GROSS REGIONAL PRODUCT AS AN INDICATOR OF FINANCIAL STABILITY OF REGIONAL DEVELOPMENT AMID ECONOMIC MODERNIZATION: THE CASE OF THE KARAGANDA REGION

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Abstract. Ensuring the financial stability of the regions in the context of global economic instability and changes in the modernization of the economy of Kazakhstan has become the main factor of sustainable development. The objective of the study is to develop a methodological approach to assessing and forecasting the financial sustainability of regional development in the context of economic modernization using the Karaganda region as a case study and to develop practical recommendations. The application of methods of analysis and synthesis, comparative and structural analysis, and dynamic analysis of socio-economic indicators made it possible to use econometric modeling methods to forecast GRP. Within the framework of a unified statistical and econometric approach, a linear trend model of the GRP dynamics of the Karaganda region was created based on official statistical data for 2010-2024, estimated by the least square's method. The resulting model was used to generate point and interval forecast estimates of GRP for 2025-2027. The forecast results indicate a continued, stable, upward trend in regional economic development; even the lower bound of the 95% confidence interval reflects positive dynamics for the indicator. Furthermore, as the forecast horizon increases, the width of the confidence interval widens, indicating an increase in uncertainty and confirming the scenario-based, predictable nature of the forecast estimate with a limited amount of initial data. The research results can be used by state and local government bodies to adjust territorial development strategies, formulate investment policies, and improve the efficiency of budgetary resource use.
Keywords: modernization, financial stability, strategic management, regional economy, gross regional product, forecasting.

Аңдатпа.Жаһандық экономикалық тұрақсыздық және Қазақстан экономикасын жаңғыртудағы өзгерістер жағдайында өңірлердің қаржылық тұрақтылығын қамтамасыз ету тұрақты дамудың негізгі факторына айналды. Зерттеудің мақсаты-қарағанды облысын кейс-стади ретінде пайдалана отырып, экономиканы жаңғырту жағдайында өңірлік дамудың қаржылық тұрақтылығын бағалау мен болжаудың әдіснамалық тәсілін әзірлеу және практикалық ұсыныстарды тұжырымдау.Талдау және синтез әдістерін, салыстырмалы және құрылымдық талдауды, әлеуметтік-экономикалық көрсеткіштерді динамикалық талдауды қолдану ЖӨӨ болжау үшін эконометрикалық модельдеу әдістерін қолдануға мүмкіндік берді. Бірыңғай статистикалық-эконометрикалық тәсіл шеңберінде ең аз квадраттар әдісімен бағаланған 2010-2024 жылдардағы ресми статистикалық деректер негізінде Қарағанды облысының ЖӨӨ динамикасының сызықтық трендтік моделі құрылды. Алынған модель 2025-2027 жылдарға арналған ЖӨӨ-нің нүктелік және интервалдық болжамды бағаларын қалыптастыру үшін пайдаланылды. Болжау нәтижелері өңірлік экономиканың дамуының тұрақты өрлемелі үрдісінің сақталуын айғақтайды; бұл ретте тіпті 95 пайыздық сенімділік интервалының төменгі шекарасының мәндері көрсеткіштің оң серпінін көрсетеді. Сонымен қатар, болжау көкжиегі ұлғайған сайын сенімділік аралығының ені артады, бұл белгісіздіктің өсуін көрсетеді және бастапқы деректердің шектеулі көлемімен болжамды бағалаудың сценарийлік, болжамды сипатын растайды. Зерттеу нәтижелерін мемлекеттік және жергілікті өзін-өзі басқару органдары аумақтық даму

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стратегияларын түзету, инвестициялық саясатты қалыптастыру және бюджеттік ресурстарды пайдалану тиімділігін арттыру үшін пайдалана алады.
Түйін сөздер: жаңғырту, қаржылық тұрақтылық, стратегиялық басқару, өңірлік экономика, жалпы өңірлік өнім, болжау.

Аннотация. Основным фактором устойчивого развития стало обеспечение финансовой стабильности регионов в условиях глобальной экономической нестабильности и изменений в модернизации экономики Казахстана. Цель исследования-разработка методологического подхода к оценке и прогнозированию финансовой устойчивости регионального развития в условиях модернизации экономики с использованием Карагандинской области в качестве кейс-стади и выработка практических рекомендаций. Применение методов анализа и синтеза, сравнительного и структурного анализа, динамического анализа социально-экономических показателей позволило использовать методы эконометрического моделирования для прогнозирования ВРП. В рамках единого статистико-эконометрического подхода создана линейная трендовая модель динамики ВРП Карагандинской области на основе официальных статистических данных за 2010-2024 годы, оцененных методом наименьших квадратов. Полученная модель использовалась для формирования точечных и интервальных прогнозных оценок ВРП на 2025-2027 годы. Результаты прогнозирования свидетельствуют о сохранении устойчивой восходящей тенденции развития региональной экономики; при этом даже значения нижней границы 95-процентного доверительного интервала отражают положительную динамику показателя. Кроме того, по мере увеличения горизонта прогнозирования ширина доверительного интервала увеличивается, что указывает на рост неопределенности и подтверждает сценарный, предсказуемый характер прогнозной оценки с ограниченным объемом исходных данных. Результаты исследования могут быть использованы органами государственной власти и местного самоуправления для корректировки стратегий территориального развития, формирования инвестиционной политики и повышения эффективности использования бюджетных ресурсов.
Ключевые слова: модернизация, финансовая устойчивость, стратегическое управление, региональная экономика, валовый региональный продукт, прогнозирование.

Introduction

In the context of global economic transformations and the modernization of Kazakhstan's national economy, ensuring the financial stability of regions has become a key factor in achieving long-term socio-economic development. Economic modernization, accompanied by technological transformations, diversification of production structures, and the introduction of innovations, imposes new requirements on the regional governance system.

The Karaganda region, possessing significant industrial potential and a well-developed extractive sector, plays an important role in forming the country's Gross Regional Product (hereinafter – GRP). However, structural imbalances, dependence on global commodity price fluctuations, and limited opportunities for rapid economic diversification create risks to financial stability. The financial stability of a region is largely determined by its ability to maintain steady GRP growth, ensure a balanced budget system, and efficiently utilize investment resources. At the same time, regional disparities in Kazakhstan are highly pronounced: oil-refining regions generate budget surpluses and have greater investment opportunities, whereas areas with predominantly agricultural and industrial production often depend on transfers from the republican budget. The relevance of this research is driven by the need to develop scientifically grounded approaches to forecasting and enhancing the financial stability of regional economies amid modernization processes. This is particularly significant in light of Kazakhstan's strategic goals related to attracting investment, developing infrastructure, and maintaining budgetary balance. Achieving these objectives requires the application of modern econometric analysis methods, which make it possible not only to assess current indicators but also to model potential changes under the influence of internal and external factors.

The practical value of the study lies in the integration of econometric modeling and statistical analysis methods for assessing and forecasting regional financial stability, enabling the formulation of a comprehensive set of measures to strengthen it under conditions of economic modernization.

Research methods

The study's methodological framework is built on a comprehensive statistical-econometric approach, combining theoretical analysis, empirical data analysis, and applied quantitative methods. The methods used are not viewed as isolated tools, but rather are applied within a unified framework for analyzing the dynamics and sustainability of regional development.

The research methods are presented in a structured form, focusing on the following aspects: The study utilized a combination of theoretical, empirical, analytical, and econometric methods. The theoretical framework was developed using analytical and synthesis methods, allowing for a unified approach to regional development, financial sustainability, and economic modernization. Induction

and deduction were used to formulate generalized conclusions based on the analysis of empirical data for the Karaganda region, while a comparative method was used to compare the dynamics of its socioeconomic indicators with similar industrial regions of the Republic of Kazakhstan and identify regional characteristics and development imbalances.

The empirical part of the study is based on the collection of official statistical data and content analysis of strategic and policy documents regulating the region's socioeconomic development, including socioeconomic development forecasts for the Republic of Kazakhstan and regional industrial and innovative development programs. Content analysis was conducted to identify priorities for economic diversification, investment areas, and regional policy instruments that influence the sustainability of GRP growth. The analytical and statistical tools included a dynamic analysis aimed at identifying trends in GRP and related indicators for 2010–2024, as well as a structural analysis of the GRP sectoral structure to determine dominant and promising trends in the regional economy.The econometric analysis was based on a linear trend model estimated using the least squares method. This approach was used to identify long-term trends in GRP, obtain point forecast values, and calculate confidence (interval) forecasts with a 95% confidence level.

It should be noted that the GRP forecast for 2025–2027 is based on annual data for 2010–2024, which includes a limited number of observations. Therefore, the forecast is tentative and scenario-based and is used not as a tool for precise prediction, but rather as a means of assessing the likely development trajectory and analyzing the sustainability of identified trends. Interval forecasts allow for uncertainty and reduce the risk of overestimating point values, which is especially important in conditions of foreign economic volatility. Thus, the applied system of methods represents a holistic statistical-econometric approach, within which the least squares method is used to assess the trend and construct both point and interval forecasts, and the results of the econometric analysis are supplemented by structural and qualitative analysis, ensuring the scientific validity of the conclusions and increasing the applied significance of the study for the purposes of regional economic policy and strategic planning.

Literature Review

Regional development depends on understanding the dynamics of each region, that is, the complex interaction of economic, social, and environmental factors. According to Bruno Jardim, Miguel de Castro Neto, André Barriguinha, and Pedro Sarmento (2021), indicators play a crucial role in this understanding by providing quantifiable measures of regional well-being and progress. When effectively applied, such data can offer insights into various aspects of a territory to support the provision of high-quality services and infrastructure, as well as innovative governance and sustainable planning (Neves et al., 2020). Regions play an important role in ensuring a country’s sustainable development; however, the modernization of regional financial centers remains a dominant driver of economic stability. The level of innovative development of regions and the country as a whole plays a significant role in economic growth (Uskelenova& Nikiforova, 2024). On one hand, the dynamics of economic growth require innovation; on the other hand, innovation serves as the foundation for enhancing the competitiveness of both the country and its regions (Hu et al., 2018). E. Garmashova and A.M. Drebot emphasize that accelerated diversification and industrialization are impossible without reforming regional development (Garmashova&Drebot, 2020), as well as without designing and implementing a new paradigm of regional policy. Since financial development plays a vital role in every economy by stimulating economic growth and improving the industrial sector, the integration of financial systems of regional economies to form regional financial cooperation may be of great importance (Sokira et al., 2021). Regions demonstrate diverse characteristics across the territories they encompass, which hinders the development and application of unified indicators compared to the more concentrated and well-defined nature of urban areas (Soe, 2023). Particularly in regions that include rural areas, inequalities in digital resources and opportunities compared to cities significantly affect the feasibility and diversity of data resources that can be effectively utilized (Dubois &Seilker, 2022). Such diversity in landscapes, demographics, and economic activity creates challenges in developing standardized indicators universally applicable to different territories (Nikitaeva et al., 2022). Traditional regional indicators often prioritize overall development, encompassing social, economic, and environmental aspects (Billones et al., 2021). Gross Regional Product (GRP), employment rate, income per capita, productivity, and investment levels are standard measures frequently used to assess economic performance in various regions. For example, GRP is widely used to compare the economic output of regions within a country, providing

insights into regional disparities (Wangke &Kainde, 2021).The development of an adequate system of indicators for assessing regional development and its practical implementation can increase the reliability and effectiveness of government decision-making (Gospodarchuk& Zeleneva, 2022).In the context of modernization processes, GRP becomes not only a tool of statistical accounting but also a key element of the strategic planning and management system, capable of serving as a reference point in developing long-term socio-economic growth programs.

In the author's opinion, the role of GRP as an indicator of financial stability will continue to grow, especially under conditions where regions must quickly adapt to technological changes, global economic challenges, and internal structural reforms. For the Karaganda region, which possesses significant industrial potential, it is essential not only to maintain a positive GRP growth trend but also to ensure its qualitative improvement through the expansion of non-resource sectors, enhancement of innovation activities, and improvement of the investment climate.

Results and Discussion

Under the current social and economic challenges, the creation of an effective decision-making model has become a crucial task for the management system. Despite the existence of a relevant legislative framework, the participation of the local population remains low due to limited financial authority, which restricts the impact of adopted decisions on the socio-economic development of the region. To address this issue, the territorial development strategy provides for the expansion and reorientation of sales markets, as well as the development of infrastructure to stimulate the region's innovative activity. In order to enhance investment attraction, and in accordance with the instruction of the Head of State, an Investment Council was established to improve the investment climate in the region.

The economic performance of regional economies is evaluated through Gross Regional Product (GRP) indicators, which represent the total value of all goods and services produced within a region. Regional differences in economic performance in the Republic of Kazakhstan are clearly evident between oil-producing regions (Atyrau and Mangystau), agricultural regions (East Kazakhstan), and industrial regions (Karaganda and Pavlodar).

Let's examine the indicators characterizing the Karaganda and Pavlodar regions, where GRP is one of the key indicators reflecting the level of economic development and financial stability of the region. Its dynamics integrate the results of all economic sectors, the efficiency of resource utilization, the level of investment activity, and the competitiveness of the territory (Table 1).

Table 1. Indicators characterizing the Karaganda and Pavlodar regions

Year	GRP, million tenge	GRP per capita, thousand tenge	Physical volume index of GRP, % compared to the same period of the previous year	GVA per employed person, thousandtenge	Investments in fixed capital, thousand tenge
Karaganda region					
2010	1 872 842,3	1 387,7	106,4	2 402,7	211 085 000
2011	2 387 705,2	1 762,1	106,0	2 992,2	253 048 000
2012	2 446 510,3	1 798,5	101,2	3 070,3	323 816 000
2013	2 621 888,8	1 919,1	107,5	3 240,3	405015132
2014	2 899 976,8	2 110,6	103,2	3 810,7	411851992
2015	3 107 085,6	2 248,9	102,7	4 044,9	343 351 103
2016	3 712 055,9	2 682,6	102,4	4 836,1	317 571 168
2017	4 284 362,6	3 100,9	103,7	5 720,7	363 266 850
2018	4 734 402,0	3 431,9	103,0	6 238,4	489 029 821
2019	5 388 260,6	3 911,0	105,8	7 072,8	811 432 734
2020	6 099 856,2	4 431,7	100,1	8 189,0	692 347 518
2021	6 069 356,6	5 419,3	103,1	10 047,3	796 866 367

2022	7 278 059,2	6 412,9	100,3	11 593,9	724 917 845
2023	7 711 828,2	6 793,9	102,4	13 502,2	876 522 542
2024	9 237 175,4	8 141,0	111,3	15 681,2	1 456 700 866
Pavlodar region					
2010	1 031 878,6	1 384,6	106,4	2 245,7	185 492000
2011	1 520 492,6	2 036,7	110,8	3 240,5	207 716000
2012	1 520 575,9	2 032,8	108,1	3 266,1	263 513000
2013	1 758 133,5	2 341,3	100,1	3 744,7	276 246000
2014	1 746 774,4	2 315,8	100,9	3 724,0	353 112000
2015	1 736 155,9	2 293,1	100,3	3 751,8	451 714000
2016	1 975 487,3	2 606,9	99,4	4 317,7	439 764000
2017	2 369 297,8	3 134,3	104,0	5 245,6	483 795000
2018	2 746 652,1	3 641,1	106,2	6 111,1	411 958000
2019	3 029 608,9	4 023,3	105,3	6 768,7	494 620000
2020	3 120 136,9	4 151,4	96,9	7 181,5	487 154000
2021	3 883 826,6	5 185,0	103,9	8 832,5	571 927000
2022	4 296 923,7	5 685,8	101,3	9 759,3	742 793000
2023	4 371 041,7	5 793,8	101,5	10 104,6	797 475000
2024	5 150 822,2	6 845,2	105,0	11 819,5	839 747000
Note – compiled based on data from stat.gov.kz					

According to the data presented in Table 1:
1) Karaganda Region remains the larger economy over the entire period: in 2024, GRP was 9,237,175.4 million tenge versus 5,150,822.2 million tenge for Pavlodar Region (approximately 1.8 times higher).
2) In terms of long-term growth rates, both regions are comparable:
- Karaganda: GRP growth from 2010 to 2024 +393% (≈ 4.93 times).
- Pavlodar: GRP growth from 2010 to 2024 +399% (≈ 4.99 times).
3) Modernization in Karaganda Region is more strongly converted into per capita income growth, which is a marker of more sustainable expansion of the economic base (not only the "gross" but also the distribution of the effect on the population).
4) Based on the real growth criterion, Karaganda demonstrates a more pronounced modernization acceleration effect in 2024, while Pavlodar is more dependent on cycles (especially in 2020).
5) Karaganda Oblast is improving labor efficiency more quickly, which is key to financial sustainability: the growth of the tax base and revenues is driven not only by volume but also by productivity growth.
A comparison of Karaganda and Pavlodar for 2010–2024 shows that GRP truly serves as an integral indicator of the financial sustainability of regional development in the context of modernization:
- it simultaneously reflects the scale of the economic base,
- the dynamics of real growth,
- investment activity, and the quality of reproduction through productivity.
Karaganda Region demonstrates a higher level of financial stability due to:
- a larger economy (GRP in 2024: 9.24 trillion tenge versus 5.15 trillion tenge),
- more pronounced growth in GRP per capita (8,141,000 tenge versus 6,845,200 tenge),
- higher and faster-growing GVA per employee (15,681,200 tenge versus 11,819,500 tenge),
- a strong acceleration of real growth in 2024 (FII of 111.3%).

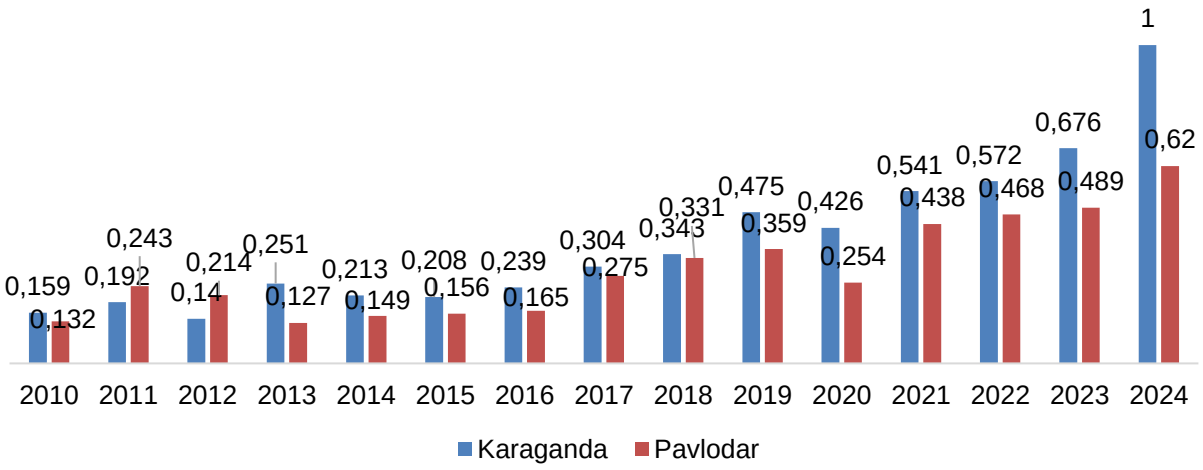
Pavlodar Region, however, is characterized by a relatively higher investment capacity (a significant share of investments in GRP) and sustainable GRP expansion. However, its trajectory is more sensitive to economic shocks and cycles (FII declines below 100% in some years), reducing the stability of its dynamics. Overall, the results confirm that:

- regional financial stability depends not only on the growth of gross regional product (GRP) as a whole, but also on its qualitative structure-growth in GRP per capita and productivity, as well as the ability of investments to transform into sustainable real output;
- based on these criteria combined, the Karaganda Region appears more resilient in the context of economic modernization.

To comprehensively assess the financial stability of regional development in the context of economic modernization, the study calculated the Financial Stability Index (FSI). Unlike gross indicators, which primarily reflect the scale of economic activity, the FSI characterizes the quality and sustainability of economic growth and its ability to be sustained in the face of structural transformations and external shocks.

The FSI is a composite indicator that includes key macroeconomic and structural characteristics of the regional economy: gross regional product, GRP per capita, GRP physical volume index, gross value added per employee, and fixed capital investment. To ensure comparability of the indicators, min-max normalization was applied, after which aggregation was performed with equal component weights. This approach allows us to assess not only the dynamics of economic growth, but also the degree of its sustainability and effectiveness, which is especially important when analyzing industrial regions (Figure 1).

Figure 1. Dynamics of the FSI index of Karaganda and Pavlodar regions for the period from 2010 to 2024



Note: compiled by the authors

A comparison of GRP and FSI dynamics shows that growth in gross regional product alone is not always accompanied by an equivalent increase in financial stability. In both regions, GRP has demonstrated a steady upward trajectory from 2010 to 2024, but the FSI dynamics reveal differences in the quality of economic growth. In the Karaganda region, GRP growth in recent years has been accompanied by an acceleration in the FSI, indicating the modernization of development and greater resilience of the economic system. In the Pavlodar region, GRP growth is more extensive and cyclical, reflected in more volatile FSI dynamics.

Thus, the FSI complements the GRP indicator, allowing for a more accurate assessment of the financial stability of regional development in the context of economic modernization. Diversification through deep processing, industrial digitalization, energy modernization, and the development of service chains increases the resilience of the regional economy, as it simultaneously strengthens GRP (scale), GRP per capita growth (social return), GVA per employee (productivity), and the investment base (future growth), while also reducing the cyclicality of real output (IFO). As a result, under a moderate scenario, GRP growth of 2–5% over 5 years and productivity increases of 3–7% are expected, while under an accelerated scenario, these are 5–10% and 8–15%, respectively, leading to growth in FSI and reduced regional sensitivity to external shocks.

The financial potential of the Karaganda region is shaped by a complex set of factors, including economic, fiscal-budgetary, socio-demographic, infrastructural, institutional, and managerial components, as well as external macroeconomic and geopolitical conditions. Together, these determine the stability of financial flows and the overall potential for regional development within the context of economic modernization. Factors influencing the financial capacity of the Karaganda region include:

- tax revenues (from businesses and the population) - depend on the level of economic activity, employment, and profitability of enterprises;
- investment activity - creates jobs, expands production, and ultimately increases the tax base and budget revenues;
- transfers from the national budget - determine the amount of additional resources for funding programs and projects;
- the region's economic specialization - a focus on industry and raw materials sectors increases revenue dependence on prices and external market conditions;
- budget expenditures and their management effectiveness - the level of financial sustainability depends on cost control and priority funding for key areas;
- the distribution of budget resources between territories and projects - influences balanced development and investment returns;
- the demographic situation - the size of the working-age population, employment, and migration determine revenue potential and the burden on social spending.

The financial capacity of regions can be viewed as a function of their economic activity and efficiency. Enhancing productivity, developing high value-added industries, and diversifying the economy are the key conditions for sustainable growth of regional budgets. Initially, using the Irwin criterion, it was established with 95% confidence that the original time series does not contain any anomalous observations (Table 2).

Table 2. Verification of anomalous observations in the time series

Year	GRP, million tenge	Observed value of the Irwin criterion	CalculationFormulas
2010	1 872 842,3		Observed Value of the Irwin Criterion $\lambda_t = \frac{\lvert y_t - y_{t-1} \rvert}{\sigma_y}, \; t = \overline{2,11}$ Critical Value of the Irwin Criterion $\lambda_{0,05} = 1,3$
2011	2 387 705,2	0,4498	
2012	2 446 510,3	0,0514	
2013	2 621 888,8	0,1532	
2014	2 899 976,8	0,2430	
2015	3 107 085,6	0,1809	
2016	3 712 055,9	0,5285	
2017	4 284 362,6	0,5000	
2018	4 734 402,0	0,3932	
2019	5 388 260,6	0,5713	
2020	6 099 856,2	0,6217	
2021	6 069 356,6	0,0136	
2022	7 278 059,2	0,5396	
2023	7 711 828,2	0,1936	
2024	9 237 175,4	0,6810	
Note – compiled by the authors based on the calculations performed			

Using the "ascending" and "descending" runs test, it was determined that the considered time series contains a trend component (Table 3).

Table 3. Test for the presence of a trend

General form of the "ascending" and "descending" runs criterion (to confirm the presence of a trend, it is sufficient for at least one inequality to be violated)	Calculated values with a probability of error $0{,}05 < \alpha < 0{,}0975$
$\nu(n) > \left[\frac{2n-1}{3} - 1{,}96\sqrt{\frac{16n-29}{90}}\right]$	1 ≤ 6,115
$K_{\max} < [K_0(n)]$	10 ≥ 5
Note – compiled by the authors based on the calculations performed	

Using the least squares method, which minimizes the distance of the function graph from the original data points, an approximation of the original data was performed. As a result, the following linear trend model was obtained:

$$У_t = 753128{,}579 + 487953{,}642t$$

where:
У^t – GRP, million tenge;
t = 1 2010 year,
t = 15 – 2024 year,
R^2 = 0,949 – the model explains approximately ≈ 94,9% of the GRP variation,
Standard error of regression Se = 524764,960 million tenge.
To assess the adequacy of the model, the residual series was examined for the following properties: zero mean, randomness of residuals, and conformity to a normal distribution (Table 4).

Table 4. Model adequacytest

Property beingtested	Statisticused		Threshold	Conclusion
	Name, calculationformula	Obtainedvalue		
Randomness	Criterion of “peaks” (turning points) $p > \left[\frac{2}{3}(n-2) - 1{,}96\sqrt{\frac{16n-29}{90}}\right]$	8	>3	Adequate
Normality	RS-criterion $RS = \frac{e_{\max} - e_{\min}}{S}$	3,29	2,80-3,91	Adequate
Equality of the mathematical expectation of the residual series levels to zero	Student’s*t*-statistic $t_{набл.} = \frac{\lvert\bar{e}\rvert}{S}\sqrt{n}$	0,00	≤2,14	Adequate
Note – compiled by the authors based on the calculations performed				

To assess the accuracy of the model, the following was calculated:

- the mean relative approximation error, the value of which indicates an acceptable level of model accuracy:

$$E_{relative} = \frac{1}{n}\sum_{i=1}^{n}\frac{|e_t|}{y_t} \cdot 100\% = 10{,}841\%, \qquad (1)$$

- maximum annual error – 33,733%;
- minimum annual error – 0,340%;

- median error – 8,884%.

Thus, the model is of sufficient quality and can be used for forecasting. To calculate the point forecast, the corresponding values of the factor $t = n + k$ were substituted into the constructed model. For constructing the interval forecast, the confidence interval at the significance level $\alpha = 0{,}05$ was determined. The width of the confidence interval was calculated using the following formula:

$$U(k) = S_e t_\alpha \sqrt{1 + \frac{1}{n} + \frac{\left(n + k - \bar{t}\right)^2}{\sum_{t=1}^{n} \left(t - \bar{t}\right)^2}}, \quad (2)$$

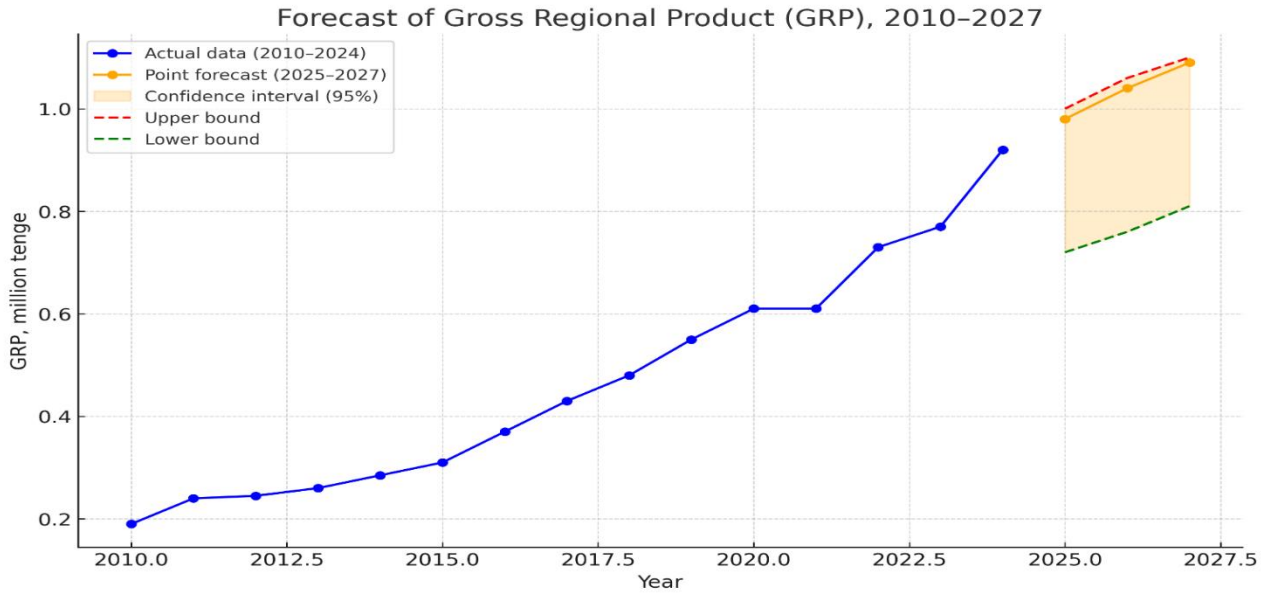
The results of the point and interval forecasting for 2025–2027 are presented as estimates of expected indicator values and corresponding confidence intervals. For example, in 2025, the point forecast is 1,290,231.08 million tenge, while the interval forecast shows that the indicator value could range from 7,270,155.8 million tenge (lower bound) to 9,850,617.9 million tenge (upper bound).

In 2026, further growth is expected: the point forecast value reaches 1,320,124.57 million tenge, and the confidence interval expands from 7,728,215.9 million tenge to 10,368,465.1 million tenge, reflecting the increase in uncertainty with a longer forecast horizon. In 2027, the point forecast is 1,352,753.43 million tenge, with the interval forecast ranging from 8,183,540.7 million tenge to 10,889,047.6 million tenge.

Overall, the forecast calculations indicate continued positive growth in the medium term. At the same time, the widening confidence intervals indicate an increasing influence of external and internal uncertainty factors as the forecast horizon increases, requiring consideration of scenario risks when formulating regional economic and financial policies.

The forecast indicates a steady growth of the GRP in the Karaganda region in 2025–2027. Interval estimates confirm that even under the minimal scenario, the upward trend will persist (Figure 2).

Figure 2. Point and interval forecast of the GRP of the Karaganda Region for 2025–2027



Note: compiled by the authors based on the performed calculations.

A point forecast can be used in the field of strategic planning as a baseline scenario when developing regional socio-economic development programs. When planning the budget, an interval forecast can be applied:

- the upper bound serves as a reference point for an optimistic scenario;
- thelower bound represents a conservative scenario to minimize the risks of revenue shortfalls.

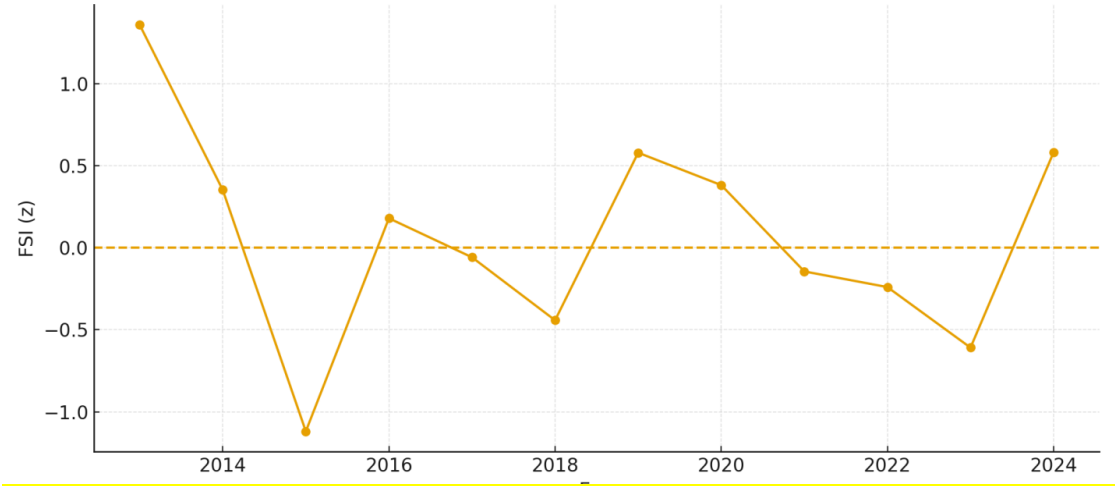
Using a linear GRP trend model estimated using the ordinary least squares method allows us to identify the overall long-term trend in regional economic development. However, this approach has several limitations:

- First, the linear specification assumes a constant growth rate, which does not fully reflect the nonlinear nature of economic dynamics and the influence of cyclical and crisis factors;
- Second, the model is sensitive to structural breaks and exogenous shocks, such as the 2020 pandemic or external economic restrictions, which may bias parameter estimates given the limited sample size.

To partially address these limitations, it would be advisable to further expand the model by introducing dummy variables reflecting crisis years or periods of structural change. This would allow for one-off deviations from the trend without distorting the long-term trend. Alternatively, polynomial trend models, models with structural breaks, and, when the time series is expanded, autoregressive and trend-cyclical models could be used. The use of such approaches will improve the accuracy of assessments and deepen the analysis of the sustainability of regional economic development.

The Financial Stability Index (FSI) demonstrates that the sustainability of regional growth in the Karaganda region is determined by a triad of key factors: **investment intensity, growth stability, and productivity**. The peaks observed in **2019 and 2024** were driven primarily by high levels of investment intensity (IIC), which strengthened the region's economic foundation and supported steady development. In contrast, the downturn recorded in **2023** was caused by a combination of weak GRP growth and increased volatility, reflecting heightened economic uncertainty and temporary structural imbalances (see Figure 3).

Figure 3. Financial Stability Index (FSI), z-average



Note – Compiled by the authors based on the performed calculations

The Financial Stability Index (FSI) represents the average of the standardized (z) contributions of four key components for each year:

- GRP growth rate (z_g_vrp_pct);
- Growth of Gross Value Added per employed person (productivity) (z_g_vds_emp_pct);
- Investment intensity (investment-to-GRP ratio) (z_iic_pct);
- Stability: the negative of the three-year standard deviation of GRP growth rates (z_neg_std3), where lower volatility corresponds to higher stability.

Characterizing the dynamics of the Financial Stability Index, as shown in Figure 3, the following observations can be made:

- 2013 – high level (≈1.36): peak investment intensity (z_iic ≈ +1.36). This serves as the starting point of the series, excluding the stability component (edge of the dataset).
- 2014 – moderately positive level (≈0.35): average GRP dynamics, supported by productivity growth and investment intensity.

- 2015 – minimum level (≈–1.12): a simultaneous decline in growth, productivity, and investment intensity, indicating a systemic stress year.
- 2016–2018 – restructuring zone: 2016 (≈0.18) and 2017 (≈–0.06) show relatively good growth and productivity, but weak investment intensity drags overall stability downward.
- 2018 (≈–0.44): both productivity and investment intensity dropped, while stability provided slight support but was insufficient to offset the decline.
- 2019 – one of the peaks (≈0.58): strong investment intensity (+1.20) and high stability (+1.35) combined with positive growth — a model of a "healthy" and balanced profile.
- 2020 – above average (≈0.38): amid the COVID-19 crisis, maximum stability (+1.60) was achieved despite only moderate growth and investment intensity.
- 2021 – near zero (≈–0.14): a sharp increase in productivity (+1.63) was offset by weak GRP growth (–2.08) and a deterioration in stability.
- 2022 – slightly negative level (≈–0.24): despite a strong GRP growth rate (+1.24), increased volatility (–1.33) and low investment intensity (–0.84) pulled the overall stability indicator downward.
- 2023– the second "trough" (≈–0.61): weak GRP growth, low investment intensity, and high volatility (–1.34) formed a combination indicative of low financial resilience.
- 2024 – a return to high stability (≈0.58): strong investment activity (+1.49) combined with solid GRP growth (+1.22). Although volatility remained slightly above the average level (–0.52), it was already noticeably lower than in 2022–2023, reflecting the recovery of stability.

For the Karaganda region, the FSI is defined by the triad of Investment Intensity (IIC) **–** Stability **–** Productivity, which together determine the overall financial resilience and sustainability of regional economic growth.

$$\text{IICt} = \frac{\text{Investment in fixed capital}t}{\text{GRP}t} * 100\%, \qquad (3)$$

The peaks of stability (2019 and 2024) were achieved due to high investment intensity (IIC) combined with acceptable GRP growth rates and, in 2019, exceptionally strong stability.

2024 = $\frac{1456700,9}{9237175,4}$ * 100% ≈ 15,8% - high level.

2019 = $\frac{811432,7}{5388260,6}$ * 100% ≈ 15,0% - also a high level, marking a peak year of financial stability supported by both strong investment and stable growth dynamics.

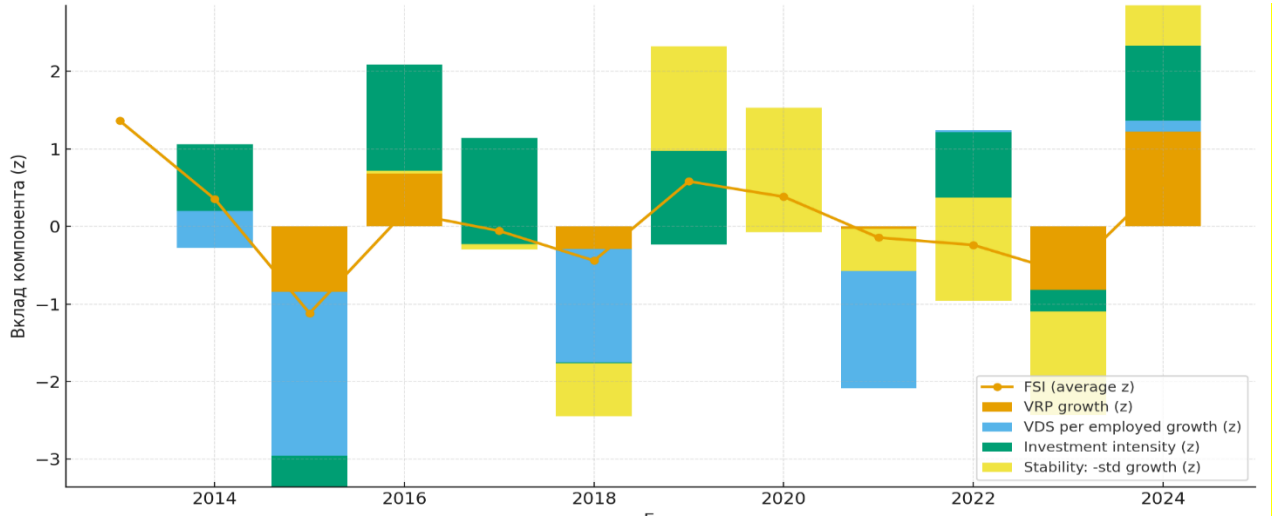
The downturns (2015 and 2023) are periods of low IIC/efficiency combined with high volatility and/or weak growth.

The results of the FSI analysis show that the sustainability of economic growth in the Karaganda region is primarily determined by investment intensity (IIC) and the stability of growth rates. The peaks of the index occurred in 2019 and 2024, precisely due to high investment intensity; in 2019, this effect was additionally reinforced by record stability. In contrast, the downturns observed in 2015 and 2023 resulted from a combination of low investment intensity, weak economic growth, and increased volatility, which collectively reduced the region's financial resilience.

Labor productivity (measured as the growth of gross value added per employee) acts as an important but secondary driver of stability: its sharp increase in 2021 was insufficient to offset the overall weak growth and instability in the economy.

The period of 2022–2023 can be described as a phase of *"growth through turbulence"*, during which high volatility exerted downward pressure on the FSI, reflecting the economy's struggle to maintain balance amid external shocks and internal adjustments. Meanwhile, 2024 marks a turning point toward a healthier profile of regional development — characterized by strong investment inflows and solid GRP growth, which together elevate the FSI. However, the stability component still requires improvement to consolidate this positive trend and ensure sustained, balanced growth in the future (see Figure 4).

Figure 4. FSI: contribution of components by year (standardized Z-scores)



Note – Compiled by the author based on the calculations performed

Thus, in the context of Kazakhstan's economic modernization aimed at innovative development, production diversification, and improving the quality of life of the population, GRP acquires particular importance as an indicator of the effectiveness of management decisions and the implementation of territorial development strategies.

Based on the conducted analysis, the author has proposed recommendations aimed at strengthening the financial sustainability of regional development in the Karaganda region, enhancing its competitive advantages, and creating conditions for sustainable GRP growth in the medium and long term. Recommendations for improving the financial stability of the Karaganda region include:

1. Diversification of the regional economy. Reducing dependence on raw materials by developing mechanical engineering, the chemical industry, and agro-processing, as well as supporting small and medium-sized businesses as a source of sustainable growth and employment.
2. Enhancement of investment policy. Improving the investment climate by strengthening institutional support for investors and introducing targeted incentives for high-value-added projects.
3. Infrastructure modernization. Developing transport, logistics, energy, and industrial infrastructure, including the creation of industrial parks and technology parks for the implementation of Industry 4.0 technologies.
4. Using GRP as a strategic monitoring tool. Integrating GRP into the system of key indicators of the regional strategy using scenario forecasting to assess development risks and opportunities.
5. Ensuring financial stability through budget planning. Linking budget commitments to realistic GRP forecasts and establishing a regional stabilization fund to mitigate the effects of external economic shocks.

Conclusion

Modernization of the Karaganda Region's economy should be based on shifting GRP growth from extensive to innovation-driven investment, where sustainability is ensured not only by increased output but also by increased productivity (GVA/employee), stronger real economic growth (RIF), higher GRP per capita, and a sustainable investment flow. To this end, it is advisable to identify five priority diversification areas, each with measurable impacts on GRP dynamics and the Financial Sustainability Index (FSI). An analysis of GRP dynamics and the Financial Sustainability Index (FSI) An analysis of the gross regional product (GRP) dynamics in the Karaganda region for 2010–2024 and the results of point and interval forecasting for 2025–2027 demonstrate the region's potential for sustainable economic growth. However, its realization is limited by sectoral imbalances and high dependence on external commodity prices, necessitating a transition from extensive GRP growth to a structural and technological development model. Interval forecasts indicate continued positive dynamics even under a conservative scenario, confirming the high probability of sustainable development in the medium term. The use of econometric methods and scenario modeling ensures the formation of scientifically sound management decisions and a coordinated trajectory for the region's long-term socioeconomic development.

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ЖАЛПЫ ӨҢІРЛІК ӨНІМ ЭКОНОМИКАНЫ ЖАҢҒЫРТУ ЖАҒДАЙЫНДАҒЫ ӨҢІРЛІК ДАМУДЫҢ ҚАРЖЫЛЫҚ ТҰРАҚТЫЛЫҒЫНЫҢ КӨРСЕТКІШІ РЕТІНДЕ: ҚАРАҒАНДЫ ОБЛЫСЫНЫҢ ЖАҒДАЙЫ

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ВАЛОВЫЙ РЕГИОНАЛЬНЫЙ ПРОДУКТ КАК ПОКАЗАТЕЛЬ ФИНАНСОВОЙ УСТОЙЧИВОСТИ РЕГИОНАЛЬНОГО РАЗВИТИЯ В УСЛОВИЯХ ЭКОНОМИЧЕСКОЙ МОДЕРНИЗАЦИИ: НА ПРИМЕРЕ КАРАГАНДИНСКОЙ ОБЛАСТИ

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