

# Factors of industrial growth in the Republic of Kazakhstan: investments, innovations, and modernisation

Zhanna R. Ashimova 

ORIGINAL ARTICLE

Candidate of Economics, Senior lecturer  
Almaty Technological University, Almaty, Kazakhstan  
E-mail: ashimovazanna2022@gmail.com

Zhanay J. Abitov 

Master Student, Software Engineer, Kcell, Almaty, Kazakhstan  
E-mail: abitovpro@gmail.com

Diana Z. Abitova 

Software Engineer, Amazon, Berlin, Germany  
E-mail: abitov.zh.77@gmail.com

Amina M. Uristembek 

Head of the Export Sales Department of Dolce LLP, Almaty, Kazakhstan  
E-mail: a86310818@gmail.com

**Abstract.** The modern conditions of structural transformations of the Republic of Kazakhstan economy accompanied by the transition from a raw material model to an innovation-oriented development. Therefore, the identification of factors determining the dynamics of industrial growth is becoming a key area of scientific research. This analysis concerns with the strategic objectives of increasing the effectiveness of state investment and industrial policy, the practical challenges associated with reducing inter-regional disparities, and accelerating the modernisation of production facilities. Increasing the effectiveness of state investment and industrial policy, reducing interregional imbalances, and accelerating the modernisation of the national economy in terms of the transition to an innovation-oriented growth model provide the relevance of the research. The purpose of the research is to identify and quantify the relationships between the main drivers of industrial development, including investments in fixed assets, commissioning of new fixed assets, and the production of innovative products. The objectives of the research are as follows: correlation and regression analysis of these factors, the analysis of their impact on industrial production, verifying of the statistical significance of the obtained dependencies, identification of the institutional constraints, and ways to overcome them. The methodological base of the study implements the official statistical data from the Bureau of National Statistics of the Republic of Kazakhstan, 2017-2024. To comprehensive assessment of the impact of these factors on industrial production, the research uses the methods of paired correlation analysis, multiple linear regression, and regional comparison. To determine the statistical significance of the dependencies, we consider the p-levels, the institutional and structural features of the industrial sector. An analysis shows a strong positive relationship between investments in fixed assets and industrial production ( $r = 0.8738$ ), a moderate relationship between the introduction of new fixed assets and production growth ( $r = 0.3991$ ), and a significant role of innovative products in shaping industrial growth ( $r = 0.7976$ ). The scientific novelty of the research consists in the integration of the innovation factor into a single quantitative model of industrial growth, and identification the specifics of the temporary distribution of the effect of capital investments. This approach clarifies the structure of the determinants of industrial development, and identifies institutional constraints to prevent their implementation. The practical significance of the results includes their applicability for improving the mechanisms of industrial and investment policy, developing effective modernisation strategies, and stimulating research and development activities. The findings help to establish long term regional development programs, government support tools, and conditions for strengthening the competitiveness of Kazakhstan's industrial sector.

**Keywords:** correlation analysis; investments in the economy of Kazakhstan; factors of economic growth; institutional environment; economic policy of Kazakhstan

**JEL codes:** G31, H21, H25, H54, H81

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## Introduction

The Kazakhstan economy is undergoing a transition from resource dependence to a model of sustainable, innovation-oriented growth. Therefore, the quality of capital investments, the production facilities renewal, and the involvement of innovations in technological chains play a key role. To assess the effectiveness of economic policy, it is necessary to compare the dynamics of indicators, identify well-established relationships between investments in fixed assets, industrial production, the introduction of new fixed assets, and the release of innovative products.

However, there are limitations in descriptive statistics and pair dependencies, institutional factors, inter-regional heterogeneity, and time lags in the investment effect. Moreover, there is no complex analysis of investment activity and industrial production in the national literature. Therefore, the impact of fund modernisation and innovation is underestimated. This particular research provides the comprehensive analysis through integration the innovation factor into a single quantitative scheme and comparing of national and regional trajectories.

An analysis of scientific and analytical literature allows us to identify five main areas of economic growth:

1. Macroeconomic determinants of growth.
2. Investments and innovations as sources of development.
3. Digitalization and industrial transformation.
4. Regional growth and sustainable development.
5. Institutional and cluster conditions.

### 1. Macroeconomic factors of economic growth

The system macroeconomic determinants of growth are considered in the papers by Sukharev O.S. [1], Tenkovskaya L.I. [20], Alpatova E.S. [21], Melyantsev V.A. & Adrova I.S. [27], Sharokhina S. [23], Dubovik M., Dmitriev S. & Aitkazina M. [12]. The authors examine the impact of government strategies, GRP, macroeconomic cycles, and household incomes on growth processes. They reveal a tendency to increase the influence of regional imbalances, the need for a transition to an innovative development model, and the role of macroeconomic stability.

### 2. Investments and innovations as sources of development

The special attention is paid to the investment process, its relationship to innovation, and impact on economic security in the papers by Tinkova E.V. & Dikareva V.A. [2], Sinitsyn A.V. & Kopein V.V. [3], Shadchenko N.Yu. & Belmesov M.A. [4], Chebotarev S.S. & Gimadeev A.D. [5], Birzhanova A., Nurgalieva A. & Nurmagambetova A. [10], Nivorozhkina L.I. [29]. The scientific works substantiate the role of «green» investments and digital assets.

### 3. Digitalization, industry, and technological transformation.

Serebrennikova A.G. et al. [15], Rodionova D.G. & Alferyeva D.A. [8], Chuprova S.V. [7], Aleshkova A.V., Burika M.V. & Ivashkina M.V. [9], Tolstykh T.O. & Shatsky A.A. [25], Isaeva N.S. [26], Salimova T.A. et al. [18] focus on the digital transformation of the manufacturing sector and the innovation industry. The authors explore the industrial Internet of Things, the mechanisms of innovative production sustainability, the value of food, the dynamics of industrial growth, and the sustainable development of cluster structures. The scientific works highlight the role of digital platforms and AI in industrial policy.

### 4. Regional development and sustainability of territories.

The papers by Mirsaidov A.B. & Murtazoev O.K. [19], Kuanyshbaev S. et al. [11], Baitursunova A. et al. [10], Yurenkov I.N. [16], Cherevko V.E. [14], Kulikov M.V. [28], Kupriyanov A.N. [30] consider regional specifics and sustainable development. The regions are active drivers of growth at presence of infrastructure, institutions, and human capital.

### 5. Institutional and theoretical-methodological approaches.

The theoretical and methodological base of the research is presented by Bulina A.O., Mozgovaya K.A. & Pakhnin M.A. [17], Lubkova E.M. et al. [22], Afanasyeva E.V. & Tregub I.V. [25], etc. These papers present models of economic growth, classification of development factors, and institutional mechanisms to support innovation. The system of clusters, the interaction of government and business, the impact of human capital on growth rates are described.

According to the literature review, modern scientific knowledge on the problems of economic growth is based on the investment activity, innovative production, regional sustainability, and institutional design. The common element is the transition to the digital economy and the use of knowledge and data management technologies.

These works [1-30] form a reliable theoretical and empirical basis for selection the direction of research and developing a methodological approach to analyse the sources of economic growth in terms of modernisation and digitalization.

The object is the research is the macroeconomic system of the Republic of Kazakhstan; the subject is the statistically observed relationships between the volume of industrial production, investments in fixed assets, the introduction of new fixed assets, and innovative production. The purpose of the research is to identify and quantify the stable relationships between the drivers of industrial growth and production in terms of institutional and regional specifics.

The research defines and address the following tasks: to form a system of correlation estimates and a multiple regression model, determine the strength and direction of the relationships, verify the statistical significance and stability of the results, conduct inter-regional comparisons, interpret the identified patterns in the logic of institutional economics, propose applied recommendations for investment, industrial, and innovation policy.

Research hypotheses:

H1 – the increase in real investments in fixed assets is positively related to the volume of industrial production;

H2 – the effect of commissioning new fixed assets is manifested with a time lag and increases production;

H3 – an increase in the output of innovative products is associated with an increase in industrial production and the competitiveness of industries;

H4 – regions with high values in investment, fund input, and innovative products demonstrate steadily higher industrial production volumes; low values for a combination of factors are associated with lagging.

The empirical base is the official ranks of the Bureau of National Statistics, 2017-2024 (national and regional levels); a comparable 2019-2024 subarray is used for multiple regression. The following methods are used: pair correlation (Pearson), multiple linear regression, visual analytics, possible multicollinearity of investment and introductory indicators, the influence of lags in terms of the regional structure. We correct and correlate the indicators if necessary.

To improve the accuracy of the results, the initial series were analysed for outliers and abnormal values. The research includes inter-regional comparisons to identify differences in the dynamics of industrial development in the regions of Kazakhstan.

The novelty of the research consists in a quantitative assessment of the role of investment, fund renewal, innovation in a single model of industrial growth, institutional interpretation of the relationships obtained in terms of the time lags and regional specifics. The contribution of the research is a structured empirical hypothesis test to correction policy instruments.

The results clarify the priorities of modernisation and R&D, improve the mechanisms for synchronising investment and innovation policies, and provide targeted support to regions with institutional bottlenecks.

The article contains theoretical and methodological prerequisites, description of data and methods, results of correlation, regression analysis and visual analytics, institutional interpretation and discussion, conclusions and recommendations for economic policy development.

To quantify the interrelationships of industrial growth key factors in the Republic of Kazakhstan, a correlation and regression analysis was conducted based on data for 2017-2024, presented in Tables 1-4 and

Figures 1-4.

The following predictors are selected:

$X_1$  – investments in fixed assets (Table 2);

$X_2$  – commissioning of new fixed assets (Table 3);

$X_3$  – the volume of innovative product production (Table 4);

as a dependent variable,  $Y$  is the volume of industrial production (Table 1).

The choice of predictors is provided by their theoretical significance in the industrial growth model and confirmed by a preliminary analysis of the data.

**Table 1** – Volume of industrial production (goods, services), by value (million, KZT)<sup>1</sup>

Region	2017	2018	2019	2020	2021	2022	2023	2024
The Republic of Kazakhstan	22 790 208	27 218 063	29 380 341	27 028 505	37 606 242	48 777 088	46 991 786	51 469 083
Akmola region	561 289	659 726	791 161	1 040 510	1 138 936	1 515 044	1 793 149	1 977 240
Aktobe region	1 597 085	1 865 976	1 856 761	1 595 499	2 247 442	2 827 312	2 544 949	2 833 892
Almaty region	795 683	892 772	1 009 815	1 246 533	1 500 789	1 651 713	1 753 148	1 930 456
Atyrau region	5 508 219	7 077 539	7 888 133	5 174 828	8 557 591	13 341 731	10 815 028	11 104 713
West Kazakhstan region	1 914 501	2 480 524	2 392 109	1 822 866	2 843 130	3 924 946	3 527 138	3 731 562
Zhambyl region	374 029	421 146	476 971	518 243	639 110	881 373	856 257	939 524
Karaganda region	2 318 440	2 519 789	2 620 992	2 965 669	4 353 606	3 865 349	3 531 680	4 113 712
Kostanay region	764 326	883 375	1 206 982	1 541 948	2 333 110	2 470 019	2 670 333	2 913 343
Kyzylorda region	731 408	941 395	852 146	653 270	808 579	977 984	1 043 543	1 100 284
Mangystau region	2 316 201	2 892 269	2 908 789	2 156 452	2 726 723	3 182 644	3 065 797	3 095 385
South Kazakhstan region	832 113							
Pavlodar region	1 778 385	1 984 949	1 988 957	2 117 002	2 783 335	3 230 473	3 157 697	3 513 708
North Kazakhstan region	240 530	243 039	263 575	315 516	394 666	519 686	674 861	714 237
East Kazakhstan region	1 581 530	1 860 098	2 153 903	2 400 350	2 763 416	2 217 698	2 319 999	2 657 831
Astana	573 927	646 674	884 345	1 184 455	1 543 914	1 972 354	1 933 017	2 569 685
Almaty	902 536	917 883	1 001 187	1 081 642	1 420 750	1 763 727	2 096 033	2 153 410
Shymkent		492 259	579 554	670 531	812 873	967 251	1 090 720	1 198 530

<sup>1</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

Region	2017	2018	2019	2020	2021	2022	2023	2024
Turkestan region		438 643	504 953	543 184	738 264	907 944	1 054 754	1 278 283
Zhetisu region						297 397	325 226	358 892
Ulytau region						1 036 540	1 141 372	1 267 162
Abai region						1 225 894	1 597 075	2 017 223

**Table 2 – Investments in fixed assets, fields of implementation (thousand, KZT)<sup>2</sup>**

Region	2019	2020	2021	2022	2023	2024
The Republic of Kazakhstan	12.576.793.455	12.270.144.010	13.242.233.420	15.251.104.090	17.649.312.955	19.461.332.759
Akmola region	333.722.774	436.632.714	514.683.093	579.972.904	613.526.016	585.508.552
Aktobe region	598.864.111	648.036.184	817.135.802	960.038.538	1.025.761.687	910.842.275
Almaty region	647.330.718	682.407.156	733.425.671	613.940.487	737.743.410	1.017.661.274
Atyrau region	4.328.235.889	3.178.960.005	2.910.114.254	3.003.503.184	2.934.834.321	2.059.586.083
West Kazakhstan region	586.265.454	481.485.200	428.741.908	537.886.227	675.202.835	749.911.167
Zhambyl region	296.397.932	350.068.077	398.609.176	428.501.575	536.595.421	533.862.418
Karaganda region	811.432.734	692.347.518	796.866.367	724.917.845	876.522.542	1.456.700.866
Kostanay region	288.736.884	336.598.703	431.178.669	492.069.660	561.627.131	640.216.190
Kyzylorda region	400.208.745	292.344.162	308.941.474	413.284.091	513.730.912	673.703.713
Mangystau region	556.558.080	582.278.874	629.137.706	785.759.298	1.102.171.850	1.085.676.613
Pavlodar region	494.619.730	487.154.305	571.926.837	742.793.468	797.474.875	839.747.433
North Kazakhstan region	234.490.082	286.251.507	333.149.434	368.460.383	443.683.769	565.406.729
East Kazakhstan region	621.913.489	729.115.274	834.080.468	555.270.644	648.603.766	773.934.927
Astana	919.106.767	1.125.210.530	1.225.027.055	1.462.523.930	1.655.031.985	1.992.816.598
Almaty	820.448.723	976.794.888	1.187.619.882	1.407.989.996	1.803.183.330	2.069.933.449
Shymkent	194.958.322	278.737.026	462.481.709	549.617.823	661.740.269	768.155.483
Turkestan region	443.503.021	705.721.887	659.113.915	742.587.923	948.809.712	1.396.142.169
Zhetisu region				291.989.301	356.716.595	537.347.629
Ulytau region				175.499.451	228.961.647	244.438.815
Abai region				414.497.362	527.390.882	559.740.376

<sup>2</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

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**Table 3 – Commissioning of new fixed assets (thousand, KZT)<sup>3</sup>**

Region	2019	2020	2021	2022	2023	2024
The Republic of Kazakhstan	7.710.033.342	7.966.175.357	9.895.405.868	9.171.647.893	20.855.397.418	23.542.941.118
Akmola region	317.272.761	357.829.377	375.440.328	524.412.801	504.125.826	360.110.412
Aktobe region	430.689.725	329.919.543	482.254.648	516.824.713	553.943.368	488.541.675
Almaty region	488.397.432	377.988.429	392.055.089	321.635.548	576.514.621	512.072.628
Atyrau region	1.453.603.470	1.271.061.565	1.965.932.288	828.413.999	10.285.907.842	11.779.704.973
West Kazakhstan region	375.703.027	226.443.282	198.492.287	582.107.746	319.938.311	434.656.927
Zhambyl region	164.446.509	229.233.687	278.895.555	276.251.450	433.653.085	426.844.808
Karaganda region	653.623.850	489.209.863	575.832.399	393.832.191	409.967.579	742.751.567
Kostanay region	203.891.419	224.402.773	279.039.019	320.288.304	458.635.471	399.367.627
Kyzylorda region	298.941.395	283.196.262	179.679.129	221.409.482	274.757.049	372.853.954
Mangystau region	387.136.749	563.584.892	682.385.252	437.098.334	450.850.490	768.563.279
Pavlodar region	338.568.171	439.028.009	400.620.586	490.144.898	433.158.466	656.034.147
North Kazakhstan region	182.054.044	265.882.292	267.213.006	270.697.013	331.798.509	376.937.761
East Kazakhstan region	393.427.403	448.143.308	872.865.491	338.823.328	380.440.382	451.110.105
Astana	806.887.233	945.887.612	1.120.870.678	1.206.250.675	1.749.891.997	2.221.357.463
Almaty	711.084.205	733.504.129	948.818.868	991.065.775	1.575.434.158	1.551.530.030
Shymkent	150.890.346	224.041.487	306.605.832	383.287.833	582.896.625	574.270.337
Turkestan region	353.415.603	556.818.847	568.405.413	484.681.760	903.128.323	800.482.342
Zhetisu region				151.424.498	191.679.856	194.602.112
Ulytau region				72.316.894	111.605.522	106.645.033
Abai region				360.680.651	327.069.938	324.503.938

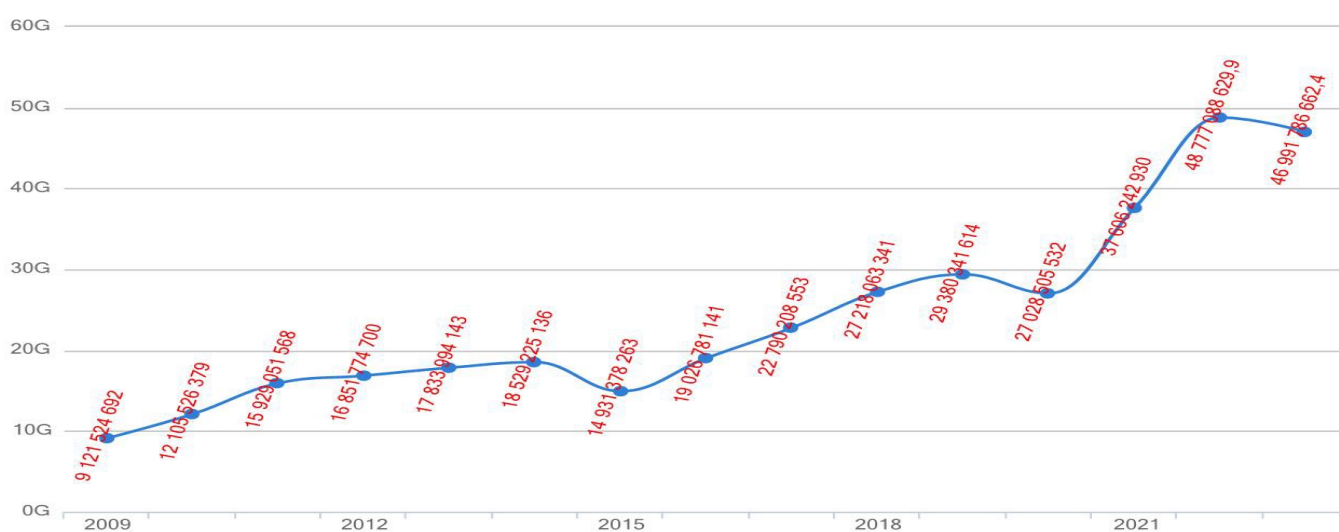
**Table 4 – Total volume of innovative products (goods and services) (thousand, KZT)<sup>4</sup>**

Region	2017	2018	2019	2020	2021	2022	2023	2024
The Republic of Kazakhstan	844.734,9	1.064.067,4	1.113.566,5	1.715.500,1	1.438.708,5	1.879.123,1	2.399.758,1	1.838.998,4
Akmola region	15.721,9	25.644,6	17.793,0	56.366,5	112.279,2	252.818,1	235.024,4	113.133,9
Aktobe region	39.442,0	44.299,9	51.421,7	59.026,1	86.445,2	85.005,2	90.889,2	77.278,1
Almaty region	12.624,2	18.351,2	20.443,6	59.571,0	66.339,0	54.262,5	43.905,6	94.553,5
Atyrau region	5.768,0	8.819,8	7.536,3	402.420,3	40.422,1	18.036,5	70.439,7	107.209,5
West Kazakhstan region	18.122,1	23.398,7	24.713,4	21.671,3	19.774,1	19.753,0	26.068,0	29.384,0

<sup>3</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

<sup>4</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

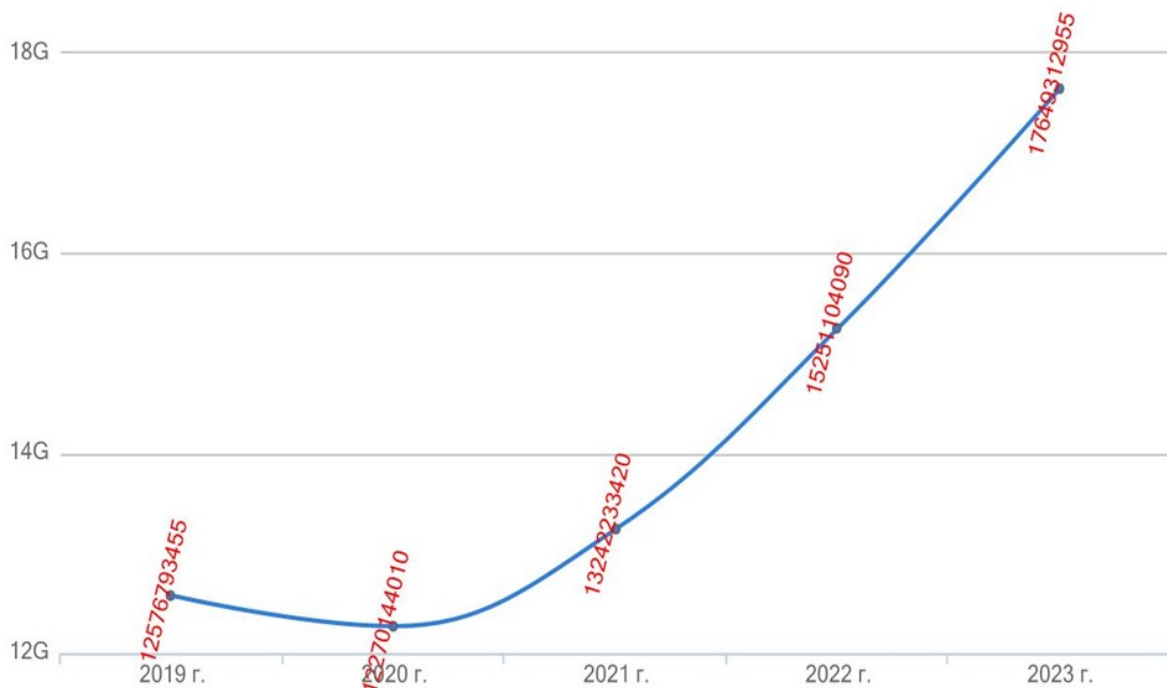
Region	2017	2018	2019	2020	2021	2022	2023	2024
Zhambyl region	50.854,7	66.782,3	77.092,5	67.430,7	77.650,2	60.765,9	36.212,4	37.971,8
Karaganda region	32.048,0	54.778,0	74.007,0	145.720,6	246.050,8	224.972,6	271.601,2	124.392,5
Kostanay region	91.502,6	124.014,9	211.088,3	349.012,4	378.988,5	528.652,6	898.777,3	580.272,8
Kyzylorda region	5.505,8	6.401,7	16.425,2	19.925,7	33.111,2	42.355,7	54.795,7	95.247,0
Mangystau region	294,9	651,0	7.971,3	5.317,2	4.233,2	8.522,9	12.668,3	9.426,1
South Kazakhstan region	125.231,6							
Pavlodar region	177.881,5	250.032,0	44.503,7	96.984,4	97.164,0	115.194,9	122.689,6	124.419,3
North Kazakhstan region	13.804,9	9.396,5	8.652,1	26.066,0	25.196,4	82.386,6	117.152,3	131.662,9
East Kazakhstan region	80.472,0	174.068,8	223.618,8	116.747,0	37.549,2	58.127,5	18.385,7	24.840,3
Astana	149.277,5	112.146,2	129.468,7	67.314,0	41.456,4	33.090,5	38.433,3	57.755,2
Almaty	26.183,3	30.228,4	48.948,4	56.491,2	62.846,8	118.191,7	146.822,9	165.007,7
Shymkent		101.678,0	136.084,8	150.588,3	95.024,9	28.116,6	27.718,6	42.243,8
Turkestan region		13.375,7	13.797,5	14.847,6	14.177,3	27.421,6	17.720,0	14.448,7
Zhetisu region						27.662,4	25.968,4	3.200,1
Ulytau region						983,8	71.060,7	x
Abai region						92.802,7	73.424,7	6.044,3



**Figure 1.** The volume of industrial products (goods, services) production, in value terms

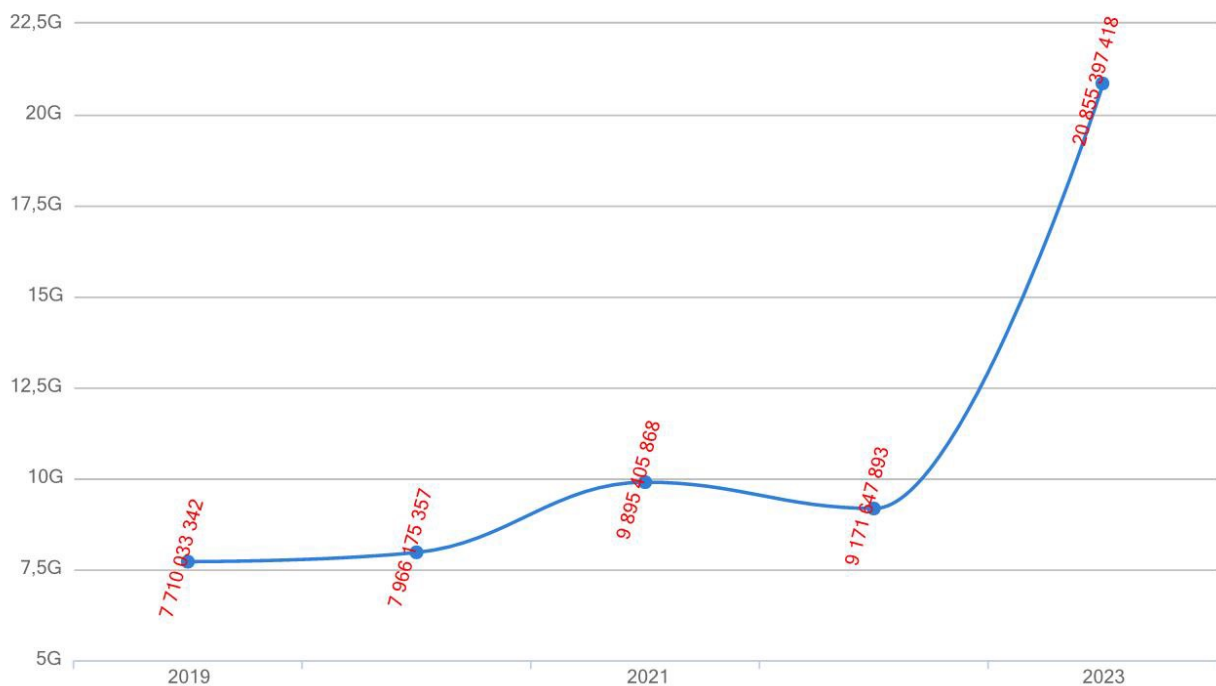
Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>5</sup>

<sup>5</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/>



**Figure 2.** Indicator: Investments in fixed assets by the fields of implementation

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>6</sup>



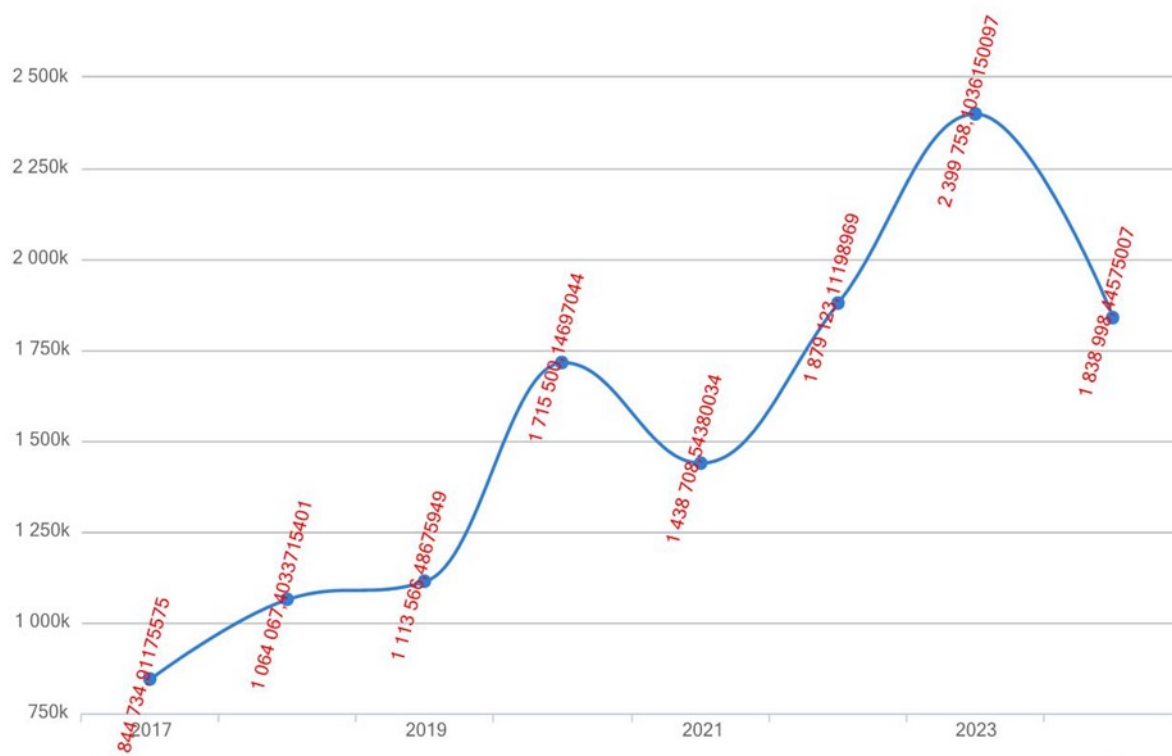
**Figure 3.** Commissioning of new fixed assets

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>7</sup>

(accessed on 02.02.2026).

<sup>6</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

<sup>7</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).



**Figure 4.** Total volume of innovative products (goods and services)

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>8</sup>

### Main part

The study of the interrelationships between macroeconomic indicators – investments, industrial production, the introduction of new fixed assets, and innovative products – ensures a descriptive analysis to a structural understanding of economic growth. The data obtained provide a basis for diagnosing the current state of the industrial sector and identifying points of institutional tension. The correlation analysis is complemented by visual analytics and strategic interpretation for multidimensional interpretation of statistical dependencies. The section presents the results of correlation coefficients calculations, their interpretation, and identification of the economic logic of their relationships. It agrees with previously published studies [1-30]. However, it generalises the methodological base.

The authors proposed the following models of correlation analysis (Models 1,2,3) and model of multiple linear regression (Model 4). The results are shown in in Tables 5 and 6.

#### Model 1. Paired linear correlation (Pearson)

Variables: Y – the volume of industrial production (Table 1, Figure 1);  $X_1$  – investments in fixed assets (Table 2, Figure 2).

Objective: to assess the degree of linear dependence of industrial production on the level of investment.

Hypothesis:  $H_1$  – an increase in investment is statistically significantly associated with an increase in industrial production (the expected sign is positive).

Estimate:  $r = 0.8738$ ;  $p$ -value  $< 0.01$ ; the relationship is strong and significant (Figure 3, Table 5).

#### Model 2. Paired linear correlation (Pearson)

Variables: Y – volume of industrial production (Table 1, Figure 1);  $X_2$  – commissioning of new fixed assets (Table 3, Figure 4).

<sup>8</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

Objective: to identify the relationship between the renewal of production facilities and industrial production.

Hypothesis:  $H_2$  – modernisation of funds positively correlates with industrial production.

Estimate:  $r = 0.3991$ ;  $p$ -value  $> 0.05$ ; the relationship is moderate, requires clarification with lags (Figure 5, Table 5).

Model 3. Paired linear correlation (Pearson)

Variables:  $Y$  – the volume of industrial production (Table 1, Figure 1);  $X_3$  – the volume of innovative products (Table 4, Figure 6).

Objective: to assess the impact of innovation activity on industrial production.

Hypothesis:  $H_3$  – the growth of innovative products is accompanied by an increase in industrial production.

Estimate:  $r = 0.7976$ ;  $p$ -value  $< 0.01$ ; the relationship is strong, but requires regression testing with a small number of observations (Figure 7, Table 5).

Hypothesis:  $H_4$  – The combined impact of investments in fixed assets, the commissioning of new fixed assets, and the volume of innovative products significantly affects the volume of industrial production in Kazakhstan. The regions with high indicators in three factors demonstrate steady growth in industrial production. It is confirmed by an increase in production volumes by value. On the contrary, regions with low indicators of these factors have lower industrial development and production volumes (Figure 8).

We calculate the correlation models based on the data in Tables 1-4 and summarise the results in Table 5.

**Table 5** – Correlation analysis of industrial production volume (goods, services), investments in fixed assets, commissioning of new fixed assets, and the volume of innovative products of the Republic of Kazakhstan

Indicator 1	Indicator 2	Correlation coefficient, $r$	Interpretation
Investments in fixed assets by the fields of implementation (2019-2024)	Volume of industrial production (goods, services), by value	0.8738	Strong positive correlation; investment growth is accompanied by an increase in industrial production
Volume of industrial production (goods, services), by value (2019-2024)	Commissioning of new fixed assets	0.3991	Moderate positive correlation; the increase in production is partly due to the modernisation of production assets
The total volume of innovative products (goods and services) (2017-2024)	The volume of production of industrial products (goods, services)	0.7976	Strong positive correlation; innovative products have a stable impact on the industrial sector

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>9</sup>

Table 5 shows the results of three correlation analyses:

1. The difference between investment and industrial production:  $r = 0.8738$  indicates a strong direct relationship. Each increase in investment is accompanied by a proportional increase in output. The investments are the main drivers of industrial development.

<sup>9</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

2. Between the volume of production and the introduction of new fixed assets:  $r = 0.3991$ . It is a moderate connection. The growth of industrial production stimulates indirect modernisation of funds. There is a structural lag between production activity and equipment upgrades.

3. Between the volume of innovative products and industrial output:  $r = 0.7976$ . The correlation is high. Innovation activity has a steady impact on production growth. The effect is particularly high in the high-tech and manufacturing sectors. The innovations enhance the multiplicative effect of investments.

These dependencies are consistent with the provisions of the theory of endogenous growth. According to the theory, the internal factors are investment and technological renewal. Moreover, innovations provide the economic development. Additionally, the research results agree with the Cobb-Douglas production function. According to it, industrial production depends on a combination of capital and technological factors. The gap between high investment and the limited effect of fund renewal and R&D requires institutional incentives aimed at increasing returns on investment.



**Figure 5.** Correlation of the volume of industrial products (goods, services) of production, by value, and investments in fixed assets by the fields of implementation

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>10</sup>



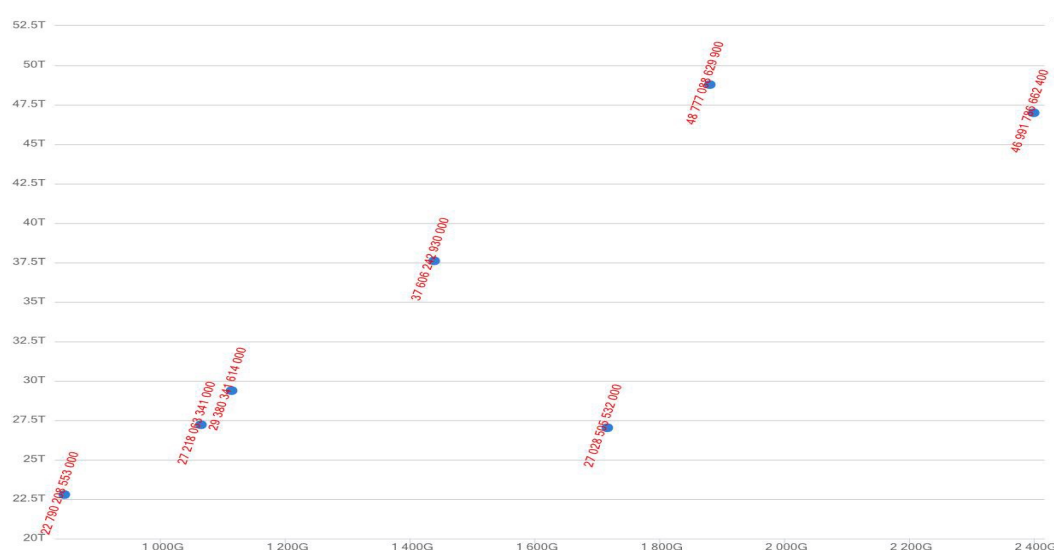
**Figure 6.** The volume of industrial products (goods, services) production by value, and the commissioning of new fixed assets

Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>11</sup>

<sup>10</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

<sup>11</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and

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**Figure 7.** The total volume of innovative products and the volume of industrial production (goods, services)  
 Source: Indicators of industrial and innovative development of the Republic of Kazakhstan, 2000-2024<sup>12</sup>

**Table 6** – Identified internal and external problems and recommendations for their elimination

Identified internal problems	Recommendations
Low level of investment growth in fixed assets	Increasing the financing of infrastructure projects, attracting private investment through public-private partnerships
Weak correlation between investment and industrial production	Strengthen the project effectiveness of investments, implementation of a post-investment control system, monitoring and analysis of costs
Inconsistent commissioning of new fixed assets	Development of a clear schedule for equipment modernisation, set of the priorities for investments in the renovation of fixed assets
Shortage of institutional incentives for industrialisation	The optimisation of fiscal policy, increasing the role of public and private programs to support small and medium-sized businesses, providing tax and customs preferences for manufacturers
Insufficient contribution of innovative products to the growth of industrial production	The promotion of R&D, stimulation of innovation in enterprises, integration of science and business, and start of industrial startups
Low level of technological renewal in regional industries	Digitalization and automation programs, establishing the industrial zones to attract investments and modern technologies
Weak correlation between funding and industrial growth rates	The mechanisms for coordinating investment and production planning, implementation of technologies for tracking investment flows
Absence of a systematic approach to estimating the effectiveness of capital investments	Development of a unified methodology for assessing the return on investment in fixed assets, establishment of systems for real-time investment analysis and monitoring

Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026).

<sup>12</sup> Indicators of industrial and innovative development of the Republic of Kazakhstan (2000-2024). Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics. Source: <https://stat.gov.kz/api/iblock/element/113866/file/ru/> (accessed on 02.02.2026)

Identified internal problems	Recommendations
Low international competitiveness of individual regions	Implementation of a strategic planning system based on the analysis of international experience, activation of foreign trade, and promotion of domestic goods to foreign markets
Low diversification of sources of foreign investment	Expanding the geography of foreign investment, developing trade with key partners, and attracting foreign investors to high-tech industries
Instability of external economic conditions	Development of anti-crisis measures, establishing the reserve funds to protect against economic fluctuations, strengthening trade and investment relations with key partners
Inefficient use of export potential	Improving the quality and competitiveness of products, establishing export clusters, and increasing government support for exporters
Excessive dependence on foreign technologies and equipment	Development of own production facilities for the production of high-tech products, support for domestic developments and start-ups in the field of high technologies
Insufficient integration into global supply chains	The development of logistics infrastructure, establishing the partnerships with international companies, implementation of standards are the international requirements

Source: Authors

Therefore, improvement of the investment climate, quality and competitiveness of products on the foreign market, optimisation of investment and production processes within the country are relevant.

### Conclusion

The research involves a comprehensive analysis of the interrelationships between investments in fixed assets, the introduction of new fixed assets, the volume of innovative products, and industrial production in Kazakhstan, 2017-2024. The results showed a strong correlation between investment and industrial production ( $r = 0.8738$ ), a moderate relationship between the introduction of new funds and production ( $r = 0.3991$ ), and a high importance of the innovation component ( $r = 0.7976$ ). The multiple regression model shows the positive impact of a combination of factors; a lag effect of investments within 1-2 years.

The results confirmed the existence of a close positive relationship between investments in fixed assets and the volume of industrial production in Kazakhstan ( $r = 0.8738$ ,  $p < 0.01$ ). It agrees with the results by E.V. Tinkova and V.A. Dikareva [2] on the growth of investment activity is a key indicator of industrial development. The established relationship between the commissioning of new fixed assets and industrial production ( $r = 0.3991$ ,  $p < 0.05$ ) demonstrates a moderate influence. It agrees with the results by of N.Yu. Shadchenko and M.A. Belmesov [4] on increasing the efficiency of long-term capital investments growth.

The significant role of innovative products ( $r = 0.7976$ ,  $p < 0.01$ ) confirms the thesis that innovations are an independent factor in industrial development. It agrees with the research results by A.V. Sinitsyn & V.V. Kopein [3], D.G. Rodionov & D.A. Alferyev [8] on the interdependence of the investment process and the innovative activity of enterprises. Moreover, the identified asynchronous effect of investments with a time lag of 1-2 years correlates with the concept by M.V. Kulikov [28] on the role of the institutional environment in slowing down the implementation of capital investments.

The novelty of the analysis is in the integration of the innovation factor into a single model of industrial growth. The scientists O.S. Sukhareva [1] and L.I. Tenkovskaya [20] focus on macroeconomic trends and the general investment environment. However, this particular research offers quantitative evidence of the complex impact of investments, renovation of fixed assets, and innovations.

The practical significance of the results is their implementation as a basis for state industrial policy formation. Moreover, the conclusions confirm the expediency of synchronising investment programs with

measures to stimulate R&D. It correlates with the proposals of T.A. Salimova et al. [18] on consideration of the innovation clusters as a strategic factor in industrial development.

The limitation of the research is the use of aggregated macroeconomic data. It prevent us to assess the industry specifics and differences in dynamics of large and small enterprises. Moreover, a time lag of 1-2 years requires more in-depth modelling, including the use of panel data and distributed lag estimation methods, similar to L.I. Nivorozhkina et al. [29].

Promising areas for further research are as follows: expanding an analysis time horizon to confirm identified relationships sustainability; industrial and regional samples to identify differences in the dynamics of industrial development; additional factors, i.e. human capital (A.O. Bulina et al. [17]) and digitalization of production processes (A.G. Serebrennikov et al. [15]); the development of scenario models for predicting industrial growth under the influence of external economic factors.

Hence, research results serve to the development of economic analysis of industrial growth theory and practice, confirm the importance of integrated accounting of investments, innovations and renewal of production assets, and provide new trends for interdisciplinary research in terms of institutional economics and industrial policy.

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#### CONFLICT OF INTEREST

The authors declare no conflict of interest.

#### AUTHORS' CONTRIBUTION

Zhanna R. Ashimova – conceptualization, project administration, writing – original draft.

Amina M. Uristembek – writing – review & editing.

Zhanay Z. Abitov – investigation.

Diana Z. Abitova – formal analysis.

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