. Учитывая текущую эпидемиологическую ситуацию, результаты исследования показывают, что разработка собственной системы онлайн-прокторинга могут повысить для вузов экономическую эффективность набора иностранных студентов в ближайшие годы.

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Introduction

The COVID-19 pandemic, which began in 2020, has become a real test for higher education systems around the world. For the first time in history, university education faced the threat of being put on hold for such a long period of time (without any certainty regarding how long this situation may last). Universities managed to continue their courses with the help of distance learning technologies (Huang et al., 2020, Grande-de-Prado et al., 2021). With the exception of subjects requiring laboratory or other special equipment (these subjects were moved to later semesters), almost every lesson was eventually moved online (Alessio & Messinger, 2021, Johnson et al., 2021, Chung et al., 2020, Graham, 2019, Reedy et al., 2021).

However, the difficulties faced by universities and students and/or applicants were not limited to the educational process. There were other significant consequences of the pandemic and the general lockdown: these included rescheduling and cancellation of international events, for instance, partnership weeks and other significant networking events where real-life communication plays an important role (according to the EAIE, these effects were mentioned by 20% of respondents – representatives of European universities) (Rumbley, 2020). Other problems included difficulties in communication with internal and external partners (migration authorities, municipal authorities, partner universities, etc.) (mentioned by 16,9% of respondents) (Rumbley, 2020), an abrupt end to extracurricular activities and extracurricular interaction with other students, professors[1], etc.

Despite the unpredictable epidemiological situation, according to the report of the Ministry of Science and Higher Education of Russia, almost every university showed its preparedness to mobilize and work in a new mode and thus maintain a sense of stability for the faculty and students (Klyagin et al. 2020). The most successful up-to-date practices of Russian universities of adapting their educational process to the reality of the pandemic are described on the website of the Association of Global Universities *Keep on studying. Keep on teaching*[2]. For instance, there is a website created by the St.Petersburg Electrotechnical University specifically to support applicants who have chosen difficult subjects for their final exams[3]. Other online solutions include the

[1] Lessons of the Stress Tests. Higher education during the pandemic and after. Analytical report made by university rectors and working groups (edited by Barannikov K.A et al.) (In Russ.) Retrieved from: https://www.hse.ru/data/2020/07/06/1595281277/003_%D0%94%D0%BE%D0%BA%D0%BB%D0%B0%D0%B4.pdf

[2] Resource for supporting students and professors of Russian universities Keep on studying. Keep on teaching in Russian). Retrieved from: https://od.globaluni.ru/keep-learning/practices/?sectionId=193&page=1

[3] Case of supporting applicants in choosing traditionally complex subjects, platform solutions (Kupriyanov M.S., Chirtsov A.S., ETU "LETI") (In Russ.) Retrieved from: https://od.globaluni.ru/upload/medialibrary/812/81240a4e3c-90881c1aabeb2cc7769dec.pdf

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Digital Assistant of the ITMO University[4], lecture broadcasting in virtual MIPT classrooms[5], student navigator for distance learning of Immanuel Kant Baltic Federal University[6], and so on.

A special place in the practices of Russian and international universities is occupied by online proctoring in conducting entrance and midterm exams. Proctoring is a procedure of monitoring and controlling remote exams (Jia & He, 2021).

The purpose of this research was to assess the economic efficiency of the proctoring system for international admissions by using the case of the Moscow Institute of Physics and Technology (MIPT). This research objective determined the following tasks: first, to analyze the use of the online proctoring system in Russia and other countries; second, to identify the peculiarities of the online proctoring program developed by the MIPT in comparison with other systems used around the world; and, finally, to estimate the economic impact of the proctoring system during the international admission campaign at the MIPT in 2020.

Background

During the pandemic, the number of international applicants to Russian universities fell dramatically (this happened mostly for economic and psychological reasons), which made the competition for them even more fierce. This, in turn, made the problem of organizing entrance exams online and ensuring their transparency even more important.

According to the survey conducted by the International Association of Universities, one of the main problems faced by universities during the pandemic was the decline in the number of international applicants (this effect was mentioned by 46% of respondents)[7]. In the report of the website about education abroad Educations.com (*The Impact of COVID-19 on Study Abroad: April 2020 Survey Results,* dated April 24, 2020)[8], only 5,4% of the respondents who had previously planned to study abroad answered that they wanted to go through with the admission; 13,5% planned to postpone their enrollment; 5,4% wanted to cancel the whole process; and 38,8% found the question difficult to answer. These data clearly show that uncertainty, fear for one's health, difficulty in predicting how the situation will develop and many more factors significantly reduced the demand of international students and only 5,4% of those who had expressed their desire to study abroad before kept their decision. Therefore, universities had to switch to new models of student selection and teaching faster and more efficiently than their rivals (Kuh, 2005).

Apart from the difficulties associated with the transition to online learning, universities faced one more problem – the difficulty of ensuring transparent and fair entrance exams. In Russia, this problem was particularly urgent for midterm exams, final exams, diploma and thesis defense, and so on. This was also the case with entrance exams organized for overseas applicants since the vast majority of Russian students take the Unified State Exam, which serves both as school finals and as university entrance exam (Li et al., 2021). A study conducted by the Ministry of Science and Higher Education of the Russian Federation showed that more that 70% of respondents feared that the chances of cheating at online exams would be higher. A possible risk of dishonest behavior among students during online exams conducted without a special surveillance system was described in previous research (Dawson, 2015, Kitto & Saltmarsh, 2007, Corrigan-Gibbs et al., 2015).

If face-to-face examinations were for some reasons impossible, universities actively used online testing systems (Collis & Moonen, 2004, Shraim, 2019, Anderson, 2008). During the pandemic, these systems were successfully used not only by the leading Russian universities (e.g. the proctoring system of the ITMO University based on the National Open Education Platform[9]; the MIPT proctoring system[10]; *OMV* proctoring sys-

[4] ITMO University Avatar Project is Now in Beta Testing (ITMO official website, A. Nikulina). Retrieved from: https://news.itmo.ru/ru/science/it/news/9696/

[5] Watch live streams using virtual classrooms (MIPT official website, news section) (In Russ.) Retrieved from: https://mipt.ru/education/elektronnoe-obuchenie/news/news200831

[6] Introducing a demo version of the navigator on distance learning for students of Immanuel Kant Baltic Federal University (Immanuel Kant Baltic Federal University official website, news section) (In Russ.) Retrieved from: https://kantiana.ru/news/studencheskie/predstavlyaem-demoversiyu-navigatora-studenta-bfu-im-i-kanta-po-distantsionnomu-obucheniyu/

[7] International Association of Universities. The Global Voice of Higher Education. Retrieved from: https://iau-aiu.net/Covid-19-Higher-Education-challenges-and-responses

[8] The Impact of COVID-19 on Study Abroad: April 2020 Survey Results (Abby Guthrie Svanholm). Retrieved from: https://institutions.educations.com/insights/student-survey-covid-19-and-study-abroad

[9] National platform for open education (Instructions for passing midterm and final attestations using ITMO proctor system) (In Russ.) Retrieved from: https://openedu.ru/proctoring-manual-itmoproctor/

[10] MIPT platform for online-testing. Retrieved from: https://exams.mipt.ru/

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tem of Peter the Great St. Petersburg Polytechnic University[11]) but also by regional universities (e.g. the Vyatka State University used a proctoring system for defense procedures)[12].

The Moscow Institute of Physics and Technology (MIPT) is a leading Russian university with a focus on training specialists in physics, mathematics, IT, biology, biomedical physics and related disciplines. The problem of selecting applicants from non-CIS countries has been relevant for a long time, first of all in terms of conducting entrance exams and to ensure transparent and efficient midterm testing. In order to solve this problem, at the initiative of the university's International Department, in 2019, an in-house proctoring system was developed.

Today, proctoring is actively used at universities around the world (Linden & Gonzalez, 2021) – the COVID-19 pandemic and transition to distance learning forced universities to apply this technology on a larger scale – not only to international but also to local students (Grajek, 2020). Therefore, at present, the topic of the proctoring system usage at universities has become more relevant than ever, many publications of 2021 are dedicated to this topic (Raman, R. et al,2021; Kharbat, F.F., Abu Daabes, A.S., et al., 2021)

Today the most popular services used worldwide are as follows: *ProctorUlive+* and *Proctor Track Proctor Live AI* (for real time monitoring); *Proctorio*, *Proctor Urecord+* and *review+*, *Respondus Monitor*, *Proctor Track Proctor Auto and QA*, *Integrity Advocate*, *Examity*, *HonorLock* (for checking exams with post-review function) and *TopHatTest* (this service allows not only to automatically follow the activity on the student's personal computer (if there are any applications opened, etc.) – this system, in our opinion, is ineffective and may be used for a limited number of tests).

In Russia, the company *Examus* has developed a service called *Examus.Proctoring,* which has practically monopolized the sector. There are a lot of leading Russian universities that cooperate with this company, such as the Higher School of Economics, Financial University, Ural Federal University, RANEPA and many others. The company offers three options for conducting exams: automatic (the system independently verifies the student's ID, observes their behavior, direction of their gaze, analyzes sound in the room, records violations on video and prepares reports); asynchronous (post-viewing video mode, which allows to check automatic notifications of the system about recorded violations); and synchronous (proctors monitor students in real time). The fundamental difference between the systems like Examus.Proctoring and the system implemented in the MIPT is that unlike ready-made tools, the in-house system of the MIPT is an entirely independent platform and does not depend on any third-party applications.

As mentioned above, the majority of universities use the first or second type of the system (it is obvious that the third method of conducting exams (with a live online proctor) is the most reliable but it is also the most expensive one and, therefore, the least profitable (Gourlay, 2021). The MIPT system, for its part, allows to conduct all three types of exams, however, it is used more often for exams with real-time monitoring and it is this function that has been constantly supplemented and improved. At present, the system can be used to conduct online surveillance of up to 20 participants for each proctor simultaneously, with an unlimited number of proctors. 200 participants can take a test simultaneously. The system provides a flexible configuration of the conditions display, prompts adding, auto-check setup, options generation. Thus, each event can be configurated as conveniently as possible, taking into consideration the specifics of each subject and requirements for a concrete exam, which would be impossible with a third-party system or it would cost so much money that it would be infeasible.

Results

The development of the MIPT proctoring system began in 2018, long before the start of the pandemic, and its goal, as we mentioned above, was to facilitate organization of entrance exams for international applicants. In 2019–2020, some improvements were still underway, for example, the interface was being improved, the functionality was refined, but in general, in 2019, the MIPT already had its own working proctoring system. Therefore, when the pandemic struck, the univer-

[11] Polytechnic university introduced new monitoring system for online exams (Feature was prepared by SPbPU Department of Public Relations. Text by Raisa Bestugina) (In Russ.) Retrieved from: https://www.spbstu.ru/media/news/education/polytech-new-system-monitoring-progress-online-exams/

[12] The first remote defenses of qualification work took place at Vyatka State University (Vyatka State University official website, news section) (In Russ.) Retrieved from: https://www.vyatsu.ru/internet-gazeta/v-vyatgu-proshli-pervyie-distantsionnyie-zaschityi.html?utm_source=BenchmarkEmail&utm_campaign=COVID-19_%7c_RU_%7c_%d0%92%d1%8b%d0%bf%d1%83%d1%81%d0%ba_2&utm_medium=email

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sity did not have to search for any solutions for conducting distance exams and attestations – it was enough to simply scale up the existing system for the whole university. It is important to note that in accordance with the clause 5.4 of the MIPT's Admission Rules, entrance exams are conducted online if the ID of the applicant is verified. In other words, the system was ready for conducting any exams including entrance ones (for both international applicants and applicants from the Russian Federation). Overall, the university spent about 2.5 million of rubles on the creation of this system, which proved to be highly effective as it allowed to achieve a significant increase in the number of international applicants (see Fig. 1).

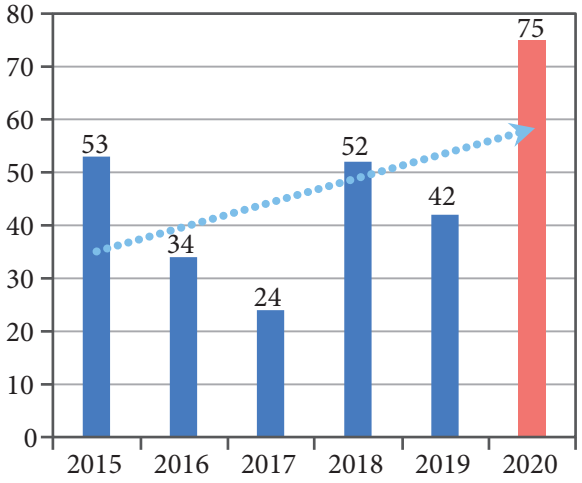

Figure 1. *Number of fee-paying international applicants by years*
Source: MIPT annual report on international admission for 2020/2021

It is important to mention that in previous years, the tuition fee for international applicants was 435,000 rubles per year (for each level of education). However, due to the epidemiological situation in 2020 and the predicted decrease in the ability to pay in case of potential international applicants, the administration of the university decided to cut the cost of education (by 17% on average) and divide it depending on the level of education. As a result, in 2020, the cost of education for international Bachelor's students was 320,000 rubles; for Master's students, 350,000 rubles; and for PhD students, 375,000 rubles. In 2020, 75 international applicants were admitted to the MIPT on the contract basis, 22 Bachelor's students, 48 Master's and 5 PhD students. Therefore, it is possible to count and compare the revenue from international applicants studying on the contract basis in 2015–2020.

Figure 2 shows that the revenue from international student enrollment in 2020 (despite the pandemic) grew by 41% in comparison with the previous year and by 44.5 % in comparison with the average revenue from the previous 5 years.

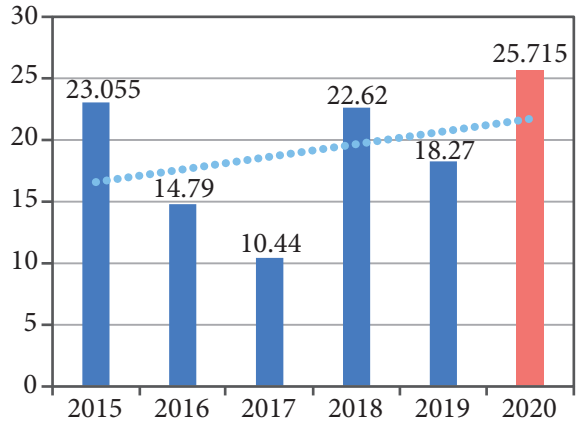

Figure 2. *Revenue from enrollment of international students in 2015–2020 (mln rbs)*
Source: MIPT annual report on international admission for 2020/2021

The number of fee-paying students is not the only indicator that reflects the positive effect of the system. Since the very day the MIPT was founded, it has been a center of attraction for the most talented students from all over Russia and the CIS countries. And in recent years there has been an increasing interest in the university from applicants from non-CIS countries. It should be noted that, despite the predictions, their share increased significantly in the year when the pandemic began (Fig. 3) – for the first time in 6 years it amounted to 39% – in other words, more than 1/3 of the international admission.

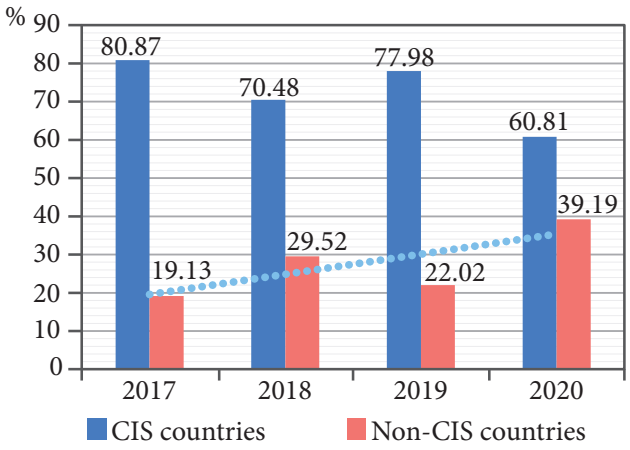

Figure 3. *Distribution of students from CIS and non-CIS countries*
Source: MIPT annual report on international admission for 2020/2021

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In addition, the percentage of international students has grown significantly in the overall number (up to 15.11%) (Fig. 4).

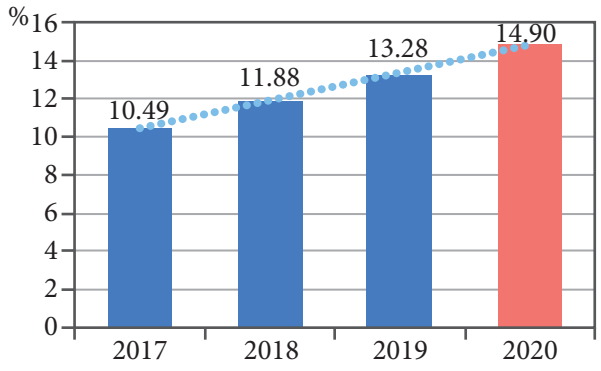

Figure 4. *Growing percentage of international students in the overall number of MIPT students (%)*

Source: MIPT annual report on international admission for 2020/2021

To put this in context, at the universities of Tomsk region, this figure was 27%[13], in the Higher School of Economics (St. Petersburg), which is considered as one of the most internationalized universities, 31%[14]; and in the University of Tyumen, 10%. The Southern Federal University[15] came closest to the MIPT of the percentage of students from non-CIS countries – 33%.

The system has been actively used during the university's admissions campaign in 2020/21. In this period, more than 50 events were created and conducted (around 20 full exams with oral and written parts). The International Department conducted testing sessions for students from non-CIS countries as well as tests at the MIPT's preparatory department for international students.

Due to the lockdown, many internal exams, retaking exams, contests and tests were carried out by different departments of the universities with the help of the proctoring system (in total more that 70 events).

Economic model of the MIPT proctoring system

At the MIPT, Members of the faculty and staff act as proctors at examinations. Thus, the MIPT does not bear any variable costs while conducting the exams, which is a definitive advantage in comparison with the majority of similar systems, where each exam has to be paid for separately, depending on the number of applicants and proctors involved.

[13] RIA Novosti (Applicant's navigator): International admissions have increased at universities of Novosibirsk and Tomsk (In Russ.) Retrieved from: https://na.ria.ru/20200916/studenty-1577336422.html

[14] Report on HSE University – St. Petersburg international work for 2019–2020 academic years.

[15] "On the priority tasks in the field of internationalization of the university" (report of the vice-rector for project-innovation activities and international cooperation of SFedU, 2020)

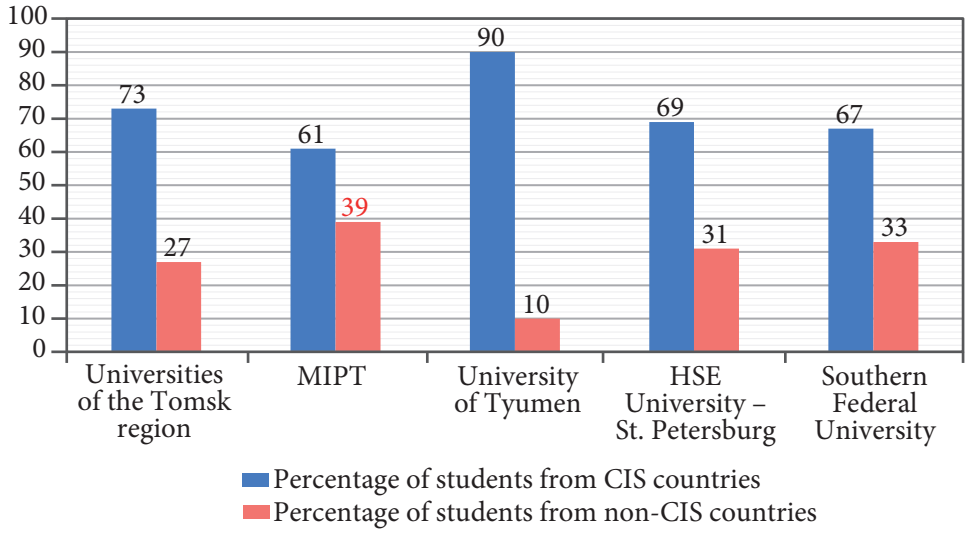

Figure 5. *Distribution of students from CIS and non-CIS countries in Russian universities (%)*

Source: MIPT annual report on international admission for 2020/2021, RIA Novosti (Applicant's navigator): 'International admissions have increased at universities of Novosibirsk and Tomsk' (dated 16.09.2020), Report on the HSE University – St. Peterburg international work for 2019–2020 academic years, 'On the priority tasks in the field of internationalization of the university' (Report of the Vice-Rector on Project Innovation Work and International Cooperation SFedU, 2020)

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We have compared the MIPT proctoring system with one of the most popular international systems – *Proctorio* and *Examinity* and the most popular system in Russia – *Examus*. These systems were chosen because of the similarity of their features: each of them can be used to conduct an exam with a live online proctor (that is, with real-time human monitoring). This format appears to be the most transparent and is capable of completely replacing the face-to-face examination format (D'Souza & Siegfeldt, 2017, Kuh et al., 2005)).

The systems may be compared according to the two groups of criteria:

1. *Operational* – the criteria that characterize the quality of the system, its accessibility and the transparency of the examination process, such as being a browser-based platform (that is, there is no need for installing a special program or a desktop application); user support 24/7 and the possibility to conduct exams with a live online proctor;

2. *Financial* – these criteria include the costs of each event for the university, the dependence of the cost on the number of participants, and the need to enter into a contract with external counterparties. Moreover, it is important to take into account the possibility of re-configuring the system for free to adjust it to the university's needs or for a specific event (in other words, free customization).

The results of this comparison are presented in Table 1.

As indicated in Table 1, the ability to work in a browser is provided only by the Russian systems such as *Examus* and the MIPT system. Foreign systems require an installation of a special program (or in some cases could be integrated into some types of universities LMS software), which means that Russian systems are more accessible for international applicants. 24/7 user support is available in all the options, except for the MIPT's system. However, this is just a formal distinction – during the exams and the days before their start and several hours after, the MIPT staff also provide support on a 24-hour basis, so in fact technical support is not available only on the days when there are no exams.

Financially, the MIPT system wins on all three points, in fact, the costs of operating the resulting product are negligible for the university and, most importantly, the system is flexible and can be easily adjusted.

For instance, the MIPT acted as a partner of Moscow Center of Quality of Education and the Department of Education of Moscow in conducting pre-professional exams for two groups: academic (scientific and technological) and engineering. 15 MIPT professors acted as proctors. The total number of exams was 16 and total number of events, more than 30. The pre-professional exams were organized by the Moscow Center of the Quality of Education with the financial support of the Department of Science and Higher Education of Moscow (the total number of participants – 340). Furthermore, at the request of the Federal Agency of the Commonwealth of Independent States Affairs, Compatriots Living Abroad and International Humanitarian Cooperation (Rossotrudnichestvo), the MIPT held exams in its proctoring system for students seeking to obtain quotas for education in the Russian Federation in mathematics and physics in Moldova, Armenia, Uzbekistan and Abkhazia. The assignments were developed by MIPT professors. The staff of the International Department acted as proctors (the total number of participants: in mathematics – 502, in physics – 301).

Table 1

Comparison of the most popular products for online proctoring in Russia and other countries

System	Browser-based application	Ability to conduct an exam with a live proctor	Customization	User support 24/7	Variable costs (Depending on the number of applicants)	Payment for the services of an external counterparty
Examus	Yes	Yes	Paid	Always	Yes	Yes
MIPT proctoring	Yes	Yes	Free of charge	Only during examinations	No	No
Proctorio	No	Yes	Paid	Always	Yes (with a live online proctor)	Yes
Examinity	No	Yes	No	Always	Yes (with a live online proctor)	Yes

Source: Comparison is based on the analysis of the companies' websites offering the most popular solutions for proctored exams: https://ru.examus.net/, https://proctorio.com/, https://www.examity.com/

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Conclusion

In this article we examined the experience of developing and applying an in-house online proctoring system at the Moscow Institute of Physics and Technology and analyzed the effect of this system on the results of the 2020 international admissions campaign. Furthermore, the experience of applying the ready-to-use online proctoring systems in Russia and abroad was analyzed and compared. The study showed that not only does the MIPT system perform on a par with ready-to-use solutions in terms of quality, accessibility for users and transparency of conducted exams but it is also much more profitable from the economical point of view since, unlike its counterparts, it does not bear variable costs and does not need any significant additional investment while using it.

During the pandemic, when the demand for education overseas dropped dramatically all over the world, the MIPT managed to ensure successful recruitment of international students and increase the profit from their admission by 40%. The overall cost of the system for the university was about 2.5 million rubles, while the difference in the revenue from the enrollment of fee-paying overseas students was 7.5 million between 2020 and 2021 (the pandemic year). In its current state (without any crucial improvements requiring significant financial investment) the system will be able to function for several more years. Thus, we may assume that the system has shown its full financial efficiency and that other universities and organization can benefit from the MIPT's experience of developing its own online proctoring system.

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Information about the author

Anna D. Oykher – Deputy Director of the International Department, Moscow Institute of Physics and Technology (9 Institutsky per., Building 7, Dolgoprudny, Moscow Region, 141701, Russia); e-mail: anna.oykher@gmail.com

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Информация об авторе

Ойхер Анна Дмитриевна – заместитель директора международного департамента, Московский физико-технический институт (141701, г. Долгопрудный, Московская обл., пер. Институтский, 9); e-mail: anna.oykher@gmail.com

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Russian oil and gas regions during the COVID-19 crisis and their digital transformation

R.R. Akhunov[1] ✉, **L.R. Akhunova**[2], **S.G. Marichev**[1], **R.I. Nizamutdinov**[1]
[1] *Ufa Federal Research Centre, Russian Academy of Sciences, Ufa, Russia; akhunov@list.ru*
[2] *Bashkir State University, Ufa, Russia*

ABSTRACT
Relevance. One of the key long-term strategic goals of Russia's economic development is to increase the share of the digital and green economy in the gross product of the country and its regions. The recession caused by the pandemic has brought to the forefront the challenges of digitalization in the country's oil and gas sector, which was among the hardest hit sectors, and thus required significant effort on the part of regional governments.
Data and methods. The study provides an overview of the Russian and international research literature on the ways to foster economic recovery and growth after the COVID-19 pandemic, including the publications of the United Nations and the World Economic Forum. Methodologically, the study relies on the empirical, general scientific methods and methods of economic statistics. We used in our calculations the data from the open-access statistical yearbook 'Russian Regions' published by Rosstat.
Results The study analyzed the challenges of digitalization faced by Russian oil and gas regions to show the need for institutional transformations on the national level. We also formulated some recommendations for the improvement of the evaluation of regional governments' digitalization efforts in the context of the COVID-19 pandemic and the more general evaluation of the digital transformation of regional economies.
Conclusions To stimulate economic growth of Russian oil and gas regions recovering from the pandemic, a viable strategy would be to place a greater emphasis on their sustainable and digital development. In the international rankings such as the EDGI Ranking presented annually by the United Nations Department of Economic and Social Affairs (UN DESA), Russia occupies a high position in terms of e-government services and digitalization in other spheres. Nevertheless, as far as the Russian oil and gas regions are concerned, there are considerable disparities in terms of digitalization. To accelerate digital transformation, we would highly recommend to improve the methods of evaluation of the digital progress in regional government, especially to include a set of indicators characterising regional governments' responses to the challenges posed by the COVID-19 pandemic.

KEYWORDS
oil and gas regions, digitalization of economy, regional informatization, technological modernization of the oil and gas industry, assessment of the digitalization of regional governments, COVID-19 pandemic, digital maturity indicators, evaluation of the digital sector

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Российские нефтегазовые регионы в период коронакризиса и их цифровая трансформация

Р.Р. Ахунов[1] ✉, **Л.Р. Ахунова**[2], **С.Г. Маричев**[1], **Р.И. Низамутдинов**[1]
[1] *Уфимский федеральный исследовательский центр Российской академии наук, Уфа, Россия; akhunov@list.ru*
[2] *Башкирский государственный университет, Уфа, Россия*

АННОТАЦИЯ
Актуальность. Одной из стратегических целей экономического развития Российской Федерации в долгосрочной перспективе является повышение доли цифровой и «зелёной» экономики в валовом продукте страны и её регионов. Экономический спад, вызванный пандемией новой коронавирусной инфекции COVID-19, актуализирует задачи цифровизации нефтегазовых отраслей российской экономики как одних из наиболее пострадавших, тем самым предъявляя вызовы региональным органам государственной власти и управления.
Данные и методы. Для проведения исследования были использованы и проанализированы российские и зарубежные работы по теме преодоления последствий мирового кризиса, вызванного пандемией новой коро-

КЛЮЧЕВЫЕ СЛОВА
нефтегазовые регионы, цифровизация экономики, региональная информатизация, технологическая модернизация нефтегазовой отрасли, оценка цифровизации региональных правительств, пандемия COVID-19, показатели цифровой зрелости, оценка цифрового сектора экономики

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навирусной инфекции COVID-19, в том числе публикации Организации Объединенных Наций и Всемирного экономического форума. В работе были использованы эмпирические, общенаучные и экономико-статистические методы исследования. Аналитические расчеты проведены по материалам статистического сборника «Регионы России», находящегося в открытом доступе на официальном сайте Росстата.

Результаты. В рамках исследования был произведен анализ проблем цифровизации, стоящих перед нефтегазовыми регионами. Обоснована необходимость институциональных преобразований на государственном уровне. Даны рекомендации по совершенствованию систем оценки цифровизации региональных правительств в условиях преодоления кризиса, вызванного пандемией COVID-19, и региональных экономик в целом.

Выводы. Для стимулирования экономического роста российских нефтегазовых регионов, восстанавливающихся после пандемии, необходимо сделать больший упор на их устойчивое и цифровое развитие. В международных рейтингах, таких как рейтинг EDGI, ежегодно представляемый Департаментом по экономическим и социальным вопросам ООН (ДЭСВ ООН), Россия занимает высокие позиции касательно электронного правительства и цифровизации в других сферах. Тем не менее, в российских нефтегазовых регионах существуют значительные различия в плане цифровизации. Чтобы ускорить цифровую трансформацию, мы настоятельно рекомендуем улучшить методы оценки цифрового прогресса в региональных органах власти, в особенности включить набор показателей, характеризующих реакцию региональных правительств на вызовы, создаваемые пандемией COVID-19.

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ДЛЯ ЦИТИРОВАНИЯ
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Introduction

The effects of the 2020 pandemic varied significantly across different industries: while the traditional industries were hit the hardest by the coronacrisis, tech giants reported soaring profits. The sectors that were most affected by the pandemic were aviation, public services and the oil and gas industry.

In 2020, the double blow of the COVID-19 pandemic and the oil price shock resulted in Russian oil and gas regions losing a significant part of their revenue. The budgets of such regions as the Yamalo-Nenets and Nenets autonomous districts, the republics of Bashkortostan, Tatarstan and Komi and Astrakhan region suffered the most as their tax and non-tax revenue dropped by more than 10%[1]. Despite the unprecendented financial support from the federal government, the rise in public expenditure to fight the pandemic also turned oil and gas regions into the regions with the highest ratio of budget deficit to their own revenues: in Tumen region, for example, the deficit was 19.6%, in the Yamalo-Nenets Autonomous District and Bashkortostan, 14.3%[2]. The production index for 2020 declined significantly in the service sector (–17,3% in comparison with 2019) and the mining sector (–7%)[3].

[1] Tipenko N.G. Analysis of the Implementation of Regional Budgets in 2020, p. 9. Retrieved from: https://www.es-eur.ru/Files/file14395.pdf

[2] Ibid.

[3] Information for Monitoring of the Socio-Economic Situation in Russian Regions in January-December 2020. Retrieved from: https://rosstat.gov.ru/folder/11109/document/13259

In order to stay competitive, oil and gas regions have to keep up with the global trends such as digitalization and sustainable development. Digitalization can become a major driver for economic growth, but to achieve this, it is first necessary to ensure ICT diffusion across Russian regions.

This research aims to demonstrate the key role played by digitalization and environmentalization in the recovery of the Russian oil and gas regions from the pandemic. This research purpose is determined by the events of the pandemic year of 2020, which saw a major rise in environmental awareness in all spheres, including the global economy. Many decisions taken in this period point to the long-standing nature of this trend. During the lockdowns many people had to spend more time in front of their computer screens, which led them to appreciate the benefits of digitalization, in particular, its potential as an instrument of cost-cutting and business development.

The above-described research objective determined the following research tasks:

– describe the reasons why technological modernization in the oil and gas industry is essential for the country's economic growth;

– explore the questions of digitalization in regional governance and propose measures for the improvement of the methodology used to evaluate e-government services in Russian regions and the performance of regional executive governments during the COVID-19 pandemic;

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– analyze the existing evaluation methodologies and formulate recommendations for their improvement.

Literature review

The impact of the pandemic on regions specializing in oil and gas production is discussed in a recent study by Akhunov and Nizamutdinov (2020), which examines the situation in the corporate sector during the 2020 pandemic and sheds light on the long-term risks that stem from the long-term sustainable development trends in global economy. Gadzhiev et al. (2021), Lanshina et al. (2020) and Zhiznin et al. (2021) discuss the impact of the pandemic on environmentalization and digitalization and the major role these trends play in the future sustainable economic development. They also highlight the mutual influence of digitalization and environmentalization.

Oil and gas regions undoubtedly present a specific case of resource-dependent regions. In research literature, there is no general agreement as to the quantitative criteria of a 'resource-dependent' or 'oil and gas region'; instead, preference is given to qualitative criteria: for example, the distinctive feature of these regions is that their economy is reliant on the exploitation of natural resources (in our case oil and gas reserves) (see, for example, Kryukov et al., 2017). Another distinctive feature pointed out by some authors is the export orientation of this sector (Levin et al., 2015).

The development of the digital economy is discussed in the UN's 2019 report, the report of the U.S. Bureau of Economic Analysis (BEA) of 2019, and in the study of Tatarinov (2016). Brynjolfsson and Collis (2017) propose a methodology for the evaluation of the digital economy's contribution to economic growth. This methodology is underpinned by the idea that the recent growth in the digital economy has determined significant welfare gains, which, however, are not reflected in GDP since many digital goods have zero price. It is proposed to measure the digital economy by using the indicator GDP-B, which quantifies the benefits rather than costs of free digital goods and services.

The indicators for measuring the progress of the digital transformation in Russian cities and regions are described in the reports of the Higher School of Economics (2018) and the National Research Institute of Technologies and Communications (NIITC). Despite the rapidly increasing share of companies implementing digital strategies, the extent of digitalization on the national and regional levels still leaves much to be desired. Among the most prominent aspects of the digital transformation during the COVID-19 pandemic is the delivery of the increasing number of public services in the electronic form (Chizada et al., 2021).

Our study relies on the approach to studying e-government and the principles of its operation described in the works of Fang (2002) and Ndou (2004). Ndou, quoting the UN and ASPA's report, defines e-government as 'the public sector's use of the most innovative information and communication technologies, like the Internet, to deliver to all citizens improved services, reliable information and greater knowledge in order to facilitate access to the governing process and encourage deeper citizen participation' (Ndou, 2004, p. 4). Institutional transformations linked to the development of e-government are discussed by Sei-fert (2003), who highlights the increasing speed of digital transformation in the activities of governments and the wider range of e-government solutions available nowadays. The use of digital solutions for delivering government services during the pandemic is also considered by Ahmed et al. (2020) and Shahroz et al. (2021).

Data and methods

The study relies on empirical and general scientific methods to investigate the role of oil and gas regions in national economic growth. To analyze the indicators of the digital maturity of oil and gas regions, the methods of economic statistics were applied.

The study comprised the following stages: first, we analyzed the factors of economic growth in Russia during the pandemic and tested the hypothesis about the need to modernize oil and gas enterprises in Russia. Second, we evaluated the level of digital maturity of executive government bodies and identified the key priorities in advancing the digitalization of regional executive governments. Third, we analyzed the existing methods of digitalization evaluation in different sectors of national economy and formulated our recommendations for the advancement of digital transformation in the Russian economy.

In this study, oil and gas regions in Russia are defined as the regions with the total share of production of oil, gas, coke and petroleum products exceeding 15% of gross regional product (GRP). 15% of GRP is quite a substantial figure, which shows a significant impact that the sector has on regional economies. In the structure of GRP of

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regions, there are sectors and subsectors whose share exceeds 15%. Normally a region has just one or, in rare cases, two such sectors, which play a key role in this region's economy. Our choice of 15% as the lower threshold was partially determined by the available empirical data since it is at this level that most of the disparities between the oil and gas regions tend to occur (see Fig. 1).

To avoid data duplication, that is, the data for autonomous districts being considered twice – as separate regions and as parts of larger regions, we analyzed autonomous districts separately from the regions they are part of and in the analysis of larger regions excluded the data on autonomous districts. As a result, our analysis covered in total 19 Russian oil and gas regions (see Table 1).

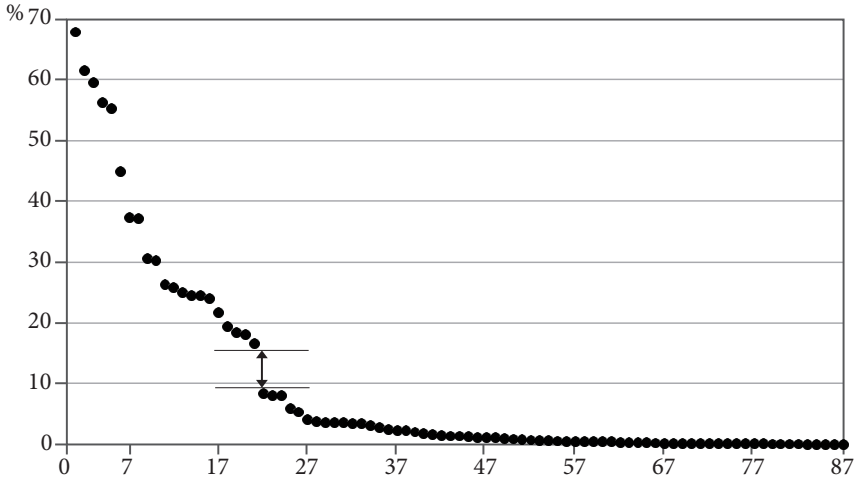

Figure 1. *Share of oil, gas, coke and petroleum products in GRP of Russian regions in 2019, %*
Source: The authors' calculations were based on the data from Rosstat for 2019 (Sectoral Structure of Gross Value Added of the Regions of the Russian Federation in 2019. Retrieved from: https://rosstat.gov.ru/storage/mediabank/DA162kUL/Struktura19.xlsx) and from the Statistical Yearbook 'Russian Regions 2020' (Russian Regions. Socio-Economic Indicators in 2020. Retrieved from: https://rosstat.gov.ru/storage/mediabank/LkooETqG/Region_Pokaz_2020.pdf)

Table 1

Russian oil and gas regions

Oil and gas regions	Share of oil and gas production in GRP, %	Share of coke and refined petroleum products in GRP, %	Total share of oil, gas, coke and petroleum products in GRP, %
Nenets Autonomous District	68.03	0	68.03
Yamalo-Nenets Autonomous District	56.97	4.54	61.51
Khanty-Mansiysk Autonomous District	58.04	1.51	59.55
Sakhalin region	56.43	0.06	56.50
Astrakhan region	42.25	2.44	44.69
Komi Republic	34.69	2.82	37.50
Orenburg region	34.03	3.40	37.43
Tatarstan Republic	25.37	5.23	30.60
Perm region	20.29	9.99	30.29
Tomsk region	24.04	1.95	25.98
Udmurt Republic	24.45	0.24	24.68
Tyumen region (autonomous districts excluded)	17.21	6.99	24.21
Omsk region	0	24.20	24.20
Republic of Sakha (Yakutia)	23.63	0.13	23.76
Irkutsk region	20.98	0.67	21.65
Krasnoyarsk region	18.61	0.87	19.49
Samara region	16.79	1.82	18.61
Volgograd region	4.95	13.23	18.18
Republic of Bashkortostan	1.74	15.10	16.84

Source: The authors' calculations were based on the data from Rosstat for 2019 (Sectoral Structure of Gross Value Added of the Regions of the Russian Federation in 2019. Retrieved from: https://rosstat.gov.ru/storage/mediabank/DA162kUL/Struktura19.xlsx) and from the Statistical Yearbook 'Russian Regions 2020' (Russian Regions. Socio-Economic Indicators in 2020. Retrieved from: https://rosstat.gov.ru/storage/mediabank/LkooETqG/Region_Pokaz_2020.pdf).

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This study provides an overview of the Russian and international research literature on the ways to create economic recovery and growth after the COVID-19 pandemic, including the publications of the United Nations and the World Economic Forum. For our calculations, we used the data from the statistical yearbook 'Russian Regions' for 2020, which is publicly available on the official website of Rosstat.

Results

In this study, we intend to analyze the digitalization rates of regional governments and regional economies in general. We also seek to demonstrate the pivotal role of the oil and gas sector in the digitalization of the Russian economy.

Digitalization of Russian oil and gas regions as a factor of the country's economic growth

In accordance with the report of the World Economic Forum, most economic growth potential in the post-crisis period will be enjoyed by the 'green tech' companies generating added value from digital technologies used to create a greener future[4].

The oil and gas industry is crucial for many Russian regions and for the country in general. Lately, the industry has managed to make a certain progress in terms of technological development, which includes such spheres as digital transformation and sustainability. For example, according to the Deputy Minister of Energy Pavel Sorokin, the expected aggregate effect of using AI technologies in the oil industry will be about 5.4 trillion roubles in the period between 2025 and 2040[5].

Many Russian industrial organizations are planning to invest billions of roubles into modernization of their businesses. Thus, global trends present challenges not only to companies striving for modernization but also companies generating demand on the market of digitalization and sustainability. Investment into the digital and green economy through the multiplier effect can fuel growth in other sectors of economy. On the other hand, these funds may also be spent elsewhere to purchase modern equipment and technologies. Oil and gas regions play a special role in digitalization as they can help drive the advancement of digital and environmental technologies due to the sheer scale of their economies and the opportunities opened by digitalization in the oil and gas sector. Digital technologies can be used in all phases of oil production: from exploration to sale. According to expert evaluations, the global market of digital technologies used for oil exploration and extraction is worth 2 billion dollars a year[6]. After 2021, the share of Russian companies in this market will rise from 5 to 6–7%. Moreover, oil and gas regions are now seeking to deal with the risks to their security associated with the global transition to renewables. Digital technologies can give oil and gas regions a competitive edge that they need so much to stay afloat[7].

The possible benefits of digital transformation in the oil and gas industry, which will turn this sector into the locomotive of digitalization in the Russian economy, are as follows:

1. Oil reserves are being depleted faster than they are being discovered and new oil fields are now harder to find (Shmal, 2020). Digital solutions will increase the efficiency of oil exploration. For example, Russian companies such as Tatneft and Gazpromneft are already using the digital twin technology and AI for oil exploration. Since the areas with milder climatic conditions and easily minable oil deposits are already known, the newly found deposits are usually located in the areas that are difficult to access, which leads to a rise in the use of automation in the oil and gas industry.

2. More and more oil reserves are becoming stranded, which brings to the fore the question of cost-cutting in their exploration. Digital solutions increase the profitability of stranded oil production (Dmitrievsky, 2020) and enhance oil recovery (the reserves-to-production ratio). Quite illustrative in this respect is the US Shale Revolution, which would not have been possible without digital technologies. According to the Russian Ministry of Energy, measures to support digitalization in the oil industry will cut the exploration costs by up to 15% and cut the costs of commissioning of new

[4] Chief Economists Outlook 2021 / World Economic Forum (13.06.2021). Retrieved from: https://www.weforum.org/reports/chief-economists-outlook-2021

[5] Presentation of Pavel Sorokin at the congress 'Innovation Practice: Science and Business'. Retrieved from: https://minenergo.gov.ru/node/19641

[6] Digital Economy Report of the United Nations. Value Creation and Capture: Implications for Developing Countries (2019) United Nations Conference on Trade and Development. Retrieved from: https://unctad.org/en/PublicationsLibrary/der2019_overview_ru.pdf

[7] Research Focus: Digitalization of the Oil Sector (20.06.21). Retrieved from: https://iz.ru/1126511/valerii-voronov/nauchnyi-aktcent-kak-neftianaia-otrasl-perekhodit-na-tcifrovye-tekhnologii

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facilities[8]. In monetary terms, the amount of cost saving would be about 700 billion roubles a year[9].

The comprehensive digitalization of oil extraction can be illustrated by the recent case of the digital oilfield launched by Rosneft in Bashkortostan in 2019, which was the first project of this kind in Russia. A digital oilfield means permanent data collection at all stages of the oilfield's lifecycle – from exploration to mining – and centralized data processing on a digital platform for enhanced efficiency and profitability. According to Rosneft, the use of digital technologies has led to an increase in the number of remotely controlled objects by almost 60%. The company has also managed to cut its logistics costs by 5% and increase the energy efficiency of oil extraction by 5%[10]. In monetary terms, the effect from the use of digital solutions at the oilfield in Bashkortostan was estimated as 1 billion roubles a year[11].

3. It is necessary to raise the environmental sustainability standards of oil and gas production. The oil and gas sector has a huge infrastructure, which encompasses a myriad of assets but is also vulnerable to damage and may be prone to malfunctions (Zemtsov et al., 2020). Automation of equipment and infrastructure diagnostics helps prevent or mitigate the consequences of equipment failure, including the negative environmental impact of pollution leaks, and increase the energy efficiency and productivity of labour.

Investors, from private investors to investment funds and governments, now tend to be attracted more by green and digital technologies. According to PwC, 31% of investors take into account the climate change factor in their decision-making and 41%, the factor of cybersecurity. 83% and 86% of investors respectively reported their concern about these questions[12].

The use of digital solutions to address the challenges of environmental security may well serve as one of the instruments for attracting investors. Thus, digitalization and environmentalization go hand in hand.

Moreover, in view of the current situation in Russia, the trend for sustainability is more relevant than ever. Climate change has not left Russia unaffected, especially its vast permafrost areas. The thawing permafrost, according to the Ministry of Natural Resources, depending on the speed of the melt, may lead to the losses of approximately 5 trillion roubles by 2050[13]. Climate change will have a detrimental impact on transport and industrial infrastructure, production assets and so on.

Global warming, however, was not the only challenge faced by Russia in 2020: in the same year, the country went through a series of natural and anthropogenic disasters – from droughts and wildfires to the spills of oil and hazardous substances. Apart from the damage inflicted on the natural environment and human communities, global warming has detrimental economic effects: hundreds billions of roubles were spent on emergency response and recovery efforts to minimize the damage. The negative anthropogenic impact on the environment in Russia largely stems from the country's economic dependence on raw materials production as well as the use of obsolete and outdated facilities and equipment. Therefore, the most effective response to these challenges would be the diversification of the national economy and technological modernization. Digitalization could be an answer to many of these questions, including the need to enhance the efficiency of nature conservation activities.

Enhancement of regional governments' digital maturity

Innovation policy-making plays a key role in providing institutional support for digital transformation, such as federal and regional programs, which include subsidies and preferential lending to organizations implementing digital and green technologies. According to the UN, there is a strong positive correlation between economic growth and the level of digitalization in public administration[14]. The growth in the digital economy strongly correlates (0.92) with e-government development (Zhao et al., 2015). Therefore, the task of increasing the digital maturity of the Russian government may become the backbone

[8] Presentation of Pavel Sorokin at the meeting of the Working Group 'Digital Transformation of the Oil and Gas Industry'. Retrieved from: https://minenergo.gov.ru/node/19270

[9] Ibid.

[10] Rosneft Launches the Project 'Digital Deposit' in Bashkiria. Retrieved from: https://www.rosneft.ru/press/news/item/195043/

[11] Ibid.

[12] ESG-Factors in Investment. PWC Report of 2019. P.15. (19.06.21). Retrieved from: https://www.pwc.ru/ru/sustainability/assets/pwc-responsible-investment.pdf

[13] Press-Service of the Ministry of Natural Resources of Russia. By 2024 the State System of Permafrost Monitoring will Cover the Whole Territory of the Cryolithic Zone. Retrieved from: https://clck.ru/W79gm

[14] E-Government Survey 2020 (15.06.21). Retrieved from: https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2020

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of successful technological modernization of the national economy.

To stimulate the digitalization of public administration in Russia, it is necessary to monitor and evaluate the progress in this sphere.

On the international level, digital efforts of national governments are measured by the United Nations with the help of the composite indicator E-Government Development Index (EDGI). In 2020, Russia ranked 36th in this ranking[15]. The EDGI consists of three subindices measuring the level of online services, the development status of telecommunication infrastructure and human capital. In 2020, the EDGI of the Russian Federation was 0.8244, which is a quite impressive result. In the last decade, this figure grew from 0.5136 in 2010 to 0.7345 in 2021. However, despite the absolute growth in this indicator, in the same period, in the ranking Russia dropped from 27th in 2012 to 36th in 2020. Our calculations show that the sphere of telecommunications infrastructure in Russia still holds much potential for improvement since the value of this subindex is 0.77, which is lower than the values of other subindices – that of online services (0.82) and human capital development (0.88).

In order to ensure a stable progress in the sphere of e-government, it is important to evaluate the level of the digital maturity of public administration not only on the federal but also on the region level.

Since 2016, the level of digitalization in Russian regions has been monitored with the help of the regional digitalization index. On several occasions, the methodology of index calculation has been revised. Eventually, the decision was taken to introduce another index – the National Index of Digital Economy Development, which is currently being devised by the Ministry for Digital Development, Communication and Mass Media within the national project 'Digital Economy'[16].

To measure the level of regional governments' digitalization, it is also possible to apply the methodology proposed by the Ministry for Digital Development. This methodology focuses on assessing the performance of the chief executive officers of regional governments. In total, the methodology encompasses 20 indicators, including the digital maturity of regional governments[17]. In its turn, digital maturity is evaluated with the help of 34 subindicators for the four key areas: education, municipal services and construction, public transport and public administration[18].

If we compare the above-described Russian methodology with that of the United Nations, the following observations can be made:

– the Russian methodology uses a larger number of indicators, which makes the process of data collection and calculations more difficult, although there is a slight improvement in the evaluation accuracy. Moreover, a large number of indicators makes calculations less transparent;

– the Russian methodology aims to evaluate the level of digitalization in different spheres while the UN's methodology focuses on different digitalization areas;

– both methodologies have no indicators to estimate the effects of the COVID-19 recovery measures.

In our view, in order to stimulate the development of e-government in the Russian Federation, the following tasks should be addressed:

– first, it is necessary to simplify the indicator system, bringing it closer to the international methodology, in order to make the two systems more comparable and to ensure compliance with the most advanced global practices in the digitalization of the public sector;

– second, as the estimations of international experts show, the development of the ICT infrastructure should be prioritized and the corresponding evaluation methodology should be introduced;

– third, it is essential to devise methods for the evaluation of e-government development in the light of the COVID-19 recovery measures.

There is evidence that the mortality rates during the pandemic were directly related to the efficiency of national and regional governments

[15] E-Government Survey 2020 (15.06.21). Retrieved from: https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2020

[16] Project 'Digital Public Administration' (15.06.2021). Retrieved from: https://digital.gov.ru/ru/activity/directions

[17] The Decree of the President of the Russian Federation of 04.02.2021 No. 68 'On the Evaluation of the Efficiency of the Chief Executives (Chief Executive Officers of the Government) of the Subjects of the Russian Federation and of the Performance of the Executive Bodies of the Subjects of the Russian Federation'.

[18] Decree of the Government of the Russian Federation of 3.04.2021 No. 542 'On the Approval of the Methodology of Calculation of the Indicators of Performance of the Chief Executives (Chief Executive Officers of the Government) of the Subjects of the Russian Federation and of the Performance of the Executive Bodies of the Subjects of the Russian Federation, and the Annulment of Certain Acts of the Decree of the Government of the Russian Federation of 17 July 2019 No. 915'.

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(Chizada et al., 2021). Moreover, during the pandemic, increasing technical demands were placed on governments (Ahmed et al., 2020; Shahroz et al., 2021), and these demands should be reflected in the evaluation systems.

To save time, a simpler evaluation design can be used. For example, we can use a limited number of indicators, including the following:

– the number and quality of government agencies: statistics, security level;

– the number of inquiries submitted through e-government portals;

– the amount and quality of open-access data on the activities of government agencies;

– the number of mentions of regional government agencies in the mass media, Internet and social media in the context of digitalization and the volume (or number) of searches for particular keywords containing the names of government agencies.

To evaluate how efficiently the government used digital technologies to confront the COVID-19 pandemic, we need to look at the indicators shown in Table 2 below.

Evaluation of the digitalization of Russian oil and gas regions

It should be noted that the evaluation of e-government development is not the only priority and that there are other important tasks linked to digital development in the economic sphere. Unfortunately, the existing methodologies fail to provide a complete picture of the digitalization in the socio-economic sphere.

The most widespread approach is to look at the share of R&D expenditure as a percentage of national GDP. For example, the UN's 'Digital Economy Report 2019' estimates the size of the digital economy as 4.5–15.5% of world GDP. In Russia, this indicator is significantly lower – only 1.7% (it is planned to raise this indicator level to 5% by 2024). However, the drawback of this approach is that it focuses only on the effort invested into the digital transformation and says little about its outcomes. Among the leading technologies that power a large part of innovation are robotics and sensor devices, machine learning, blockchain, digital twins and so on. There is another indicator – value added per rouble of capital invested into digitalization and the creation of the digital economy – but it is not considered as the main one (Ahmad & Ribarsky, 2017).

There are objective impediments to digitalization on the regional level, which include the following:

1) lack of funding for digital development on the federal and especially regional levels;

2) digital inequality (the disparities in the development of digital and information technologies);

3) lack of education programs and disciplines related to the professions that actually exist but still remain outside the legal system;

Table 2

Indicators for measuring the digital transformation during the COVID-19 pandemic

Digitalization areas	Indicators
Information disclosure and measures to fight COVID-19 misinformation (infodemic)	– availability of portals, mobile apps and platforms in social media to connect and inform citizens; – availability of mental health helplines and online support
Regional and interministerial cooperation	– the number of video conferencing services used; – the number of remote working solutions installed;
E-government services	– quantitative indicators for e-government evaluation; – the number of online medical consultations conducted; – the number of digital health certificates issued; – the number of online maps of mobile healthcare facilities; – availability of POS terminals for contactless payments in public transport; – the number of downloads of mobile applications for tracking movements and social distancing; the number of digital passes issued; – availability of online platforms to help organize volunteer support for older people and other vulnerable groups; home delivery services (foods, medications, etc); – the number of online streamings of theatre performances and lectures and museum virtual tours; – availability of distance learning portals
The use of digital technologies for the delivery of new public services	– the number of downloads of applications for COVID-19 contact tracking; – level of customer satisfaction from using AI chat bots services; – the number of digital passes issued; – the number of distance learning platforms developed and the number of registered users

Source: compiled by the authors

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4) lack of centralized processing of the data on the ongoing digital projects; lack of exchange of know-how experience and expertise;

5) state industrial enterprises' lack of motivation to digitize (except for the agricultural sector);

6) compartmentalisation of information on digitalization due to mass media's catering to regional audiences.

Our calculations show significant disparities between oil and gas regions in terms of their ICT development (Table 3), in particular regarding the amount of digital transformation spending. In 2019, in this indicator, the leading regions were the Republic of Tatarstan, Khanty-Mansiysk Autonomous District and Samara region. The lowest level in this indicator was shown by the Nenets Autonomous District (764 mln roubles), which is only 2% of Tatarstan's spending on technology. The majority of oil and gas regions are below the national average in digital transformation indicators, including the share of organizations and households using PCs; the share of organizations using servers and cloud services and having websites. In terms of the number of connected devices per 1,000 people, all oil and gas regions, except for the Yamalo-Nenets Autonomous District, are considerably below the national average.

If we compare the data in Tables 1 and 3, the following pattern can be observed: the regions with the highest cumulative percentage of oil, gas,

Table 3

Digital maturity indicators of Russian oil and gas regions

	Use of ICT in organizations (in % of the total number of organizations surveyed):				Use of the Internet, %	Own website, %	Number of PCs per 100 employees, units	Use of special software, %	Digital transformation spending, mln rbs	Use of e-document flow	Use of PCs and the Internet in households, percentage of households			Internet access, in % of the total population of the region	Number of connected devices per 1,000 people
	PCs	Servers	LANs	Cloud services							PC	Internet access	Broadband Internet access		
Russian Federation	93.5	53.8	63.5	28.1	91.2	51.9	51.0	85.9	2316831.4	70.0	69.4	76.8	73.2	85.6	2109.8
Khanty-Mansiysk Autonomous District	93.9	64.7	71.3	25.5	91.1	50.2	26.0	86.4	28057.2	68.9	73.1	86.2	83.2	93.5	2077.2
Yamalo-Nenets Autonomous District	90.6	61.9	70.0	23.8	87.3	48.6	29.0	84.0	12178.6	68.6	92.4	95.0	93.9	98.4	2442.0
Tatarstan Republic	99.6	62.8	68.6	38.9	98.2	54.1	37.0	91.7	31259.2	75.9	65.6	78.1	73.8	91.2	1969.3
Orenburg region	97.3	51.3	68.4	23.4	95.6	54.6	31.0	91.2	6994.5	77.0	78.8	87.9	86.1	90.0	1989.4
Sakhalin region	93.9	62.8	71.7	24.0	92.0	53.7	40.0	87.0	6808.6	70.7	67.4	77.0	75.8	84.5	1961.6
Krasnoyarsk region	93.8	52.3	65.2	26.4	92.2	50.2	34.0	84.5	16890.4	68.1	63.0	69.5	66.4	81.2	1853.8
Republic of Bashkortostan	94.6	52.5	63.6	26.8	92.6	54.3	34.0	87.2	20802.7	73.6	62.1	77.5	72.8	91.3	1766.3
Samara region	90.1	53.7	63.2	25.6	88.4	49.5	34.0	83.5	22167.8	66.1	73.9	76.1	72.2	85.4	1946.3
Nenets Autonomous District	90.4	50.5	62.2	22.9	84.2	51.4	38.0	77.4	764.1	60.4	75.7	74.8	67.5	84.6	
Komi Republic	93.2	48.2	67.7	24.0	87.1	47.7	49.0	87.2	6235.0	72.9	76.4	79.0	78.8	84.1	1946.5
Perm region	93.3	57.6	66.7	38.8	90.4	42.6	36.0	87.5	19087.0	74.1	62.6	70.3	66.9	79.4	2009.7
Tomsk region	86.3	56.1	66.2	26.9	84.5	50.7	46.0	80.6	5806.6	66.5	64.9	73.6	72.8	83.7	1816.9
Udmurt Republic	96.5	53.4	67.3	22.9	93.7	55.0	31.0	88.8	6421.4	72.4	66.5	71.4	67.9	76.7	1796.1
Tyumen region	92.3	58.1	64.0	27.0	89.9	49.7	41.0	86.7	13864.8	72.5	67.0	68.8	66.3	89.9	2108.2
Omsk region	90.7	48.2	57.7	22.1	88.5	44.2	50.0	83.3	5291.9	69.8	67.7	78.2	76.6	83.4	1959.8
Irkutsk region	88.3	47.6	57.3	26.8	85.2	45.3	34.0	79.2	13670.5	63.7	69.1	74.5	72.8	80.5	1959.8
Republic of Sakha (Yakutia)	93.3	44.9	53.5	22.6	88.5	42.3	32.0	80.9	8560.8	63.9	61.4	87.6	77.8	88.1	1515.2
Astrakhan region	95.7	53.7	68.8	26.0	93.8	51.3	32.0	89.6	3792.9	74.7	76.1	79.5	78.8	86.9	1750.6
Volgograd region	90.1	46.6	60.2	25.0	88.2	48.9	33.0	83.0	6303.7	68.5	67.4	78.4	77.6	85.4	1772.4

Source: compiled by the authors by using Rosstat data for 2019

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coke and petroleum products in GRP (the Nenets Autonomous District, Yamalo-Nenets Autonomous District, Khanty-Mansyisk Autonomous District, Tatarstan Republic and the Republic of Sakha (Yakutia)) tend to invest the most in their digital progress. These regions are also the leaders in the majority of digital maturity indicators.

Apart from the above-described methods, there are alternative methodologies for digital transformation assessment:

1. The satellite set of the US national accounts developed by the Bureau of Economic Analysis (BEA)[19] includes all the goods and services related to digital technologies and is calculated as a percentage of GDP [4].

2. The Digital Economy Satellite Account (DESA) proposed by the OECD (Tatarinov, 2016) can be used to measure the processes of the digital economy and expand the production boundaries by including free digital services into the evaluation.

3. The methodology of calculating GDP by using consumer surplus data (Brynjolfsson, 2017; Nakamura, 2017; Bukht, 2018) is based on estimating and summing up consumer surplus generated from the use of free digital goods and quantifying the adjustment terms that would need to be added to real GDP growth to account for the contributions of these goods.

It should be noted that the above-described methodologies are in fact additional tools for calculating the share of the digital economy in GDP (Brynjolfsson et al., 2019; Brynjolfsson & McAfee, 2011; Bukht& Heeks, 2018). There is also a group of integral indices encompassing social and economic indicators that can be used for evaluation. One of such indices is the 'Digital Russia' index developed by the Higher School of Economics, which deals with regional initiatives and their outcomes. The index is calculated by using the following indicators:

– legal regulation and administration;
– workforce and education programs;
– research competencies and technological know-how;
– information infrastructure;
– information security;
– economic indicators;
– social effects.

This index is based on expert evaluations of the digitalization in Russian regions. However, it does not pay due regard to the already mentioned prior socio-economic inequalities between these regions. Another disadvantage of this methodology is that all the regions are considered and evaluated separately while many Russian regions in fact share fairly close economic and other ties with their neighbours. Therefore, it would make sense to develop a more general index reflecting the situation on the level of federal districts rather than individual regions.

To measure the spread of digital technologies, the National Research Institute of Technologies and Communications (NIITC) proposed 'Smart Cities Indicators', which are calculated for million-plus cities and comprise 26 subindicators, such as urban environment for research and innovation, public participation in urban planning and management, access to labour market information, development of communications networks for telemetry services, development of systems for environmental monitoring and management, traffic surveillance systems, transparency in public procurement. This indicator can be used to analyze digitalization in large Russian cities, make regional-level estimations and obtain a more detailed picture of digitalization in the socio-economic sphere. The drawback of this indicator is that it uses expert-based evaluations for each of the 26 subindicators, which, together with the lack or absence of some of the data, makes it less accurate and reliable.

A similar indicator – 'Digital Life of Russian Million-Plus Cities' – was developed by the Skolkovo Institute. It reflects the level of digitalization of large cities not only through such 'traditional' indicators as transport, finance, trade, health care, education, media and administration but also provides a surface-level comparison of the digital supply and demand. For example, this indicator shows that the growth in the digital demand exceeds that of the digital supply, especially in the financial sphere due to the economic stagnation and the national regulator's bank merging policy. As a result, some of the regional banks with capabilities in offering digital services had to leave the financial market.

The analysis of the indicators measuring the size of the digital economy through the system of national accounts and integral indices of digital transformation shows that the index system may prove to be quite efficient in the evaluation of di-

[19] OECD (2017), OECD Digital Economy Outlook 2017, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264276284-en

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gitalization rates in Russian regions by measuring the extent of digitalization in different socio-economic spheres. Moreover, at the end of 2021, the Ministry of Digital Development in partnership with the Rosatom corporation are planning to present the National Index of Development of the Digital Economy. In our view, it would be a good idea to introduce macro-economic indicators to improve the indices' accuracy and objectivity and to take into account the socio-economic disparities between the regions. Evaluation of the size of the digital sector should also take into consideration added value generated through the implementation of digital solutions in manufacturing and through cost-cutting (production, transaction and other costs).

Conclusion

Oil and gas regions can become a major driving force behind the digital transformation of the Russian economy. While easily-drilled oil reserves are depleted and oil gets harder and harder to extract, the oil and gas sector is increasingly turning to digital solutions to boost its efficiency and optimize performance. Digital technologies can be applied at all stages of the technological process and thus modernization can encompass a wide range of spheres. Taking into account the share of the oil and gas industry in Russia's GDP, digitalization in this sector can have a significant economic effect.

To accelerate the technological transformation of the oil and gas industry, it is necessary to enhance the level of regional governments' digital maturity of regional, which can be achieved through the improvement of the e-government evaluation systems in Russian regions and by ensuring the compliance of e-government services with the international standards. The crisis caused by the COVID-19 pandemic has also created the need to evaluate the efficiency of public services delivery by regional governments and the overall speed of the digital transformation in the public sector.

In the long-term, in order to achieve a comprehensive multiplier effect, it would be necessary to evaluate all aspects of digitalization to get a fuller picture. The index-based system of integral evaluation holds much promise as long as the existing indices are improved by adding macro-economic indicators and the interregional disparities are taken into account.

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Information about the authors

Rustem R. Akhunov – Dr.Sc. (Economy), member of the Academy of Sciences of the Republic of Bashkortostan, principal researcher, Head of the Laboratory of Modern Problems of Regional Economy, Ufa Federal Research Centre, Russian Academy of Sciences (71, Oktyabrya Ave., Ufa, 450054, Russia); e-mail: akhunov@list.ru

Liaisan R. Akhunova – PhD Student of the Innovation Economy Department of the Bashkir State University (3/4 Karl Marx str., Ufa, 450076, Russia)

Sergey G. Marichev – Junior Researcher of the Centre of Strategic and Interdisciplinary Studies of the Ufa Federal Research Centre, Russian Academy of Sciences (71, Oktyabrya Ave., Ufa, 450054, Russia)

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Rishat I. Nizamutdinov – Junior Researcher of the Centre of Strategic and Interdisciplinary Studies of the Ufa Federal Research Centre, Russian Academy of Sciences (71, Oktyabrya Ave., Ufa, 450054, Russia)

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Информация об авторах

Ахунов Рустем Ринатович – доктор экономических наук, чл.-корр. Академии наук Республики Башкортостан, г. Уфа, Российская Федерация, главный научный сотрудник, зав. лабораторией современных проблем региональной экономики Уфимского федерального исследовательского центра Российской академии наук (450054, Россия, Республика Башкортостан, г. Уфа, пр-т Октября, д. 71); e-mail: akhunov@list.ru

Ахунова Ляйсан Рустэмовна – соискатель кафедры инновационной экономики Башкирского государственного университета (450076, Россия, Республика Башкортостан, г. Уфа, ул. Карла Маркса, 3/4)

Маричев Сергей Геннадьевич – младший научный сотрудник Центра стратегических и междисциплинарных исследований Уфимского федерального исследовательского центра Российской академии наук (450054, Россия, Республика Башкортостан, г. Уфа, пр-т Октября, д. 71)

Низамутдинов Ришат Илшатович – младший научный сотрудник Центра стратегических и междисциплинарных исследований Уфимского федерального исследовательского центра Российской академии наук (450054, Россия, Республика Башкортостан, г. Уфа, пр-т Октября, д. 71)

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Prospects of China-Mongolia-Russia trade in the light of the COVID-19 pandemic

X. Zhang
Northeast Asian Studies, Heilongjiang Provincial Academy of Social Sciences, Harbin, China; zhangxiujie203@163.com

ABSTRACT
Relevance. China, Mongolia, and Russia are among each other's major trade partners. The COVID-19 pandemic has had a large impact on global trade, which creates the need to analyze further prospects of the trilateral cooperation between China, Mongolia and Russia.
Research objective. This study aims to analyze China-Mongolia-Russia trade cooperation in the context of the COVID-19 pandemic.
Data and methods. This article applies a comparative analysis method to examine the development and changes in import and export trade between China, Mongolia, and Russia before and after the beginning of the project of the China-Mongolia-Russia Economic Corridor, from 2014 to 2020. The research relies on the data from the China Trade and Foreign Economy Statistical Yearbook, Northeast Asia Economic Statistics of Sea of Japan Economic Research Institute, Ministry of Commerce of the People's Republic of China, Russian Customs, and National Bureau of Statistics of Mongolia.
Results. Along with the realization of the medium and short-term goal of raising the volume of trade turnover within the Corridor, the three countries seek to play more and more important roles as each other's trade partners. It is observed that the impact of the COVID-19 pandemic on the volume of trade has not been significant, and thus the fundamental premises of trilateral trade cooperation have remained largely unchanged.
Conclusions. To increase the volume of trade between China, Mongolia and Russia, it is necessary to improve the trade structure, reduce tariffs, establish free trade areas and actively promote the diversification of trade cooperation.

KEYWORDS
China, Russia, Mongolia, China-Mongolia-Russia Economic Corridor, import and export, trade characteristics, COVID-19

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Перспективы торговли между Китаем, Монголией и Россией в свете пандемии COVID-19

С. Чжан
Институт североазиатских исследований, Академия социальных наук провинции Хэйлунцзян, Харбин, Китай; zhangxiujie203@163.com

АННОТАЦИЯ
Актуальность. Китай, Монголия и Россия являются основными торговыми партнерами друг друга. Пандемия COVID-19 оказала большое влияние на мировую торговлю, что вызывает необходимость анализа дальнейших перспектив трехстороннего сотрудничества между Китаем, Монголией и Россией.
Цель исследования. Это исследование направлено на анализ торгового сотрудничества Китая, Монголии и России в контексте пандемии COVID-19.
Данные и методы. В данной статье применяется метод сравнительного анализа для изучения развития и изменений в импортно-экспортной торговле между Китаем, Монголией и Россией до и после начала проекта экономического коридора Китай-Монголия-Россия с 2014 по 2020 гг. основывается на данных Статистического ежегодника Китая по торговле и внешней экономике, Экономической статистики Северо-Восточной Азии Института экономических исследований Японского моря, Министерства торговли Китайской Народной Республики, Российской таможни и Национального статистического бюро Монголии.

КЛЮЧЕВЫЕ СЛОВА
Китай, Россия, Монголия, экономический коридор Китай-Монголия-Россия, импорт и экспорт, торговые характеристики, COVID-19

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Результаты. Наряду с реализацией среднесрочной и краткосрочной цели увеличения объема товарооборота в рамках коридора, три страны стремятся играть все более и более важные роли в качестве торговых партнеров друг друга. Отмечается, что влияние пандемии COVID-19 на объем торговли не было значительным, и, таким образом, фундаментальные предпосылки трехстороннего торгового сотрудничества остались в основном неизменными.
Выводы. Для увеличения объёмов торговли Китай, Монголия и Россия должны продолжить использовать свои конкурентные преимущества для улучшения структуры торговли, снижения тарифов, создания зон свободной торговли, активного содействия диверсификации торгового сотрудничества со своими торговыми партнерами.

ДЛЯ ЦИТИРОВАНИЯ
Zhang, X. (2021). Prospects of China-Mongolia-Russia trade in the light of the COVID-19 pandemic. *R-economy*, *7*(3), 192–199. doi: 10.15826/recon.2021.7.3.017

Introduction

The China-Mongolia-Russia Economic Corridor is the first multilateral economic corridor within the framework of the 'One Belt and One Road'. It has been more than six years since President Xi Jinping proposed to build the China-Mongolia-Russia Economic Corridor (hereinafter the Corridor) by docking the Silk Road Economic Belt with Russia's Trans-Eurasia Railway and Mongolia's Grassland Road initiative at the first meeting between the heads of China, Russia and Mongolia on September 11, 2014. Under the framework of the Belt and Road Initiative and the China-Mongolia-Russia Economic Corridor, the bilateral economic cooperation and trade are expanding and the foreign trade volume is increasing year by year (Li, 2019).

Since 2014, China, Mongolia and Russia have been working together to build an economic corridor. However, the three countries have also experienced various difficulties such as the economic slowdown, trade war and economic sanctions. In particular, the COVID-19 pandemic delayed some of the cooperation projects and affected the trade between China, Mongolia and Russia.

At present, China, Russia and Mongolia are all dealing with an important task of ensuring a medium and long-term economic recovery. Since foreign trade plays a crucial role in the economic development of these three countries, to meet their strategic goals, they all need to maintain productive relationships with their neighbours and economic partners under the framework of the Corridor.

Therefore, the purpose of this article is to analyze the prospects for the development of trade cooperation between China, Mongolia, and Russia while the three countries are tackling the consequences of the pandemic, in particular the trends in import and export trade.

Literature review

In general, since the Corridor has a short history, the Chinese research literature on this topic is quite scarce. The existing studies mainly focus on the background, significance, current situation and prospects of this project. With the advancement of the construction of China-Mongolia-Russia Economic Corridor and the changing international situation, the studies can lose their practical significance very quickly.

A separate group of studies deal with the trade cooperation between China, Mongolia and Russia (see, for example Wei & Yucong, 2021; Zhaoli, Yanjong & Guangwen, 2016). Most of these studies use the methods of qualitative analysis. Wei and Yibing (2016) analyzed the process of trade development and the structure of imports and exports between China, Mongolia and Russia in 1998–2014. They believe that the trade potential accumulated by China and Mongolia was significantly increased under the 'One Belt and One Road' initiative, but the bilateral trade potential of Russia and China had not been fully utilized, and there was still room for further expansion. They also pointed out that giving full play to trade complementarity is a great driving force for deepening cooperation between China, Mongolia and Russia, and that it has a great significance for promoting the construction of the Corridor.

Guangwei (2016) and Yanhua (2019) analyzed the economic effects of trade between China, Mongolia, and Russia. Qiaoyi (2016), Shumin & Rui (2017), Yingjing, Xuefeng & Nan (2017) believe that the trade complementarity and structural optimization of the three countries are essential for the development of the Corridor. Qun & Ge (2019) analyzed such problems as inefficient trade structure, low trade support and the capital gap in the construction of the Corridor, and formulated recommendations concerning the

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measures for improving the situation. Only Jin et al. (2021) forecast the outcomes of the Corridor project in the five-year period following the project's beginning through the combination of qualitative and quantitative methods of analysis. This is a relatively comprehensive study, but it does not provide any detailed analysis of the development of trade between China, Mongolia and Russia.

There are also studies focusing on the construction of the Corridor after the beginning of the COVID-19 pandemic. Qinglong (2020) reflects on how the Inner Mongolia Autonomous Region can cope with the situation. Zhou Yixin & Yan Nan (2021) describe the international cooperation mechanism for promoting the construction of the Corridor in the light of the pandemic and measures for containing and control of the pandemic.

Interestingly, Russian and Mongolian scholars are more optimistic about the prospects of Sino-Russian and Sino-Mongolian trade. For example, Suslov (2019) believes that trade can be driven by large project cooperation in the future while the Sino-Russian trade structure has not changed significantly in the past decade. Ostrovsky (2019) argues that although Russia is China's main trading partner among the countries of the Belt and Road Initiative, the proportion of China-Russia trade in China's foreign trade is not significant and Russia should seize the opportunities of China-Russia cooperation in the future. A Mongolian scholar Bulma (2021) believes that the Corridor creates great opportunities for expanding trade among the three countries. A similar view is expressed by Na (2021), who emphasizes the effects of cooperation between Mongolia and China.

Methods and Data

This article applies the method of comparative analysis to examine the development and changes in the bilateral import and export trade between China, Mongolia, and Russia before and after the construction of the Corridor began. The analysis also focuses on the impact of the pandemic and further prospects of the project. Recommendations regarding effective response strategies in dealing with the adverse effects of the pandemic are proposed.

Three stages are distinguished in the development of the bilateral import and export trade data of China, Mongolia and Russia: the first stage coincided with the beginning of the 21st century (2001–2014); the second was the period when the trade between the three countries was actively developing (2015–2019) after the construction of the Corridor; and the third stage was characterized by the impact of the COVID-10 (2020).

The core data of this paper are collected from the China Trade and Foreign Economy Statistical Yearbook, Northeast Asia Economic Statistics of Sea of Japan Economic Research Institute, Ministry of Commerce of the People's Republic of China, Russian Customs, and the National Bureau of Statistics of Mongolia.

Results

This paper continues the line of research started in (Xujie, 2021). The article also attempts to identify the positive and negative factors affecting the Sino-Mongolian-Russian trade cooperation during the pandemic.

Sino-Russian Import and Export Trade

Russia and China have a long history as trade partners. In the early stage of Russia's economic transition, Sino-Russian trade experienced great fluctuations. Since the beginning of the 21st century, Sino-Russia relations have embarked on the track of rapid development, and trade has also been on a rise. The total bilateral trade between China and Russia increased 7.93 times from US $10.668 billion in 2001 to 95.270 billion in 2014, with an average annual growth rate of 19.01%. Thus, overall trade has been displaying an upward trend (Xiufang & Ruixin, 2021). However, due to the influence of the world financial crisis in 2009 and subsequent crisis in Ukraine, Russian financial crisis, Syrian war and other factors, Sino-Russian trade experienced two significant declines, as shown in Fig. 1.

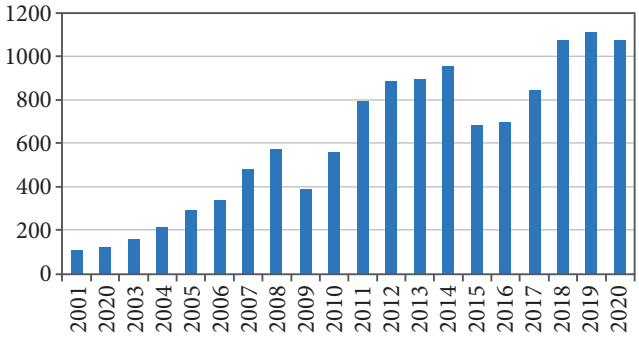

Figure 1. *Statistics of import and export trade between China and Russia*
Unit: $100 million
Source: China Trade and Foreign Economic Statistics Yearbook. Retrieved from: http://www.tjcn.org/tjnj/MMM/38498.html

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Under the framework of the Corridor and Belt initiatives, China and Russia signed the 'Memorandum of Understanding on Promoting Bilateral Trade', 'Economic and Trade Cooperation Agreement between China and the Eurasian Economic Union', and the 'Development Plan for China-Russia Cooperation in the Russian Far East (2018–2024)'. These documents aim further facilitate trade between China and Russia by building a good cooperation platform for Chinese and Russian enterprises. As a result, since 2015, bilateral trade between China and Russia grew to the level of $100 billion in 2018. In 2019, the trade volume between China and Russia reached US $110.94 billion, that is, there was a 3.58% increase. Accordingly, the proportion of the trade volume between China and Russia in Russia's total foreign trade has also increased in the past two years compared with the previous period, increasing to 16.6% in 2019, by 0.9 percentage points compared with the previous year (Table 1).

In 2020, trade between China and Russia was also affected by the COVID-19, but the bilateral trade volume still reached US $107.765 billion, exceeding the level of US $100 billion in the three consecutive years. China's exports to Russia amounted to US $50.585 billion, that is, there was a 1.7% increase. Imports from Russia were $57.181 billion, that is, they fell by 6.6%. Trade between the two countries fell by only 2.9%, which means that it remained relatively unaffected by the pandemic in comparison with other trade partners. In terms of growth in trade, Russia ranks first among China's trade partners. China remains Russia's top trade partner, while Russia is China's tenth largest trade partner.

As the two countries start to recover after the pandemic, the industrial chain and industrial structure of bilateral economic and trade cooperation will also usher in new opportunities for development. The decline in China's exports to Russia has gradually slowed, while imports of energy, mineral products and agricultural products from Russia have continued to expand. Bilateral trade between China and Russia from January to April 2021 reached US $40.21 billion, exceeding US $40 billion for the first time in the first four months, increasing by 21.2 percent compared with the same period in 2019 and doubling compared with the same period in 2016. In 2021, China-Russia trade is expected to maintain its momentum of growth, and the volume of trade is expected to hit a new high. In the complex international economic environment, China-Russia import and export trade has shown a sound momentum for development, which indicates that the fundamentals of Sino-Russian cooperation remain unchanged (Yu, 2020).

Import and Export Trade between China and Mongolia

China and Mongolia signed their first long-term trade agreement in 1986 (Nomi, 2020). China has been Mongolia's biggest trading partner since 1999, overtaking Russia. As Mongolia implements the strategy of revitalizing its mining industry and vigorously attracts foreign investment, China's direct investment in Mongolia also grows rapidly, which drives the import and export trade between the two countries (see Fig. 2). From 2005 to 2014, the trade between China and Mongolia increased more than 8 times, accounting for more than 50% of Mongolia's total foreign trade.

Table 1

Bilateral import and export between China, Mongolia and Russia from 2015 to 2019, Unit: $100 million

Year	China and Russia import and export volume	Share of total China's trade volume	Share of total Russia's trade volume	China and Mongolia import s and exports	Share of total China's trade volume	Share of total Mongolia's trade volume	Russia and Mongolia imports and exports	Share of total Russia's trade volume	Share of total Mongolia's trade volume
2015	680.2	1.7	12.1	52.8	0.13	62.1	10.98	0.21	12.9
2016	696.2	1.9	14.1	49.6	0.13	60.0	9.36	0.20	11.3
2017	842.2	2.1	14.9	67.4	0.16	63.4	12.87	0.22	12.2
2018	1071.1	2.3	15.8	85.1	0.18	65.9	17.96	0.26	13.9
201	1109.4	2.4	16.6	88.5	0.19	64.9	17.98	0.27	13.1

Source: (1) China and Russia's import and export volume from 'China's Trade and Foreign Economic Statistics Yearbook'; Retrieved from: http://www.tjcn.org/tjnj/MMM/38498.html

(2) The data on the import and export volume of China, Mongolia, Russia and Mongolia is based on the Northeast Asia Economic Statistics of the Sea of Japan Economic Research Institute; 'Northeast Asia Economic Statistics', Sea of Japan Economic Research Institute

(3) The total imports and exports of China, Russia and Mongolia are respectively based on the Ministry of Commerce of the People's Republic of China, the Russian Customs and the National Bureau of Statistics of Mongolia (http://www.mofcom.gov.cn/; https://customs.gov.ru; www.montsame.gov.mn).

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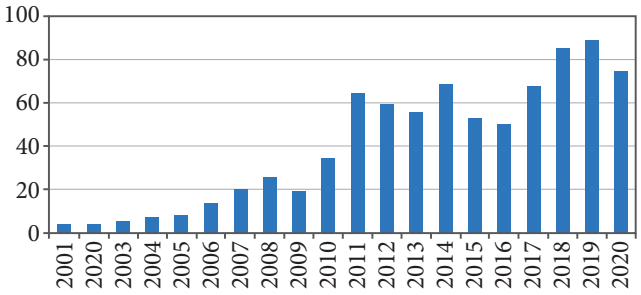

Figure 2. *Statistics of import and export trade between China and Mongolia*
Unit: $100 million
Source: 'Northeast Asia Economic Statistics', Sea of Japan Economic Research Institute. Retrieved from: https://www.erina.or.jp/publications/databook/

Due to the adjustment of domestic laws and policies, the reduction of international mineral prices, the heavy debt burden and other factors, the economy of Mongolia was exhibiting downward trends for five consecutive years from 2012 to 2016, which made the trade between China and Mongolia unstable. With the help of the International Monetary Fund, China and other countries, the short-term debt problem of Mongolia was solved and the economy of Mongolia recovered. A substantial contribution to this process was made by the 'One Belt and One Road' and 'Road to Development' construction projects. In 2017 and 2018, the trade between China and Mongolia rose dramatically by 35.9% and 26.3%, respectively. From 2015 to 2019, the import and export volume of China and Mongolia accounted for more than 60% of Mongolia's total foreign trade (Xiujie, 2019) (Table 1).

Since the outbreak of COVID-19, China and Mongolia have maintained normal import and export trade. Erenhot, the largest land port on the Chinese-Mongolian border, handled 16.1572 million tons of imports and exports in 2020, which means that there was a 9.8% increase in comparison with the previous year and a record high for the port. However, in 2020, the trade volume between China and Mongolia declined, with the total bilateral trade volume reaching 7.4 billion US dollars, there was a 16.85% decline in comparison with the same period of the previous year. The total exports to China were US $5.49 billion, that is, there was a decrease by 19.15% year-on-year. The total import volume from China was US $1.91 billion, which means a decrease by 7.28% year-on-year.

After the pandemic, as national economies will start to recover, the demand for gold, copper, oil and coking coal will increase, and the prices will also rise, which will naturally bring more development opportunities to Mongolia and also stimulate trade between China and Mongolia. Bilateral trade between Mongolia and China rose to US $2.446 billion in the first quarter of 2021, accounting for 68.9% of Mongolia's total foreign trade. Mongolia's exports in the first quarter were $2 billion, and exports to China were $1.85 billion, accounting for a whopping 92.5%. On January 1, 2021, China and Mongolia implemented the tariff concession arrangement under the Asia-Pacific Trade Agreement, which means that lower tariffs will be applied to goods imported by China and Mongolia to promote the growth of the import and export trade between the two countries.

Import and Export Trade between Russia and Mongolia

For a long time, the progress in the economic and trade relations between Russia and Mongolia have been much less significant than the progress in the political sphere (Lijun & Chao, 2016). Figure 3 shows that in 2008, for the first time, the volume of exports and imports between Russia and Mongolia reached the level of $1 billion. Since then, the volume of trade between Russia and Mongolia rose continuously, reaching nearly $2 billion in 2012. However, due to a number of external and internal reasons, the volume of exports and imports was only $936 million in 2016.

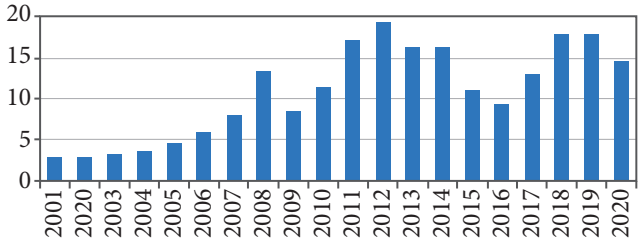

Figure 3. *Statistics of import and export trade between Russia and Mongolia*
Unit: $100 million
Source: 'Northeast Asia Economic Statistics', Sea of Japan Economic Research Institute. Retrieved from: https://www.erina.or.jp/publications/databook/

Under the framework of the Corridor, the cooperation between Russia and Mongolia has become more pragmatic and rational. As Mongolia managed to overcome some of its economic difficulties, the volume of trade between the two countries started to grow after 2016. It should be noted that Russia has long been Mongolia's second-largest trade partner after China (Zhihong, 2021). In 2020, the bilateral trade volume

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was about $1.457 billion, which signifies a fall by 18.97% in comparison with the previous year. The volume of Mongolia's exports to Russia was $57 million, which shows a fall by 16.7% and imports, $1.4 billion, that is, a fall by 19.02%.

Analysis of the prospects of trade cooperation between China, Mongolia and Russia

Based on the above analysis, we can make the following conclusions. First, the development of bilateral trade between China, Mongolia and Russia has not been stable. Driven by the construction of the Corridor, the volume of trade has increased. The bilateral trade between China and Russia and Mongolia fluctuated slightly only in 2016, which was mainly due to the mistakes in the adjustment of foreign investment policies in Mongolia and the debt crisis, resulting in a relatively large economic decline for two consecutive years. Second, the proportion of bilateral trade between China, Mongolia and Russia in the total trade volume has also increased in recent years. In particular, Mongolia's exports to China account for more than 84% of its total exports, and Mongolia's imports from China account for more than 32% of its total imports, which shows that Mongolia has a high degree of trade dependence on China. However, for China, the world's largest trading country, the import and export volume of China and Russia and China and Mongolia account for a small proportion of China's total import and export volume, and their overall efficiency is lower than that of other 'One Belt and One Road' countries (Piping, 2019).

There are five key aspects of trade cooperation between China, Mongolia and Russia that are worthy of interest.

First, since the outbreak of the pandemic, China, Mongolia and Russia have managed to maintained stable relations and support each other in the joint struggle against the pandemic. Phone calls and regular meetings of national leaders helped to develop practical solutions to enhancing the countries' cooperation during the pandemic. The Sino-Russian trade relations were developing steadily in 2020[1]. China and Mongolia have launched their first 'green channel' for border crossing. Thus, trade cooperation between China, Mongolia and Russia is expanding, and the construction of the Corridor is one of the major platforms of their cooperation.

Second, the further progress of the pandemic has led the three countries to increase border control and impose more rigorous customs clearance procedures, resulting in a sharp rise in transport costs. At the same time, China, Mongolia and Russia are also at risk of the rebound and mutation of the COVID-19, which would have a negative influence on trade cooperation.

Third, although national plans such as the joint construction of the Corridor have played an important role in promoting economic and trade cooperation, there are other factors such as the macro-economic environment, institutional and legal environment and infrastructure of the host countries that may impede cooperation.

Fourth, the projects between China, Mongolia and Russia will contribute to their cooperation, for example, China and Russia announced that a new natural gas pipeline will be 'routed' through Mongolia for 'win-win' results. The railway transportation network of coal across the border between China and Mongolia is gradually improved, and the coal exports from Mongolia to China will increase in the future.

Fifth, the development of the trilateral trade relations is closely related to the changes in the global economic situation or economic politics. The Sino-US trade frictions create risks as well as new opportunities (Shilo, 2020). Mongolia, surrounded by China and Russia, prioritizes the foreign policy to develop relations with these countries while looking to the United States to balance their influence.

Conclusion

In this paper we were looking at the dynamics of trade cooperation within the China-Mongolia-Russia Economic Corridor since the beginning of the 21st century, focusing on the impact of the COVID-19 pandemic on trade in 2020 and further prospects of this cooperation. It was found that the fundamental premises underlying the Corridor project have not been influenced significantly by the pandemic. The construction of the Corridor is expected to bring the following results: infrastructure construction and improvement; enhancement of political, economic and cultural exchanges; and improvement of the border trade management system.

To achieve the goal of increasing the volume of bilateral trade between China, Mongolia and

[1] Yonghui, L. The pandemic will hardly hinder the sustained high-level development of Sino-Russian relations. Russian News, 2020.12.25.

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Russia, first of all, we should pay attention to the respective advantages of China, Mongolia and Russia, improve the trade structure and low added value among the three countries, and actively promote the diversified development of trilateral trade cooperation to expand the scale of trade. Second, China, Mongolia and Russia should improve their own trade systems, adjust their legislation in accordance with international practices, and protect the legitimate interests of the three parties. The governments of China, Mongolia and Russia need to further discuss the policy of tariff reduction, lower trade barriers, and establish free trade areas.

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Information about the author

Xiujie Zhang – Researcher of Institute of Northeast Asian Studies, Heilongjiang Provincial Academy of Social Sciences (No. 1000 Shibo Road, Songbei District, 150028, Harbin, China); e-mail: zhangxiujie203@163.com

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Информация об авторе

Чжан Сюцзе – исследователь, Институт североазиатских исследований, Академия социальных наук провинции Хэйлунцзян (150028, Китай, Харбин, Сунбей Дистрикт, Шибо Род, No. 1000); e-mail: zhangxiujie203@163.com

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The relationship between foreign direct investment and GDP in Cameroon (2000–2020)

L.P. Numbu[1, 2] ✉, **Zh.S. Belyaeva**[1]
[1] *Ural Federal University, Ekaterinburg, Russia; resor199494@gmail.com*
[2] *Gadget Zone 237, Yaounde, Cameroon*

ABSTRACT
Relevance. In the last 20 years Cameroon has faced a series of crises. The 2035 governmental programme of recovery aims to transform the country into an emerging economy nation. The effects of the COVID-19 pandemic have slowed down economic growth in Cameroon and the country is hoping to attract foreign direct investment (FDI) and thus benefit from the new business opportunities to revitalize its economy. This context makes the research on the relationship between FDI and GDP particularly relevant.
Research objective. This paper is designed to assess the relationship between GDP and FDI in Cameroon in 2000-2020. In addition, we aim to assess the scope of internationalization through FDI as a possible catalyst for economic recovery.
Data and methods. The paper uses correlation and regression analysis to show the relationship between FDI and GDP.
Results. The results show that FDI can increase Cameroon's GDP and may be used as an empirical basis for policy- and strategy-making in Cameroon.
Conclusions. We found a strong correlation between FDI and GDP in Cameroon for a 21-year period. This result is supported by the double effect of FDI on the national economy: FDI directly affects the investment component of GDP, but it also influences economic growth indirectly. The activities of foreign firms in Cameroon can support trade and even balance of payment, which indirectly influences the export and import component of GDP. Foreign subsidiaries both solely owned or joint ventures pay indirect taxes to the government and thus influence government spending.

KEYWORDS
foreign direct investment, GDP, global pandemic crisis recovery, Cameroon, business environment

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Связь между прямыми иностранными инвестициями и ВВП в Камеруне (2000–2020)

Л.П. Нумбу[1, 2], **Ж.С. Беляева**[1]
[1] *Уральский федеральный университет, Екатеринбург, Россия; tresor199494@gmail.com*
[2] *Gadget Zone 237, Яунде, Камерун*

АННОТАЦИЯ
Актуальность. За последние 20 лет Камерун столкнулся с серией кризисов. Правительственная программа восстановления на 2035 г. направлена на превращение страны в страну с развивающейся экономикой. Последствия пандемии COVID-19 замедлили экономический рост в Камеруне, и страна надеется привлечь прямые иностранные инвестиции (ПИИ) и, таким образом, извлечь выгоду из новых деловых возможностей для оживления своей экономики. Этот контекст делает исследование взаимосвязи между ПИИ и ВВП особенно актуальным.
Цель исследования. Исследование направлено на оценку взаимосвязи между ВВП и ПИИ в Камеруне в 2000–2020 гг. Кроме того, мы стремимся оценить масштабы интернационализации через прямые иностранные инвестиции как возможный катализатор восстановления экономики.
Данные и методы. В документе используется корреляционный и регрессионный анализ, чтобы показать взаимосвязь между ПИИ и ВВП.

КЛЮЧЕВЫЕ СЛОВА
прямые иностранные инвестиции, ВВП, выход из глобального пандемического кризиса, Камерун, бизнес-среда

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Результаты. Результаты показывают, что прямые иностранные инвестиции могут увеличить ВВП Камеруна и могут использоваться в качестве основы для разработки политики и стратегии в Камеруне.
Выводы. Мы обнаружили сильную корреляцию между ПИИ и ВВП в Камеруне за 21-летний период. Этот результат подтверждается двойным влиянием ПИИ на национальную экономику: ПИИ напрямую влияют на инвестиционную составляющую ВВП, но также косвенно влияют на экономический рост. Деятельность иностранных фирм в Камеруне может поддерживать торговлю и даже платежный баланс, что косвенно влияет на экспортно-импортную составляющую ВВП. Иностранные дочерние компании, находящиеся в единоличной собственности или совместные предприятия, платят косвенные налоги государству и, таким образом, влияют на государственные расходы.

ДЛЯ ЦИТИРОВАНИЯ
Numbu, L.P., & Belyaeva, Zh.S. (2021). The relationship between foreign direct investment and GDP in Cameroon (2000–2020). *R-economy*, *7*(3), 200–209. doi: 10.15826/recon.2021.7.3.018

Introduction

Developing countries, including Cameroon, seek foreign direct investment (FDI) to stimulate their economic development. Cameroon strives to gain the status of emerging economy by 2035. Over the past decades, the country's government has made substantial effort to improve the investment climate and attract foreign investors. The country's economic performance has also improved considerably since the mid-1990s. Although the current value of FDI into Cameroon is still below the projected values (Stephane, 2020), several potential investors have described Cameroon as not the best country to invest in (Efiong, 2013) in terms of the ease of doing business, taxes and political insecurity.

The current global pandemic has had its toll on nearly every nation, and while the full extent of its effects is yet to be established, many businesses in Cameroon have been trying to mobilize their resources to survive the pandemic. The current health crisis hit Cameroon at the time when the country was struggling to resolve the ongoing armed conflict in the English-speaking territories. The Anglophone crisis has led to similar effects on the economy as the COVID-19 crisis. Both crises have led to increased mortality rates and, as the government was trying to minimize the damage, to the restrictions on movement, social distancing, and lockdowns. Another problem was the falling foreign investment due to the above-described events. However, while the Cameroonian problems are known and their impact has tainted the country's reputation both internally and externally, there is a number of positive aspects which are mostly unknown to foreign investors. The government has substantially improved its FDI framework and has moved its primary focus from the natural resources sector to the service and manufacturing industries.

There are three standard types of FDI defined in theory: efficiency-seeking, market-seeking and resource-seeking FDI (Dunning, 2000). Cameroon receives mainly market and resource seeking FDI as the nation has a growing economy and has fertile land and abundant resources attractive for several foreign manufacturing companies.

There are certain differences in the factors that shape FDI into developing countries in Sub-Saharan Africa (SSA) and in other regions (Jaiblai, 2019). While high return on capital and infrastructural development boost FDI in non-SSA countries, these factors have no impact on the situation in SSA countries. Trade openness alone promotes FDI in both SSA and non-SSA (Asiedu, 2002). According to Suliman (2009), the determinants of FDI to Africa are GDP growth, openness, international reserves, literacy rate, freedom (political and civil rights), natural resources, and war. Thus, it is necessary to create policies depending on what is best to attract FDI.

All of the above explains the purpose of our research, which is aimed to evaluate the positive payoff from FDI, and address the question as to whether FDI can be a catalyst for the country's economic recovery. This study will focus on the relationship between GDP and FDI and the question as to how this relationship defines the national strategy until 2035: for the period of 2020–2027 the government is planning to turn Cameroon into a middle-income country and for 2028–2035, to turn it into an emerging market economy.

Theoretical framework

The following part examines a set of proposed variables based on the research on the effects of FDI. The current situation of the military conflict in Cameroon (Simpeh, 2019; Agwanda, 2020) is a suitable example of an internal crisis. The

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COVID-19 pandemic that is ravaging the world (Naveen, 2020) is an external crisis.

In our study, we intend to look at the relationship between GDP and FDI. Gross domestic product (GDP) is considered to be the main indicator of economic growth (Tim, 2020) in a particular country at a given time. GDP is universally defined as the monetary value of all final goods and services manufactured in a given territory. GDP levels can be influenced by different factors and variables both internal and external to national economy: e.g. consumption levels, education rates, unemployment rate, the number of firms, trade openness, foreign direct investment and volume of remittances.

Foreign direct investment is the money/resources directly injected into the national production of goods and services by a company located overseas. It can be done either by buying or by expanding the operations of an existing business in the target country (Arafatur, 2015). FDI is most often considered to be a growth catalyst and it has received increasing attention in developing and less developed countries in recent years. It is beneficial to every nation becomes it contributes to economic growth in terms of technology, skilled labor, and transfer of skills (Acemoglu, 2006; Nadeem, 2014).

Drawing from the study by Sun (2002), in an era of increased economic globalization, FDI is a significant driving force behind the interdependence of national economies especially of developing nations. Alam (2013) examined the potential determinants of FDI with the help of a panel data set of ten OECD member countries (1985–2009). The Granger causality test was used to identify short- and long-run causalities between FDI and all the variables that were proven to be significant determinants of FDI through regression analysis. The results indicate that the labor cost, quality of infrastructure and market size are the factors that influence FDI. According to modern economists, FDI has the potential to be helpful to increase GDP of developing economies (Ajayi, 2006). This assumption relies on the fact that FDI will effectively contribute to the countries' growth and will help expand their domestic markets.

Kang (2011) used regression analysis to study the bi-directional link between FDI and economic growth in Cameroon for 1980–2009 and showed a highly positive relationship between FDI and economic development. It was also established that FDI is more efficient than domestic investment in boosting economic growth. Forcha (2009) looked at the connection between FDI and economic performance of Cameroon in 1970–2007. Based on the OLS technique and the cointegration error correction mechanism (unit roots test), it was found that FDI positively responds to industrialization. The study indicates that FDI significantly impacts the economic performance of Cameroon and reacts rapidly to growth than any other variable. Hakizimana (2015) investigated the relationship between FDI and Rwanda's GDP per capita and found a positive relationship between FDI and GDP. Hassen (2012) examined the impact of FDI on Tunisia's economic growth by using the data for 1975–2009 and found that FDI could boost long-term economic growth. The examination of FDI in Kenya as the main driver for real GDP growth shows that FDI is mainly related to the situation in the market such as good infrastructure, political stability, market size and low corruption levels (Abala, 2014).

Wakyereza (2017) studied the impact of FDI on employment, poverty reduction and economic growth in Uganda in 1985–2014 by using the Vector AutoRegressive (VAR) and Ordinary Least Squares (OLS) and found that FDI has a positive influence on all the three indicators. Suleiman (2013) used dynamic OLS for SACU countries (Botswana, Lesotho, Namibia, South Africa, and Swaziland) and founnd that FDI's impact on economic growth was significant and dynamic. Among many others, Ngeny (2014) investigated the influence of FDI on Kenya's development, using time series data for 1970–2011. The findings from this study confirms that FDI has a positive effect on growth. Stoneman (1975) investigated the role of FDI on the economic growth of developing nations and his results indicate that FDI increases productivity levels as a result of higher capital stock and improves the balance of payment position of the host countries. In the paper to actualize the impact of savings and FDI on economic growth in emerging Asian economies, a VECM (Vector Error Correction Mechanism) was applied by Bayar (2014) on the data for 1982–2012. A long-run positive relationship was then established between FDI and economic growth. In the same vein, Faruk (2012) showed that FDI has a more considerable impact on economic growth by using the OLS technique to investigate the effect of FDI on the growth of the Bangladeshi economy for 1980–2011.

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Gupta (2015) applied the regression analysis method to assess the impact of FDI on India's economic growth by using secondary data for 2000–2013 and showed that FDI needs three years to start boosting economic growth. Yusuf (2020) uses the dynamic fixed effect technique to study the impact of FDI, financial development, political instability and democracy on economic growth in West Africa for 1996 to 2016. No significant relationship was found in the short run although the study detected a significant positive relationship in the long run for the coefficient of FDI. Agya (2014) explored the effect of FDI on China's economic growth, using the data for 1995–2010 and the Granger causality test. It was found that FDI does not in any way cause economic growth in the primary industry.

Cameroon's twin crisis means that as the nation lacks resources to tackle the problems, there is a need for external assistance (Forgha, 2009). Cameroon's twin crisis is an exogenous shock that affects the territory through several different transmission paths. World trade is today undergoing its fastest decline in many decades. FDI and remittances are plummeting significantly. Cameroon is not in a favorable position to address the consequences of the current economic crisis. International support to mitigate the effect of this twin crisis is vital in that it can reduce the possibility of a long-term plan failure by sustaining concessional financing to revive Cameroon's economy. The size and speed of the international response will be vital in determining the impact of the crisis on Cameroon's economic performance. This explains why the volume and the quality of FDI are today increasingly crucial for growth and resilience.

Data and methods

As noted above, this study relies on the secondary data sources to gather the data for all the variables in question (GDP growth, GDP, FDI, inflation, national debt, and trade openness) for a 20-year period. The sources we used include IMF reports, the World Bank's database and Trading Economics and Doing Business ranking. Inflation can be captured by GDP deflator; the consumer price index was taken and used as a proxy. Net trade in goods and services was the benchmark indicator for trade openness. The net inflow in FDI was chosen as the main variable. Although in our research more emphasis is given to GDP and FDI, other macroeconomic indicators were considered as well.

At the test phase, we are going to show how FDI can be used to predict the GDP of a nation. To this end, we are going to use four classes of variables. FDI is the primary independent variable (predictor) with the net capital flow as the proxy for FDI. the dependent variable is the economic growth of Cameroon seen as the change in GDP over the years. We also introduce control variables and a dummy (crisis). The national debt level can control the relationship between FDI and economic growth. It was also crucial to include past GDP, trade openness, and inflation.

The path to establishing the relationship between the macroeconomic indicators via the Pearson correlation coefficient was considered to fit best the purpose of this research (1)

$$EG_I = \beta_0 + \beta_1 FDI + \beta_2 Rem + \beta_3 INF + \\ + \beta_4 TO + \beta_5 Debt/GDP + \beta_6 (C) + \varepsilon, \quad (1)$$

where β (1, 2, 3, 4, 5, 6 and 7) are estimated coefficients, PGDP is the past gross domestic product, TO, trade openness, INF, the rate of inflation, D/GDP is the debt to GDP ratio, FDI is foreign direct investment, Rem stands for remittances and C, for crisis.

The Pearson correlation coefficient and the concept of variance are applied to examine the relationship between the macroeconomic indicators in relation to FDI and GDP. Variance explained (R^2) is adopted to identify the strength of the relationship between FDI and Cameroon's GDP, the proportion of GDP explained by FDI. Variance analysis is another method which can be used to show that FDI is a predictor of GDP. In other words, we need to convert the correlation coefficient (R) into the coefficient of determination (R^2) to obtain an indicator that would show the relationship between the variables.

The IMF and World Bank databases are used as reliable sources of global and national data. Other sites such as Trading Economics and Doing Business rankings were also used as source of data for the chosen period.

Results

The descriptive statistics of the studied variables for 21 years is given in Table 1.

Descriptive evidence is used to show the trend and relationship between the given macroeconomics indicators via the 21-year time-series data (2000–2020). It should be noted that we took new inflow to measure both FDI and remittance. For the application of natural log that the study

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assumes the value of zero for negative net values. It is for this reason that the minimum values for these multiple variables (FDI and remittances) are taken as zero. It was difficult to obtain the log values of net trade since Cameroon seems to have more imports than exports. In such a scenario, net trade is negative and does not permit the application of natural log to reduce the risk of deviation, which means that the standard deviation is high and the presence of outliers has greater significance. Trade openness, remittances, and national debt as a ratio of GDP also show the risk of deviation or presence of outliers.

It may be difficult to depict the behavior of GDP with respect to changes in FDI since the connection between the two is more complex. The bar in Figure 1 can show fluctuations of GDP from 2000 to 2020, but the movement in the line graph (FDI) is not very visible, which does not necessarily signify the absence of the relationship between the core variables of the study. It merely implies that GDP values are higher than those of net FDI, and the fluctuations seem small, especially as the values of FDI are net inflow (inflow – outflow). Cameroon's GDP appears to be on the rise with just a few noticeable drops in the given period. Despite the Anglophone crisis, Cameroon's GDP maintained the same growth rate for 2018 and 2019 financial year. The explanation may be that the system has developed a kind of a shield that can protect it in the period of crisis. Thus, the effect of the crisis on GDP and its growth will become more pronounced later. This is a sound argument since the impact of the crisis on the economy is not immediate, and the 2020 projection of GDP already indicates a fall in GDP.

Table 1

Descriptive statistics

	N	Minimum	Maximum	Mean	Standard deviation
GDP	21	10.0036	10.5884	10.376496	.1879222
Growth in GDP	21	2.0207	6.7810	4.156516	1.1947087
Inflation	21	.2336	5.3378	2.244784	1.4373599
FDI (net inflow)	21	.0000	8.9109	8.143258	1.9171350
Debt/GDP	21	9.3000	75.4000	31.723810	18.9474978
Remittances (net inflow)	21	.0000	8.3962	6.869806	2.8933400
Net trade	21	–1121429117.9	15600000.0	6890415392.9	34168534550.0
Crisis	21	0	1	.29	.463

Source: World Bank (2020). Retrieved from The World bank data Cameroon: https://data.worldbank.org/country/cameroon; IMF (2020, October). International Monetory Fund Cameroon. Retrieved from imf.org: https://www.imf.org/en/Countries/CMR; Trading Economics. (2019). Cameroon GDP. Retrieved from: https://tradingeconomics.com/cameroon/gdp; Doing Business (2020, May). Economy profile Cameroon – Doing Business 2020.

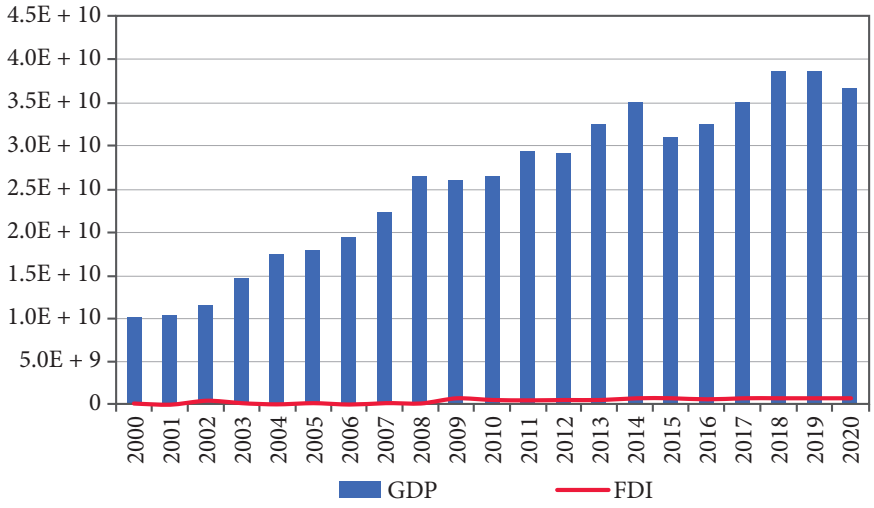

Figure 1. *Time series diagram (GDP vs FDI)*

Source: Compiled by the authors by using the data from: World Bank (2020). Retrieved from The World bank data Cameroon: https://data.worldbank.org/country/cameroon; IMF (2020, October). International Monetory Fund Cameroon. Retrieved from imf.org: https://www.imf.org/en/Countries/CMR; Trading Economics. (2019). Cameroon GDP. Retrieved from: https://tradingeconomics.com/cameroon/gdp; Doing Business (2020, May). Economy profile Cameroon – Doing Business 2020.

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To ensure visibility, the natural log values for both GDP and FDI are considered alongside GDP growth and the inflation rate in Figure 2.

It is difficult to notice any movement in the natural log values of GDP, although the volatility of the natural log values of FDI is visible. Fluctuations in GDP growth and inflation between 2000 and 2020 are quite clear. Growth of GDP seems to go in the opposite direction to the inflation rate, in other words, these two indicators are inversely related to each other. Our main focus is not on inflation or GDP growth. We intend to follow the dynamics in the relationship between GDP and FDI.

According to the first estimation (Table 2), it's not possible to explain changes of GDP growth by using FDI or any of the other indicators. It has been noted that the inflation rate, which is a percentage change in the prices of consumer goods, is more suitable for estimation of the changes in the growth rate of GDP since both are of the second-order derivatives. Though the relationship between inflation and GDP growth is insignificant, it has a p-value (0.085) that is close to 0.05 level of significance. Therefore, it is better to use GDP rather than the growth rate of GDP. It is best to relate actual FDI to actual GDP since growth is a change over a year and may not be tied to a specific year (since it refers to previous year GDP). The Pearson correlation coefficient (r) is one of the best methods of establishing a relationship between variables.

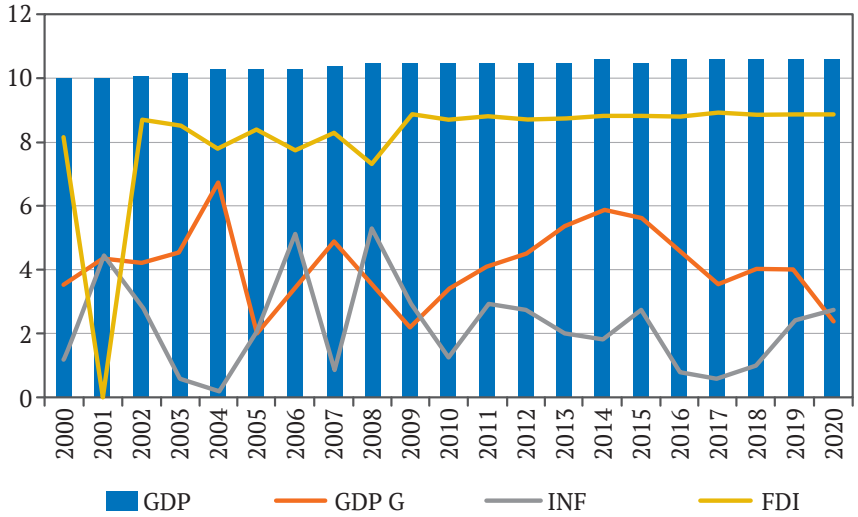

Figure 2. *Trend graph (GDP, FDI GDP growth and inflation)*

Source: Compiled by the authors by using the data from: World Bank (2020). Retrieved from The World bank data Cameroon: https://data.worldbank.org/country/cameroon; IMF (2020, October). International Monetory Fund Cameroon. Retrieved from imf.org: https://www.imf.org/en/Countries/CMR; Trading Economics. (2019). Cameroon GDP. Retrieved from: https://tradingeconomics.com/cameroon/gdp; Doing Business (2020, May). Economy profile Cameroon – Doing Business 2020.

Table 2

Estimation Data

Metric	Indicator	Beta	T-value	P-value	Std.Error	VIF	Comment
GDP growth	FDI	–.195	–.666	.516	.182	1.831	Insignificant
	Remittances	–.141	–.477	.641	.147	1.866	Insignificant
	Inflation	–.457	–1.851	.085	.246	1.306	Insignificant
	Net trade	.528	1.429	.175	.000	2.922	Insignificant
	Debt/GDP	–.074	–.319	.755	.023	1.167	Insignificant
	Crisis	–.195	–.666	.516	.603	1.831	Insignificant
	R square = 6.3 Alpha = 2.921 Significant level = 5%						

Source: Compiled by the authors by using the data from: World Bank (2020). Retrieved from The World bank data Cameroon: https://data.worldbank.org/country/cameroon; IMF (2020, October). International Monetory Fund Cameroon. Retrieved from imf.org: https://www.imf.org/en/Countries/CMR; Trading Economics. (2019). Cameroon GDP. Retrieved from: https://tradingeconomics.com/cameroon/gdp; Doing Business (2020, May). Economy profile Cameroon – Doing Business 2020.

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Table 3

Pearson Correlation

	GDP	FDI	GDP.G	INF	Rem	Debt/GDP	NT	Crisis
GDP	1							
FDI	.525*	1						
GDP.G	.021	–.049	1					
INF	–.098	–.419	–.319	1				
Rem	.840**	.556**	.062	–.171	1			
Debt/GDP	–.396	–.324	.178	–.221	.648**	1		
NT	.217	.085	–.340	.091	.112	.187	1	
Crisis	–.001	.087	.115	–.160	.218	–.268	–.137	1

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Source: Compiled by the authors by using the data from: World Bank (2020). Retrieved from The World bank data Cameroon: https://data.worldbank.org/country/cameroon; IMF (2020, October). International Monetory Fund Cameroon. Retrieved from imf.org: https://www.imf.org/en/Countries/CMR; Trading Economics. (2019). Cameroon GDP. Retrieved from: https://tradingeconomics.com/cameroon/gdp; Doing Business (2020, May). Economy profile Cameroon – Doing Business 2020.

The correlation analysis, especially the Pearson correlation coefficient has multiple uses, one of which is to test the hypothesis (positive or negative relationship). Another significant benefit is to check for multicollinearity between the predictors of an econometric model. The study sidelines the multicollinearity application and focuses on depicting the relationship between FDI and GDP in Cameroon. The Pearson correlation coefficient related to FDI and GDP is positively significant (0.525) at 0.05 significant levels, which means that an upwards trend in FDI tends to improve the level of national output.

Table 4

Hypothesis testing

	GDP (r)	R^2	100 – R^2
FDI*	.525	27.5625*	72.4375*
GDP.G	.021	0.0441	99.9559
INF	–.098	0.9604	99.0396
Rem	.840	70.56	29.44
Debt/GDP	–.396	15.6816	84.3184
NT	.217	4.7089	95.2911
Crisis	–.001	0.0001	99.9999

* Target relationship between FDI and GDP $R^2 = (r)^2 \cdot 100$

Source: Authors' calculations

Our findings agree with those of Stoneman, Sun, Suleiman, Ngeny (Stoneman, 1975; Sun, 2002; Suleiman, 2013; Ngeny, 2014) and confirm that about 27.6% (R^2) of changes in Cameroon's GDP is explained by the role of FDI. Other factors predict the other 72.4% of GDP per financial year. This statistical evidence does not confirm the hypothesis that FDI does not have a positive relationship with GDP.

The oligopolistic telecommunication industry in Cameroon has only one domestic firm – Cameroon Telecommunication (CAMTEL). Orange-Cameroon, MTN-Cameroon and Nextel are branches of foreign companies. They entered the economy as subsidiaries, not as joint ventures. Firms that extend their branches to foreign nations by establishing subsidiaries usually show physical presence that can be seen or notice in the ownership of tangible (physical) assets. The only method of entering the market that may not lead to physical asset ownership is franchising or licensing. These two methods are more practical in developed countries but are rarely applied in less developed countries. In some cases, establishing a joint venture is a better strategy for a developing economy but since local firms lack in resources of their own, foreign companies prefer to establish subsidiaries rather than joint ventures.

The monopolistic competitive banking sector in Cameroon is mostly dominated by subsidiaries of foreign banks. There are about 16 registered banks in Cameroon: NFC bank, Afriland bank and BICEC bank are locally owned banks. Poor technological development and capital scarcity has led to a strong positive and statistically significant correlation between FDI and GDP in Cameroon. To support the required level of employment for a developing economy such as Cameroon, it is necessary to facilitate the pro-

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cess of entering the market for foreign companies. If the nation does not have the resources or technical expertise to support industrialization, then it is better to open the door for those who can help create jobs.

FDI may have a direct and indirect effect on GDP. Its direct effect is that it supports the investment (*I*) component of national income via the expenditure method [GDP = $C + I + G + (X - M)$]. It helps create jobs and thus provides citizens of the country with an opportunity to improve their income, which entails higher consumption (*C*) or living standards. Subsidiaries of foreign companies such as MTN-Cameroon and Ecobank Cameroon have indirect tax obligations to the government and serve as a source of government revenue and support government expenditure (*G*). The end product of the manufacturing firms can be exported (*X*) to other nations while raw materials are imported (*M*) from other countries. The discovered effect accounts for the 27.6% explanatory power of FDI in relation to GDP.

Conclusions

We found a strong correlation between FDI and GDP in Cameroon for a 21-year period. In other words, the more open is Cameroon to FDI, the larger is its GDP. This result is supported by the double effect of FDI on the national economy: FDI directly affects the investment component of GDP, but it also influences economic growth indirectly. Foreign firms in Cameroon can support trade and even balance of payment, which indirectly influences the export and import component of GDP. Foreign subsidiaries, both solely owned or joint ventures, pay indirect taxes to the government and thus influence government spending.

Cameroon's economy has suffered a significant damage after the COVID-19 pandemic and the uprising in Southern Cameroon. Production and economic activities have either been interrupted or disrupted. Another threat to FDI in Cameroon is the instability in its two English-speaking regions. Political instability is known to discourage foreign investment: in most cases, some of the existing multinational firms either wind down their operations or close down altogether if the war persists. In the case of Cameroon, however, the war does not encompass the whole country and is fought mostly in the two English-speaking regions. The government should address such problems as military conflicts and outbreaks of diseases in order to reduce political instability and make their countries more attractive to FDI. A fall in FDI (withdrawal of foreign subsidiaries) may reduce employment, government revenue and industrialization. If the political and epidemiological situation in Cameroon improves, the impact of FDI on GDP may be tremendous.

Our findings can be used for developing policies and strategies for attracting FDI to Cameroon. The country has the potential to become an emerging economy. The government should be able to work towards enhancing the standards of living of Cameroonians and business climate, to fight corruption, put measures in place for good governance so that every citizen could get a fair share of the national cake. It is clear that if the situation remains unchanged, it may be difficult for the country to become an emerging economy by 2035.

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Information about the authors

Levis Petiho Numbu – PhD student in Economics, Graduate School of Economics and Management, Ural Federal University (19 Mira Str., 620002 Ekaterinburg, Russia), Gadget Zone 237 (Yaounde, Cameroon); e-mail: tresor199494@gmail.com

Zhanna S. Belyaeva – PhD, Associate Professor, Graduate School of Economics and Management, Ural Federal University (19 Mira Str., 620002 Ekaterinburg, Russia); e-mail: zh.s.belyaeva@urfu.ru

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Информация об авторах

Петихо Нумбу Левис – аспирант, Институт экономики и управления, Уральский федеральный университет (Россия, 620002, Екатеринбург, ул. Мира, 19); Gadget Zone 237 (Яунде, Камерун); e-mail: tresor199494@gmail.com

Беляева Жанна Сергеевна – кандидат экономических наук, доцент, Институт экономики и управления, Уральский федеральный университет (Россия, 620002, Екатеринбург, ул. Мира, 19); e-mail: zh.s.belyaeva@urfu.ru

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