

## On the Ability of Regions to Adapt to Various External Shocks



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**Abstract.** In order for Russia to successfully respond to current challenges and to prepare for new challenges, it is important to analyze the contribution of regions to solving these tasks. The basis for assessing the sustainability of the Russian regions' economies can be their reaction to the shocks they have already experienced. The article examines economic development of the regions in the context of the 2009 crisis caused by the Great Recession and the 2020 crisis associated with the COVID-19 pandemic. The choice of these very different crises was determined by the aim of the study, which is to find out how universal the ability of regions to adapt to various external shocks is. The sustainability of a region is assessed by comparing its development indicators and data on the economy as a whole. The comparison is based on the dynamics of gross product and changes in innovation activity over periods that overlap the years of business downturn. Groups of regions with different levels of stability are identified and several characteristics of these groups are given. In contrast to the point of view available in the literature, it is shown that a very successful overcoming of one crisis by a region often cannot be repeated in a crisis of another origin. We identify a group of regions, which we can characterize as possessing a relatively universal dynamic stability in the sense of gross regional product growth. As for innovation sustainability, only some of the regions were able to maintain it in different types of crises. In general, for the period from 2008 to 2021, no connection was found between the growth of gross regional product and the regions' innovative activity estimated by the increase in the volume of innovative goods, works, and services.

**Key words:** dynamic stability, resilience, adaptability, external shocks, gross regional product, innovative activity.

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## Introduction

The Russian economy has already faced four challenges in the 21st century: the Great Recession (2009), the first sanctions wave (2015), the COVID-19 pandemic (2020), and the second sanctions wave (2022)<sup>1</sup>. As we know, crisis is both dangers and opportunities to become stronger. In 2023, the Russian economy showed that it is able to grow faster than the economies of many countries that imposed sanctions against it. At the same time, Russia’s GDP growth in 2023 and the overall favorable results of the previous tests hide their different results for individual regions. Analyzing these results is important for preparing for new unknown crises, so it is of great importance to identify regions that have shown the ability to adapt to the trials caused by very different reasons. From this point of view, it is useful to look at the experience of development of Russian regions under the influence of the Great Recession and the COVID-19 pandemic. It is worth taking into account two aspects of adaptation.

On the one hand, of importance is the sustainability of the dynamics of gross regional product (GRP). Regions that are more sustainable in this respect help the whole country to pass the test. However, how universal can the ability of regions to cope with different kinds of challenges be? In (Mikheeva, 2021), the conclusion that the resilience of regions does not depend on the nature of the crisis is based on the analysis of the development of regions in the 2009 and 2015 crises. In this case, for a region to be recognized as sustainable it was sufficient for its economy to reach its pre-crisis peak level during the period

defined as the end of the crisis. This interpretation of sustainability is debatable from the point of view of economic development, since the recovery of the regional economy is enough for it. This article compares the GRP growth rates of regions for the period overlapping the crisis year with the growth rates of the Russian economy as a whole, and the stability of regions is assessed based on the results of such a comparison. We have found that the results of testing the region’s economy by different crises can be radically different. At the same time, a group of regions is identified for which we can talk about relatively universal stability in terms of GRP growth.

On the other hand, the crisis is an opportunity for economic renewal, so adaptability appears as the degree of utilization of the opportunities. The preservation or even increase in innovation activity of the regions comes to the fore. Such activity, as economic theory suggests, may be accompanied by a temporary decrease in output (Helpman, Trajtenberg, 1998). It is important to determine whether the same regions are able to sustain innovation activity in different types of crises. The presence of such regions increases the chances for innovative overcoming of the next crisis situations.

For a country like Russia, having regions with different types of resilience is essential for a successful response to challenges that are different in nature. Shocks like a pandemic are one thing, while foreign economic restrictions aimed at weakening the country’s position in technological competition are another. The problem of ensuring such combined sustainability of the Russian economy by the regions has not yet been considered in the literature.

<sup>1</sup> The years of decline in Russia’s GDP are indicated.

The article analyzes the development of Russian regions in 2008–2010 (Great Recession) and in 2019–2021 (COVID-19 pandemic). For each crisis period, the groups of regions that showed growth rates higher than the all-Russian ones or innovation activity higher than the all-Russian ones at the end of the period are identified. Groups of regions with average and lower sustainability indicators were identified. We identified a group of regions with relatively high GRP growth rates during both crisis periods and a group of regions with relatively high innovation activity during both periods. The article presents a number of characteristics of different groups of regions.

#### Literature review

The number of publications on the problems of economic resilience under external shocks continues growing, but the generally accepted terminology has not yet been established. In recent years, resilience issues are often discussed within the concept of economic resilience. OECD literature refers to resilience as the ability to cope with and recover from shocks while positively adapting and transforming their structures and livelihoods in the face of long-term stresses, change and uncertainty<sup>2</sup>. It is not just about damping perturbations, but about the dynamic stability of the system, preservation of its development potential. The research (Akberdina, 2021) presents a brief sketch of the history of the very concept of “resilience”. However, some researchers prefer to use the terms “sustainability” (Zubarevich, 2021), “shock resistance” (Zhikharevich et al., 2020; Pesotsky, 2021; Kuznetsova, 2022), “regional resistance to external shocks” (Mikheeva, 2021; Mikheeva, 2023).

The concept of resilience in its essence is close to the concept of dynamic capabilities developed in the early 1990s by D. Teece, G. Pisano and

E. Schuen in their article “Dynamic Capabilities and Strategic Management” (Teece et al., 1997) as a firm’s ability to engage in adaptation, integration and reconfiguration of internal and external organizational skills, resources and functional competencies in accordance with the requirements of a changing environment. In (Smorodinskaya, Katukov, 2021), the concept of economic resilience is correlated with the economic theory of complexity (Arthur, 2021). According to this theory, the sustainable functioning of complex nonlinear systems in a continuously changing environment requires both constant internal transformations and recombination of external relations. Since we are talking about the sustainability of socio-economic systems, an important angle of it is social resilience (Akvazba, Leonova, 2021; Romanova et al., 2022).

A significant place belongs to the discussion of resistance indicators in Russian and foreign literature (Vysotsky, 2022). The choice of such indicators is closely related to what is understood by resilience. If the pre-shock state is put at the center of attention, the characteristics of resilience can be the scale of deviation from this state, the rate of return to it after the shock. If the reference point is the initial trajectory of development, the most successful variant of resistance to shocks is the transition to the trajectory of faster growth (Akberdina, 2021).

For socio-economic systems, when analyzing resilience, orientation on their goals is justified. For example, resilience is related to the possibility of continuing its implementation for the participants of an investment project. In the conditions of innovation competition, an important aspect of resilience is the ability to use a common shock to break away from competitors. For instance, the oil shocks of the 1970s actually contributed to the acceleration of technological development of the USA and Japan in comparison with their European competitors.

<sup>2</sup> OECD, SIDA. (2017). Resilience systems analysis: Learning and recommendations report. Paris: OECD Publishing.

According to the analysis of several global economic crises, the opportunities opened during this time are successfully used by those countries that combine measures to overcome the negative effects of the decline in economic activity and preparations for subsequent economic development aimed at strengthening the country's position in the world economy. In other words, it is important not to postpone the formation of a new development trajectory to the post-recovery period. This is confirmed by the experience of corporate development. Companies that do not neglect innovation during the crisis gain an advantage over their competitors during economic recovery<sup>3</sup>.

The concept of resilience refers to both reactive and proactive measures to disturbances in the economic environment (Martin, 2012). Proactive measures include investment in research and development, as this expands the range of available options for responding to the crisis. Resilience to technological challenges is on the agenda in a period of radical renewal of the technological base of the world economy. They are one of the components of the sanctions pressure on Russia. The policy to increase technological and financial sovereignty is not only a forced response to sanctions, but also a proactive preparation for new challenges. Technological sovereignty appears as another angle of analyzing the resilience, ensuring the economic sustainability (Peskov, 2022; Romanova et al., 2022).

The sustainability of territorial economies and sustainability factors are leading directions in studies on economic resilience. These studies contain both cross-country (Hafele et al., 2023) and interregional comparisons of the resilience of the considered objects. When assessing the impact of shocks on regional economies, the dynamics of gross regional product is a frequently used indicator

of the resilience of these economic objects. This approach takes into account that the realization of many regional development goals, including the improvement of the welfare of the population, depends on the growth of GRP volume. According to (Vysotsky, 2022), in the course of interregional analysis, assessments of regions' resilience can be formed by comparing the speed of their economic development to that of the economic complex as a whole.

The publications include a very wide range of key factors promoting economic resilience of territories. A number of studies highlight the role of cities (Wang, Li, 2022), sectoral structure of the economy (Martin et al., 2016; Lazzeretti et al., 2019; Oprea et al., 2020; Akberdina, 2021), human capital, knowledge economy, regional innovation system (Christopherson et al., 2010; Oprea et al., 2020; Akberdina, 2021; Wang, Li, 2022), high level of trust between economic actors (Christopherson et al., 2010) as one of the leading factors.

Along with the importance of the industry structure, the research (Akberdina, 2022) shows the impact on the sustainability of regions of such factors as the possibility to carry out additional capitalization of regional industrial development funds and the availability of import substitution potential. The work (Smorodinskaya, Katukov, 2021) presents a different point of view on import substitution; it indicates that distributed production and trade in value-added rather amortize the crisis consequences of sudden global shocks than amplify them. In this regard, to realize Russia's chances to improve its position in distributed production in the globalization of the 2020s, it is suggested, in particular, to abandon import substitution, to increase intermediate imports for its own exports.

The paper (Malkina, 2024) assesses the impact of the pandemic and sanctions on the real sector of Russian regions using a stress index. The value of this index is the greater the lower the growth rate of the regional indicator and the greater their

<sup>3</sup> Bar Am J., Furstenthal L., Jorge F., Roth E. (2020). *Innovation in a Crisis: Why It Is More Critical Than Ever*. McKinsey Global Institute.

dispersion. Three private indicators were used to assess the stress of the real economy: the index of industrial production; the index of retail trade turnover in comparable prices; and the index of the volume of paid services provided to the population in comparable prices. It is argued that stress indices have a number of advantages over integral assessments of shock or stress resistance of economic systems. They make it possible to assess the growth and decline of stress in dynamics, which makes them suitable for forecasting crisis phenomena. On average, the most vulnerable to shocks were the subjects of the North Caucasian Federal District, while the regions of the Siberian Federal District showed the greatest resilience. The study revealed that the important factors concerning resilience of the regional real economies to a pandemic shock are the industry structure and income level in the region, and to sanctions shocks – also its spatial location.

The paper (Mikheeva, 2021) analyzes the resilience of regional economies to the crisis shocks of 2009 and 2015. Regions that did not experience a decline in GRP and regions in which the pre-crisis peak level recovered during the period defined as the end of the crisis were identified as resilient. Based on the fact that most of the regions that were resilient in the 2009 crisis turned out to be so in the 2015 crisis, it is concluded that the resilience of regions does not depend on the nature of the crisis. However, attention is drawn to the fact that depending on the nature of the crisis, the contribution of regional factors changes not only quantitatively, but also qualitatively. During the 2009 crisis, such factors as the share of urban population, market size, pre-crisis dynamics of the region, and investment growth rate were statistically significant for the dynamics of sustainable regions. In the 2015 crisis, the statistically significant drivers of sustainability were market share, presence of a large agglomeration, export quota of the region and educational composition of the labor force.

Regressors characterizing the innovativeness of regions were not statistically significant for the sustainability of Russian regions.

The 2023 study (Mikheeva, 2023) applied the already tested approach to assess the regions' resilience to specific shocks in 2020 and 2022. This time, along with GRP, a new indicator for regional statistics – the index of output of basic economic activities (BEA) – was used. The authors identified the specialization of regions as an important factor in their sustainability. The regions with a high share of agriculture and manufacturing industries related to the defense industry in the production structure turned out to be sustainable. Among the extractive regions, only some Far Eastern regions, where new capacities were commissioned, were included in the group of sustainable regions.

However, the sustainability criterion used in (Mikheeva, 2021; Mikheeva, 2023) (preservation or restoration of the GRP level) does not exclude subsequent stagnation of the regional economy. From this point of view, such a criterion is not evidence of the dynamic sustainability of the region. It is reasonable to judge dynamic sustainability by the rate characteristics of indicators (Tretyakova, Osipova, 2016). In the future, it is proposed to assess the dynamic stability of the region by comparing the results of the crisis period (GRP of the post-crisis year to GRP of the pre-crisis year) by the region and the country as a whole.

#### **Data and methods**

The study (Pyankova, Kombarov, 2023) discusses the resistance to sanctions pressure in connection with the analysis of the dependence of expenditures on the national economy of the federal budget and regional budgets on the volume of their revenue part. This dependence is considered in the form of a linear regression  $Y = a + bX$ . The attention is focused on the coefficient at the exogenous variable  $X$ . However, the actual sensitivity of expenditures on the economy with a decrease in the revenue part of the budget can

be judged not by the absolute, but by the relative change in the value of expenditures, i.e. by the ratio:  $(Y_1 - Y_2)/Y_1 = b(X_1 - X_2)/Y_1$ . As a result, if the value of parameter a is many times larger than the value of parameter b (such a ratio between them was shown by the calculations in (Pyankova, Kombarov, 2023)), then there are no sufficient grounds for the conclusion about strong sensitivity.

When analyzing the resilience of economic systems, the extent of decline in the activity under the influence of a shock and the activity of the subsequent “rebound” are often considered separately. The level of decline in business activity is a static assessment of the vulnerability of the objects under consideration. In a severe recession, the rates of recovery growth, rebound, may be high. As a result, these rates will not give an adequate representation of the dynamic stability of an economic system.

The following sections of the article, when analyzing the sustainability of constituent entities of the Russian Federation, consider the growth of their economy as a whole over the period covering both

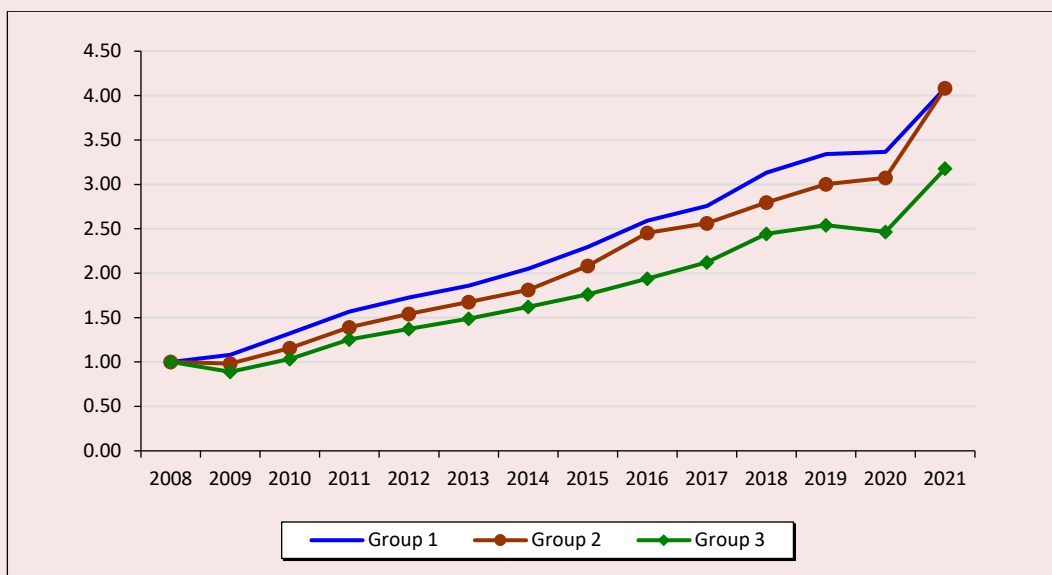
the decline in business activity and its recovery. A similar approach is used to determine the innovation sustainability of regions.

We used regional statistics of Rosstat (socio-economic indicators in the context of constituent entities of the Russian Federation) as a data source. The paper considered constituent entities of the Russian Federation without identifying intra-regional autonomous districts.

**Russian regions: Test of the Great Recession**

Gross regional product (gross value added in current basic prices) for all constituent entities of the Russian Federation grew 1.11-fold in 2010 compared to 2008. GRP growth in 26 regions amounted to 124.4 to 148.7% over this period (Group 1). GRP growth in 27 regions ranged from 111.4 to 122.2% (Group 2). These two groups of regions showed higher dynamic stability compared to the economy as a whole. The remaining 27 regions showed an increase from 89 to 111% (Group 3). *Figure 1* presents the growth of aggregate GRP (gross value added in current basic prices) by the three groups of regions in the period 2008–2021.

Figure 1. Growth of total GRP by groups of regions 1–3 in 2008–2021



According to: Rosstat data.

Table 1. Characteristics of groups of regions 1–3 with different dynamic stability in terms of GRP growth

Group of regions	Average GRP by group, 2008, million rubles	GRP growth, 2010 to 2008	GRP growth, 2021 to 2019	Growth of gross capital formation, 2010 to 2008	Share of fully depreciated fixed assets, 2010, %	Fixed capital investment per capita, 2010
Group 1	214257.7	1.322	1.22	1.33	10.1	81,441
Group 2	310730.9	1.156	1.36	1.05	12.3	44,664
Group 3	738826.7	1.034	1.25	0.98	15.6	57,531
				$R^2 = 0.187$	$R^2 = 0.111$	
Group of regions	Share of urban population, 2008, %	Growth of consumer expenditures per capita, 2010 to 2008	Volume of paid services per capita, 2010, rubles	Number of small enterprises per 10,000 people, 2010	Growth in the volume of innovative goods, 2010 to 2008	Rising research and development costs, 2010 to 2008
Group 1	69	1.308	32,454	99	0.8	1.16
Group 2	67	1.221	25,344	103	1.2	1.25
Group 3	71	1.197	30,001	110	1.1	1.22
Group of regions	Share of manufacturing industry in GRP, 2008, %	Share of manufacturing in GRP, 2010 %	Growth of exports to non-CIS countries, 2010 to 2008	Growth of imports from non-CIS countries, 2010 to 2008	Growth of debt of legal entities on credits in foreign exchange, 2010 to 2008	
Group 1	44.7	42.4	1.139	0.833	1.81	
Group 2	57.7	61.3	0.699	0.979	1.74	
Group 3	47.8	47.6	0.820	0.813	1.61	

According to: Rosstat data.

As we can see, Group 1 is the leader in terms of dynamic stability (in terms of GRP growth) from the point of view of the whole period under consideration. However, the situation began changing at the end of the period, during the COVID-19 pandemic. *Table 1* gives a number of parameters of the selected groups of regions.

According to the data of *Table 1*, the growth of gross capital formation could have a positive impact on the GRP dynamics of the first group of regions, which is associated with the low level of the share of fully depreciated fixed assets. The growth of production of goods and services in this group of regions was supported by both internal and external demand. The averaged indicators for Group 1 indicate its leadership in terms of the volume of paid services per capita, growth of consumer expenditures of the population, and growth of exports to non-CIS countries.

For many indicators there is no linear relationship between their values and the growth of group GRP. For example, the regions of Group 2 have worse dynamics of aggregate exports to non-CIS countries than the regions of Group 3. A similar situation with per capita investments in fixed assets, with the volume of paid services to the population was observed in 2010. As a result, the possibilities of regression analysis of the factors of dynamic stability of the regions are limited. The relationship between the growth of group GRP and the growth of gross capital formation ( $R^2 = 0.187$ ), the specific weight of fully depreciated fixed assets in 2010 ( $R^2 = 0.111$ ) is found, albeit weak. The coefficient of determination was determined for the whole set of regions.

It is noteworthy that with a slightly higher share of urban population in Group 3 as a whole, it is inferior to the other groups of regions in terms of sus-

tainability in the period under review. Structural shifts in favor of manufacturing industry did not provide Group 2 with leadership in terms of GRP growth rates.

As the descriptive statistics presented in Table 1 show, Group 1 that best survived the Great Recession fared worse than the other groups in the COVID-19 pandemic.

**Russian regions: Test of the COVID-19 pandemic**

A new grouping of regions is used to analyze dynamic sustainability in the period 2019–2021. The benchmark for grouping is the growth of GRP (in current basic prices) in 2021 in relation to 2019. Group 4 includes 22 regions that are leaders in terms of GRP growth (from 128.2 to 182%). Group 5 includes 30 regions (growth from 119.6 to 126.8%). Group 6 includes 30 regions (growth from 104.7 to 119.3%). *Figure 2* shows the growth of aggregate GRP by the new groups of regions in the period 2008–2021. *Table 2* presents a number of parameters of these groups.

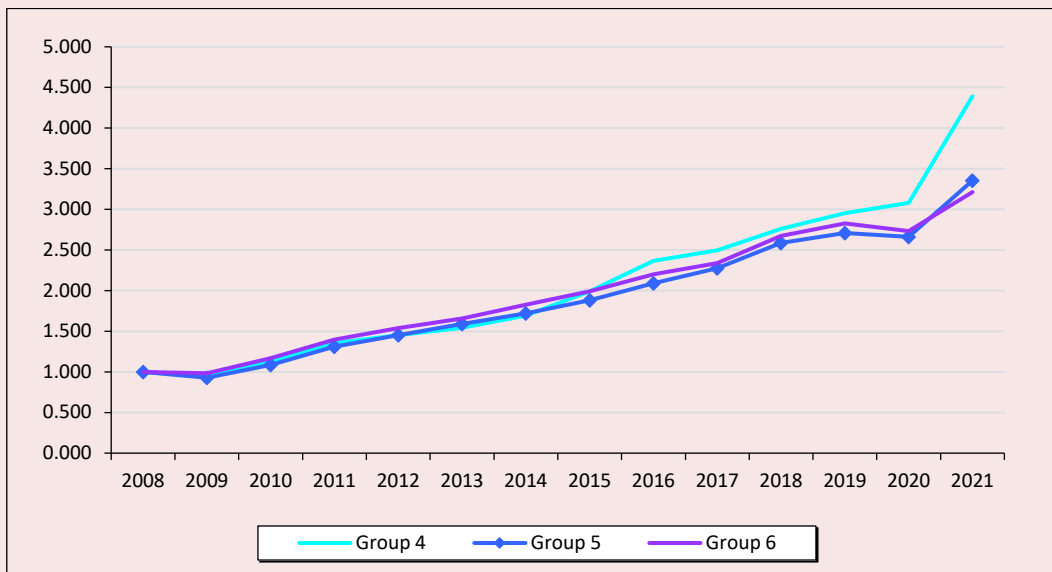
As in the previous case, the leadership in dynamic stability is combined with the growth of

consumer expenditures per capita, with the increase in exports to non-CIS countries, with a smaller share of fully depreciated funds, with superiority in the amount of investment in fixed capital per capita, with a larger volume of paid services per capita.

Unlike the shock of the Great Recession, during the pandemic period the group of regions with the smallest average size, with the smallest number of small enterprises per 10,000 population turned out to be less resistant to the new shock. Despite its epidemic character, a positive relationship between dynamic resilience and the share of urban population was evident. The most pandemic-resistant group of regions has now become the leader in the growth of innovative goods.

As before, there is no linear relationship between their values and the growth of group GRP for several indicators. Such indicators include growth of investments in fixed capital, growth of expenditures on research and development, the share of manufacturing industry in GRP, growth of imports from non-CIS countries, growth of legal entities' debt on loans in foreign currency.

Figure 2. Growth of total GRP by groups of regions 4–6 in 2008–2021



According to: Rosstat data.



Table 2. Characteristics of groups of regions 4–6 with different dynamic stability in terms of GRP growth

Group of regions	Average GRP by group, 2019, million rubles	GRP growth, 2010 to 2008	GRP growth, 2021 to 2019	Growth of investments in fixed assets, 2021 to 2019	Share of fully depreciated fixed assets, 2021, %	Fixed capital investment per capita, 2021	Patients diagnosed with COVID-19 per 1,000 persons, 2020	Doctors per 10,000 people, 2020
Group 4	993,252	1.123	1.487	1.154	17.2	224,384	35.3	50.2
Group 5	1,799,199	1.087	1.238	1.241	18.8	140,641	32.1	47.7
Group 6	641,105	1.167	1.136	1.152	23.6	99,601	32.6	48.5
						R <sup>2</sup> = 0.1	R <sup>2</sup> = 0.012	R <sup>2</sup> = 0.051
Group of regions	Share of urban population, 2019, %	Growth in consumer spending per capita, 2021 to 2019		Volume of paid services per capita, 2021, rubles	Number of small enterprises per 10,000 people, 2020	Growth in the volume of innovative goods, 2021 to 2019		Rising research and development costs, 2021 to 2019
Group 4	75	1.139		69,234	126	1.36		1.139
Group 5	70	1.124		69,251	125	1.31		1.164
Group 6	67	1.119		51,167	99	0.96		1.112
	R <sup>2</sup> = 0.128	R <sup>2</sup> = 0.011		R <sup>2</sup> = 0.113	R <sup>2</sup> = 0.086			
Group of regions	Share of manufacturing in GRP, 2019, %	Share of manufacturing industry in GRP, 2021, %		Growth of exports to non-CIS countries, 2021 to 2019	Growth in imports from non-CIS countries, 2021 to 2019	Growth of debt of legal entities on loans in foreign currency, 2021 to 2019		
Group 4	61.3	61.2		1.294	1.173	0.971		
Group 5	42.4	46.4		1.118	1.246	1.065		
Group 6	57.9	55.4		1.159	1.002	0.939		

According to: Rosstat data.

According to Rosstat data, there is no significant relationship between GRP dynamics and the number of doctors of all specialties per 10,000 population, the number of patients with the first registered diagnosis of COVID-19. A weak relationship is also observed between the growth of GRP (2021 to 2019) and the capacity of outpatient and polyclinic organizations per 10000 population in 2020 ( $R^2 = 0.094$ ).

When resilience leaders under one type of shocks lose their positions under another type of shocks, it is important to find out the characteristics of regions that have been relatively successful in passing both tests.

#### Characteristics of regions with universal stability with respect to GRP growth

The constituent entities of the Russian Federation that did not fall below 40th position in two dynamic sustainability ratings (for the Great

Recession and for the COVID-19 pandemic) were identified as regions of universal sustainability in terms of GRP growth. There were 18 such regions (Group 7). Two thirds of them are border regions. Almost half of the regions represent the Far Eastern Federal District (*Tab. 3*).

*Table 4* shows a number of characteristics of both this group of regions and the totality of the constituent entities of the Russian Federation as a whole.

We can conclude that the resilience of the regions of Group 7 to different types of challenges was ensured not at the cost of slow growth rates, since the aggregate GRP of this group in the period 2008–2021 grew 4.8-fold (the total GRP of the regions increased only 3.6-fold). The high level of per capita investment in the group under consideration helped to avoid a prolonged decline

Table 3. List of regions of universal sustainability by GRP growth

Republic of Sakha (Yakutia)	Altai Territory
Transbaikal Territory	Irkutsk Region
Primorye Territory	Saratov Region
Khabarovsk Territory	Stavropol Territory
Amur Region	Krasnodar Territory
Magadan Region	Republic of Adygea
Jewish Autonomous Region	Vladimir Region
Chukotka Autonomous Area	Voronezh Region
Saint Petersburg	Belgorod Region

Table 4. Characteristics of the group of regions of universal sustainability by GRP growth and Russian regions as a whole

Group	GRP growth, 2021 to 2008	GRP growth, 2010 to 2008	GRP growth, 2021 to 2019	Share of fully depreciated fixed assets, 2010, %	Share of fully depreciated fixed assets, 2021, %	Fixed capital investment per capita, 2010	Fixed capital investment per capita, 2021
Group 7	4.775	1.249	1.436	10.6	14.9	75,398	233,568
All regions	3.574	1.111	1.274	13.5	21.7	64,068	159,323
Group	Share of urban population, 2008, %	Share of urban population, 2019 r., %	Growth of consumer spending per capita, 2010 to 2008	Growth of consumer spending per capita, 2021 to 2019	Growth of exports to non-CIS countries, 2010 to 2008	Growth of exports to non-CIS countries, 2021 to 2019	
Group 7	68.2	70.2	1.296	1.141	0.764	1.171	
All regions	73.5	74.7	1.197	1.126	0.855	1.194	
According to: Rosstat data.							

in production. At the same time, resources were spent less than in other regions on prolonging the operation of fully depreciated funds. The growth of domestic demand played a more noticeable role in damping shocks against the background of all RF constituent entities, which is especially important when external demand declines.

#### Dynamic sustainability of regions: Innovation aspect

The response to the crisis reduction in demand can be a change in the structure of supply, an increase in the volume of innovative goods and services. It is possible to single out the regions that most actively used such an option of actions during the crises under consideration. In the Russian economy as a whole, the volume of innovative goods, works and services grew by 12.7% in 2010

compared to 2008 (hereinafter in current prices). However, 37 regions demonstrated higher rates of its growth. In 2021 compared to 2019, the total volume of innovative goods, works, services increased by 23.4%. Thirty-five constituent entities of the Russian Federation had higher growth rates of this indicator. At the same time, 21 regions were ahead of the all-Russian increase in the output of innovative products in both periods under consideration. In relation to these regions alone we can speak about their universal stability in terms of innovation activity (*Tab. 5*). At the same time, more than a third of the regions that demonstrated innovation sustainability during one crisis could not maintain it during another crisis, so there is no reason to believe that the innovation sustainability of regions in general has a universal character.

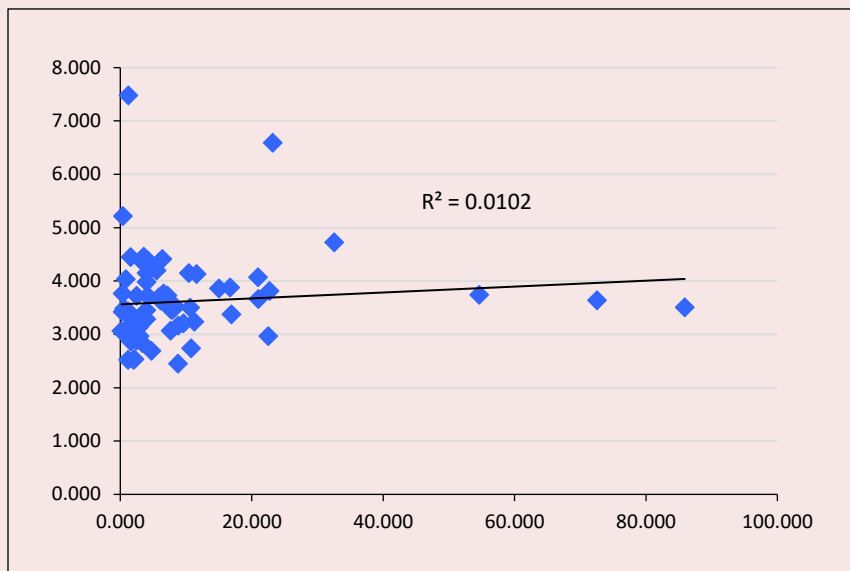
Table 5. List of regions of universal sustainability by innovation activity

Republic of North Ossetia-Alania	Karachayev-Circassian Republic
Kamchatka Territory	Omsk Region
Arkhangelsk Region	Novosibirsk Region
Saint Petersburg	Kaluga Region
Murmansk Region	Republic of Bashkortostan
Tula Region	Saratov Region
Republic of Altai	Moscow
Republic of Dagestan	Khabarovsk Territory
Leningrad Region	Republic of Tatarstan
Republic of Mordovia	Rostov Region
Republic of Karelia	

Another question is how the innovation activity of the regions is combined with the dynamics of their GRP. Let us compare the increase in GRP of the regions in 2008–2021 and the growth in the volume of their innovative products over the same period (Fig. 3).

The actual lack of relationship between the variables under consideration can be explained by the fact that the share of innovative products in GRP was and remains very low. In 2021, only in 11 regions it exceeded 10%, and in 23 regions it was less than 1%.

Figure 3. Relationship between GRP growth (Y-axis) and increase in innovative products (X-axis) in 2008–2021, based on data on 72 regions of the RF



According to: Rosstat data.

### Conclusion

The analysis of GRP dynamics under external shocks of different nature (the Great Recession and the COVID-19 pandemic) shows that the regions that coped best with one challenge may be outsiders under tests of another nature. From this perspective, regional resilience to external shocks is not universal, which is at odds with the conclusion in the literature (Mikheeva, 2021).

At the same time, it is noteworthy that the regions that were not leaders in adapting to either of the shocks, but coped quite well with both shocks. In the case of such regions it is acceptable to say that their relative stability has a universal character. A similar situation is with innovation activity of the regions. In general, it is not universal, but some regions manage to maintain innovation activity under different shocks.

The assessment of dynamic qualities did not analyze the sustainability of regions for a fuller range of trials that fell to Russia in the 21st century (the Great Recession, the first sanctions wave in 2014–2015, the COVID-19 pandemic, the second sanctions wave in 2022). We can draw attention to the fact that in Figure 2 it is after 2014 that the trajectory of the most pandemic-resistant group of regions deviates from the general trend of their

development. On the other hand, the fact that the group of regions, which best passed the crisis of 2009, retained the leadership in growth rates in the period 2014–2015, testifies to its successful adaptation to the sanctions of the first wave.

We can hardly claim to reveal the secret of regions' adaptability to shocks using very aggregate characteristics. However, in this way it is possible to identify the regions, which can be analyzed in more detail to further search for the dynamic sustainability factors.

The regions with adaptability to several types of shocks are quite heterogeneous. This suggests that the universal resilience of a particular region is achieved through a combination of both some universal and unique factors for a given region. The identification of both specific factors concerning resilience and vulnerability requires a detailed analysis of the regional economy, its sectoral structure, prehistory of development, Russian and foreign economic specialization, interaction with other regions, place in global value chains, ability to quickly localize the falling links of these chains. It is necessary to take into account the role of public authorities (federal and regional) in ensuring the sustainability of the regional economy in shock situations.

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