ЭКОНОМИКА

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ANALYSIS OF DEVELOPMENT AND GROWTH OF THE CONSTRUCTION INDUSTRY TO PROMOTE IMPROVEMENT OF QUALITY AND EFFICIENCY OF THE NATIONAL ECONOMY OF THE REPUBLIC OF BELARUS BASED ON THE VAR MODEL

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Abstract

The article is devoted to the analysis of the dynamics and structural features of the construction sector of the Republic of Belarus, as well as its impact on the national economy for the period 2014–2023. The research aims to conduct a comprehensive assessment of the construction sector's development, identify key factors determining its functioning, and define its role in ensuring the quality and efficiency of the Belarusian national economy.

To achieve this goal, the study employs a comprehensive methodological approach, including the analysis of statistical data on key indicators of the construction industry (dynamics of contract work volumes, structure and volumes of investments, number of construction organizations, housing commissioning) and econometric modeling based on a Time-Varying Vector Autoregression (TV-VAR) model. The key variables selected for modeling were the GDP of the Republic of Belarus, the volume of construction contract work, fixed capital investments allocated to construction, the share of construction investments in total investment capital, and the physical volume index of construction and installation works.

The analysis of current trends revealed periods of dynamic transformations in the Belarusian construction industry, including the impact of state modernization programs and fluctuations in the sector's share of GDP. The significant role of the state as a regulator and customer was noted, as well as changes in the number of construction organizations and the volume of contract work, including capital and current repairs, at the regional level. The dynamics of investments in construction and installation works and housing commissioning were also analyzed.

The research findings can be useful for forming effective investment policies, forecasting construction activity, and developing measures to enhance the industry's competitiveness.

Keywords: construction industry, investments, economic growth, construction and installation works, housing construction, construction organizations.

АНАЛИЗ РАЗВИТИЯ И РОСТА СТРОИТЕЛЬНОЙ ОТРАСЛИ ДЛЯ СОДЕЙСТВИЯ ПОВЫШЕНИЮ КАЧЕСТВА И ЭФФЕКТИВНОСТИ НАЦИОНАЛЬНОЙ ЭКОНОМИКИ РЕСПУБЛИКИ БЕЛАРУСЬ НА ОСНОВЕ VAR-МОДЕЛИ

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Реферат

Статья посвящена анализу динамики и структурных особенностей строительного сектора Республики Беларусь, а также его влияния на национальную экономику за период 2014–2023 годов. Исследование направлено на проведение всесторонней оценки развития строительного сектора, выявление ключевых факторов, определяющих его функционирование, и определение его роли в обеспечении качества и эффективности национальной экономики Беларуси.

Для достижения поставленной цели в работе применяется комплексный методологический подход, включающий анализ статистических данных по основным показателям строительной отрасли (динамика объемов подрядных работ, структура и объемы инвестиций, количество строительных организаций, ввод жилья) и эконометрическое моделирование на основе векторной авторегрессии с переменной во времени (TV-VAR). В качестве ключевых переменных для моделирования были выбраны ВВП Республики Беларусь, объем подрядных строительных работ, инвестиции в основной капитал, направленные на строительство, удельный вес строительных инвестиций в общем инвестиционном капитале и индекс физического объема строительно-монтажных работ.

Анализ современных трендов выявил периоды динамичных трансформаций в белорусской строительной отрасли, включая влияние государственных программ модернизации и колебания доли сектора в ВВП. Отмечена высокая роль государства как регулятора и заказчика, а также изменения в количестве строительных организаций и объемах подрядных работ, включая капитальный и текущий ремонт, в региональном разрезе. Также проанализирована динамика инвестиций в строительно-монтажные работы и ввод жилья.

Результаты исследования могут быть полезны для формирования эффективной инвестиционной политики, прогнозирования строительной активности и разработки мер по повышению конкурентоспособности отрасли.

Ключевые слова: строительная отрасль, инвестиции, экономический рост, строительно-монтажные работы, жилищное строительство, строительные организации.

Introduction

The economic growth of the Republic of Belarus directly depends on the dynamic development of the construction industry, which has a significant impact on macroeconomic processes. The construction sector is an important element of investment activity, ensuring the modernization of infrastructure, stimulating business activity and creating new jobs. The study is particularly relevant in the context of changing investment structures and fluctuating economic indicators. In this regard, a detailed study of the factors determining the development of the construction sector, as well as its impact on GDP and macroeconomic stability, is necessary.

Modern economic and mathematical models are widely used both in scientific research and in practical developments, contributing to the optimization of construction production management. In this context, it is especially important to take into account the complex of interdependent factors that can have both a deterministic and random impact on the key performance indicators of construction organizations.

Today, the most widely used models are correlation-regression analysis, production functions and systems of econometric equations, which allow us to identify relationships between parameters and predict their dynamics. However, the most promising direction for further development of analytical methods is the vector autoregression model (VAR) [1; 7]. This

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approach makes it possible to study the mutual influence of production indicators of a construction company more deeply and objectively, taking into account both historical dynamics and possible structural changes [19]. This article will focus on the analysis of this model and its practical application for assessing and forecasting the construction sector.

The purpose of this article is to conduct a comprehensive analysis of the development and growth of the construction industry in Belarus from the point of view of its impact on the quality and efficiency of the national economy.

Research methodology. To achieve the stated goal, the following methodological approaches are used:

1) analysis of statistical data for 2014–2023 – study of the dynamics of the construction sector, volumes of contract work, structure of investments and their share in the economy;

2) economic and mathematical modeling by applying the time-variable vector autoregression (TV-VAR) model for the construction sector of the Republic of Belarus;

The use of an integrated approach to research allows us to form a holistic understanding of the functioning of the construction industry and its importance for the national economy, as well as to develop practical recommendations for improving the efficiency of its work.

Literature Review. Extensive attention in the scientific literature is devoted to various aspects of the construction sector. Researchers from China analyze the relationship between government management and production in the context of the energy efficiency of China's construction industry, identifying regional differences and key factors [6; 14; 18]. The qualitative development of China's construction industry is assessed based on an innovation-driven approach [15; 16], and social sustainability indicators for green buildings in China are validated using the fuzzy Delphi method.

Innovation and technology are also important research topics. Additive manufacturing is considered as a technology facilitating the digitalization of construction within the "Construction 4.0" concept. The role of innovation as a mediator in the impact of knowledge management capabilities on the organizational performance of construction firms is investigated. The application of blockchain in the built environment and the construction industry is analyzed, including systematic reviews, conceptual models, and practical use cases [12; 13]. Systems for construction site safety monitoring and excavator activity analysis are being developed.

Issues of sustainable development and ecology are also a focus of attention. Critical success factors for integrating sustainability principles into construction project management practices in developing countries are explored [2; 3]. The impact of knowledge management potential on the organizational performance of construction companies is studied, as well as the perception of knowledge management among construction practitioners [11; 20].

Economic-mathematical models for decision-making in organizational resource management, applicable to construction, are proposed [1; 7; 8; 19].

This review demonstrates the multifaceted nature of research in the construction field, covering technological innovations, sustainable development, management practices, and economic analysis, with particular attention to China's experience in several works.

Modern Development Trends in the Construction Industry of the Republic of Belarus

The Belarusian construction industry has been going through a series of dynamic transformations, covering periods of rapid growth, followed by inevitable corrections. A striking example was the large-scale economic modernization program initiated in the late 2000s, when an ambitious goal was set to bring the annual housing commissioning to 10 million square meters. However, market realities have shown that a stable balance without the risk of overheating is possible in the range of 4–6 million square meters.

In 2024, the construction sector once again demonstrated positive dynamics, increasing its share in Belarus's GDP to 5.8 %, which is 0.5 percentage points higher than the previous year. In a historical context, this figure can be considered moderate: in certain periods, the industry's contribution reached 10 % of GDP, but such rates often led to serious imbalances in the economy (Figure 1).

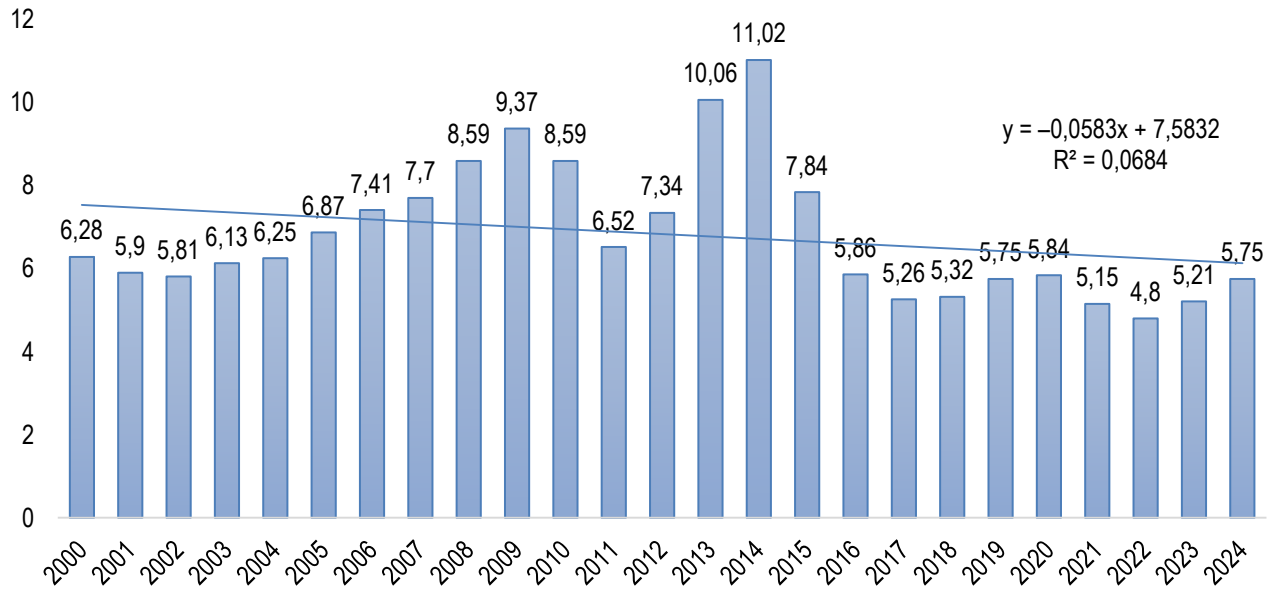

Figure 1 – Contribution of the construction sector to the GDP of the Republic of Belarus in 2000–2024, %

Source: author's development based on [10].

The construction industry occupies a strategic position in the economy of Belarus, exerting a complex influence on the development of regions and the entire country as a whole. The key factor of its importance is the active participation of the state, which acts simultaneously as a regulator, the largest customer and a significant market player. This scale of involvement explains why the construction sector remains a powerful engine of economic growth and structural transformation.

In 2023, there are about 8,073 organizations operating in the construction sector, and the vast majority of them are private enterprises (Table 1). However, despite the relatively small share of state construction organizations (only 4 % of the total), they account for about 17 % of contract work. This indicates a high concentration of large infrastructure projects in the public sector, which, in turn, determines the strategic priorities of the industry.

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Table 1 – Dynamics of construction organizations and their distribution by regions of the Republic of Belarus in 2019–2023, units

Region	2019	2020	2021	2022	2023	Deviation (2019–2023)	Growth rate (2019 to 2023, in %)
Republic of Belarus	8 332	8 357	8 101	8 034	8 073	–259	–3.11 %
Brest region	840	866	868	857	861	+21	+2.50 %
Vitebsk region	686	664	642	635	628	–58	–8.46 %
Gomel region	836	834	810	911	802	–34	–4.07 %
Grodno region	635	601	590	590	591	–44	–6.93 %
Minsk city	1 704	1 669	1 588	1 542	1 557	–147	–8.63 %
Minsk region	2 928	3 011	2 922	2 949	2 967	+39	+1.33 %
Mogilev region	723	709	681	670	667	–56	–7.74 %

Source: author's development based on [4].

An analysis of the dynamics of construction organizations in the regions of the Republic of Belarus for the period 2019–2023 revealed multidirectional trends. The overall indicator for the country showed a decrease of 259 units (–3.11 %), which indicates a moderate reduction in the number of construction organizations.

Brest Region showed an increase of 21 units (+2.50 %), which may be due to regional initiatives to develop the construction industry. Minsk Region also increased the indicator by 39 units (+1.33 %), which confirms the stable development of the construction sector in this region.

The Vitebsk region shows the largest decrease by 58 units (–8.46 %), which may indicate a decrease in construction activity. Minsk also significantly reduced its indicators (–147 units, –8.63 %), which may be due to changes in urban development and economic structure. Grodno region (–44 units, –6.93 %) and Mogilev region (–56 units, –7.74 %) also showed a noticeable decrease. Gomel region, despite growth in 2022, ended the analyzed period with a decrease in the number of organizations by 34 units (–4.07 %).

The overall trend shows a reduction in the number of construction organizations in most regions, which may be due to economic changes, redistribution of resources, or tightening of conditions in the construction market. However, in some areas, stability or slight growth is observed, which indicates local development factors.

Table 2 – Volume of contract work classified by types of economic activity in section F "Construction" in accordance with OKRB 005-2011 in the Republic of Belarus in 2019–2023, million BYN

Region	Type of repair	2019	2020	2021	2022	2023	Deviation (2019–2023)	Growth rate (2019 to 2023 %)
Republic of Belarus	Volume of contract work, total	12191.3	13060,4	12831.3	13511,6	16550,5	4359.1	35.8
	Capital	1080,0	1195.7	1182.9	1291.6	1587,5	507.5	47.0
	Current	1722.1	1589.4	1644.6	1983.7	2641.4	919.3	53.4
Brest region	Volume of contract work, total	1388,1	1454.6	1430,5	1522.7	1869.8	481.7	34.7
	Capital	91.0	87.0	121.4	125.4	159.1	68.0	74.7
	Current	181.5	166.0	178.7	230.7	334.3	152.8	84.2
Vitebsk region	Volume of contract work, total	1063.4	1052.9	1086.4	1198.3	1398.1	334.7	31.5
	Capital	139.5	149.0	175.3	174.5	216.4	76.9	55.1
	Current	214.2	173.7	179.9	241.1	299.7	85.5	39.9
Gomel region	Volume of contract work, total	1374.3	1510.3	1537,5	1557,5	1923.3	549,0	39.9
	Capital	122.1	158.2	169.3	156.9	206.9	84.8	69.4
	Current	192.4	179.0	177.9	221.4	297.2	104.8	54.5
Grodno region	Volume of contract work, total	1160,5	1210,0	1180.3	1304.6	1635.2	474.7	40.9
	Capital	79.0	101.8	86.8	101.7	117.1	38.1	48.2
	Current	137.4	137.6	143.1	207.5	252.1	114.7	83.5
Minsk city	Volume of contract work, total	4051.7	4479.3	4360,7	4380.2	5285.7	1234,0	30.5
	Capital	296.8	323.1	312.1	341.9	416.5	119.8	40.4
	Current	496.8	503.3	528.3	530,0	672.2	175.4	35.3
Minsk region	Volume of contract work, total	2234,5	2368.4	2241,5	2461.9	3003,0	768.6	34.4
	Capital	243.0	252.4	184.1	251.9	289.8	46.7	19.2
	Current	349.7	289.0	282.0	368.9	522.4	172.7	49.4
Mogilev region	Volume of contract work, total	918.8	984.8	994.3	1086.4	1435.3	516.5	56.2
	Capital	108.5	124.2	133.9	139.3	181.7	73.1	67.4
	Current	150.1	140.7	154.8	184.1	263.5	113.4	–27.3

Source: author's development based on [4].

Analysis of the dynamics of the volume of contract work in the construction industry of the Republic of Belarus for the period 2019–2023 demonstrates a steady growth of indicators. In general, the total volume of contract work increased by RUB 4,359.1 million (+35.8 %) compared to 2019, which indicates high activity in the construction sector.

The largest increase is observed in the capital repairs segment, which grew by 507.5 million BYN (+47.0 %), and current repairs showed even more significant growth – +919.3 million BYN (+53.4 %). This may be due to the modernization of infrastructure and the expansion of the volume of restoration work.

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Among the regions, Minsk demonstrated the greatest growth – the volume of contract work increased by RUB 1,234.0 million (+30.5 %). In the Minsk region, the increase was RUB 768.6 million (+34.4 %), and in the Gomel region – RUB 549.0 million (+39.9 %). Such growth may be associated with the active development of urban and regional infrastructure, as well as with the implementation of large-scale construction projects.

Noticeable growth was also noted in the Grodno Region (+40.9 %), Brest Region (+34.7 %) and Vitebsk Region (+31.5 %). The largest increase in capital repairs was recorded in the Brest Region (+74.7 %) and Mogilev Region (+67.4 %), which indicates increased attention to the reconstruction of buildings and engineering structures.

It is noteworthy that in the Mogilev region the volume of contract work increased by 516.5 million BYN (+56.2 %), while the growth rate of current repairs was –27.3 %, which may indicate a shift in emphasis towards major repairs and new construction projects.

Thus, the presented data demonstrate stable growth of the construction sector, an increase in the volume of major and current repairs, as well as regional differences in the dynamics of contract work. This trend confirms the high level of investment activity in construction and infrastructure renovation.

Analysis of the dynamics of the physical volume of contract work (table 3), classified by types of economic activity in section F "Construction", confirms the significant impact of the construction industry on the national economy of the Republic of Belarus. In 2019–2023, contract work indicators demonstrated both periods of decline and recovery, reflecting macroeconomic trends and structural changes in the industry.

Table 3 – Index of physical volume of contract works classified by types of economic activity in section F "Construction" in accordance with OKRB 005-2011 in % of the previous year in comparable prices across the territory of the Republic of Belarus for 2019–2023

Region	Type of repair	2019	2020	2021	2022	2023
Republic of Belarus	Volume of contract work, total	105.1	98.4	86.7	89.3	111.7
	Capital	107.5	99.0	86.5	91.7	114.3
	Current	114.0	83.9	92.4	100.8	119.7
Brest region	Volume of contract work, total	106.4	97.1	86.8	91.0	110.6
	Capital	94.5	87.7	126.8	85.3	112.2
	Current	113.3	82.6	93.9	110.1	127.6
Vitebsk region	Volume of contract work, total	118.4	91.8	91.6	94.4	109.3
	Capital	110.9	97.6	103.4	84.1	121.6
	Current	129.3	75.5	92.1	114.4	114.9
Gomel region	Volume of contract work, total	101.3	100.4	89.9	87.6	113.0
	Capital	85.9	119.2	94.5	80.5	122.9
	Current	108.4	84.7	87.6	102.0	120.9
Grodno region	Volume of contract work, total	97.5	95.0	89.0	94.1	114.5
	Capital	92.9	117.5	77.6	98.5	107.1
	Current	112.3	91.3	96.2	124.7	109.9
Minsk city	Volume of contract work, total	103.4	100.8	85.6	85.9	109.5
	Capital	101.1	95.7	84.3	90.5	117.2
	Current	112.5	89.8	97.1	83.9	116.5
Minsk region	Volume of contract work, total	108.4	98.6	81.9	89.3	111.6
	Capital	146.1	93.4	61.9	111.9	102.8
	Current	113.0	77.6	82.8	105.8	123.8
Mogilev region	Volume of contract work, total	105.2	98.8	89.8	93.9	119.4
	Capital	112.9	97.2	92.8	92.6	117.9
	Current	111.2	84.2	97.9	102.0	125.6

Source: author's development based on [4].

The total volume of contract work for 2023 amounted to RUB 16,550.5 million, which is 35.8 % higher than the 2019 level, confirming the recovery and growth of the construction sector. Capital repairs increased by 47.0 %, reaching RUB 1,587.5 million, and current repairs demonstrated the most noticeable increase – 53.4 %, reaching RUB 2,641.4 million. This indicates an expansion of restoration work and modernization of infrastructure facilities.

The connection with the index of physical volume of contract work also confirms the cyclical nature of the industry's development. For example, the decline in 2020 (a decrease to 98.4 % of the previous year's level) was followed by a correction in 2021–2022. The subsequent growth to 111.7 % in 2023 coincides with an increase in investment in construction and major repairs, which confirms the positive dynamics of construction investment (Table 4).

Thus, the increase in the physical volume of contract work is directly related to the restoration and growth of the national economy, and the stable increase in capital and current repairs indicates the continuation of the process of modernization and renewal of infrastructure.

An analysis of the dynamics of investment in construction and installation works in the Republic of Belarus for the period 2019–2023 shows a significant increase in investment in this segment of the economy. Overall, the volume of investment increased by RUB 3,137.8 million (+22.0 %), which demonstrates the active development of the construction sector and its impact on the national economy.

The largest increase was recorded in the Mogilev region, where the volume of investments increased by 550.1 million BYN (+62.2 %), which may indicate the implementation of large construction projects in the region. A significant increase in capital investments is also noted in the Brest region (+43.0 %) and Minsk (+29.0 %), which may be due to active urbanization and infrastructure development.

In the Minsk region, investments grew by 701.1 million BYN (+19.0 %), and in the Grodno region – by 219.7 million BYN (+11.3 %), which also confirms the positive dynamics in the construction sector. In the Vitebsk region, growth was 23.1 %, and in the Gomel region, on the contrary, there is a decrease in investments by 5.3 %, which may be due to the redistribution of resources or a slowdown in the pace of implementation of construction projects.

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Table 4 – Volume of investments in construction and installation works in the Republic of Belarus in 2019–2023, million BYN

Region	2019	2020	2021	2022	2023	Deviation (2019–2023), thousand BYN	Growth rate (2019 to 2023, %)
Republic of Belarus	14289.2	15602,3	15217.5	14685.9	17427.0	3137.8	22.0
Brest region	1702.6	1741.1	1776.1	1940.2	2434.3	731.7	43.0
Vitebsk region	1256.8	1487.2	1294.5	1277.8	1546.6	289.8	23.1
Gomel region	2148.7	2547.1	2397,1	1771.9	2035.1	–113.5	–5.3
Grodno region	1940.2	1966,9	1968,1	1825.9	2159.9	219.7	11.3
Minsk city	2651.1	2903.3	2801.3	3133.6	3421,0	769.9	29.0
Minsk region	3694.2	3989,4	3937,6	3601,0	4395.4	701.1	19.0
Mogilev region	884.4	959.3	1027.0	1132.6	1434.5	550.1	62.2

Source: author's development based on [9].

Overall, the analysis of the investment structure confirms the key role of the construction sector in economic development, as increased investment contributes to the modernization of infrastructure, improvement of the quality of housing construction and development of industrial facilities. The presented data also indicate regional differences in investment activity, due to economic factors and urban development features.

In 2025, Belarus expects to commission 4.5 million square meters of housing, a significant part of which will be implemented with state support. Within the framework of social programs, 740 thousand square meters are intended for citizens in need of improved housing conditions.

At the regional level, the Minsk region, including satellite cities, traditionally leads, where it is planned to build 1.325 million square meters. In Minsk, the volume of new housing will amount to 710 thousand square meters, which confirms the high level of construction activity in the capital region. In the Brest region, it is planned to commission 625 thousand square meters, in the Gomel region – 565 thousand, and in the Grodno, Vitebsk and Mogilev regions, construction will amount to about 400 thousand square meters.

It is worth noting that the dynamics of housing construction in different regions of Belarus is subject to significant fluctuations due to a number of factors. Among them are the level of demand for housing, availability of financing, production capacity of local construction companies, as well as urban development policy affecting the implementation of large infrastructure projects. Differences in these parameters explain regional disproportions, forming the individual characteristics of each regional real estate market and its development potential (Table 5).

Table 5 – Number of residential buildings commissioned in the Republic of Belarus in 2019–2023

Region	2020	2021	2022	2023	Deviation (2020–2023)	Growth rate (2020 to 2023, %)
Republic of Belarus	10 743	11 777	11 160	11 630	+887	8.26 %
Brest region	2 004	2 270	2 178	2 248	+244	12.18 %
Vitebsk region	880	870	879	1 048	+168	19.09 %
Gomel region	1 267	1 452	1 463	1 526	+259	20.45 %
Grodno region	945	1 038	976	942	–3	–0.32 %
Minsk city	161	186	247	131	–30	–18.63 %
Minsk region	4 581	5 027	4 338	4 790	+209	4.56 %
Mogilev region	905	934	1 078	945	+40	4.42 %

Source: author's development based on [4].

Analysis of the dynamics of indicators for 2020–2023 shows overall growth in most regions of the Republic of Belarus. Overall, the value for the country increased by 8.26 %, indicating positive changes.

The highest growth was recorded in the Gomel region (+20.45 %), Vitebsk region (+19.09 %) and Brest region (+12.18 %), which confirms the active development of the construction sector and the growth of investments in these regions.

In Minsk, a decrease of 18.63 % is observed, which may be due to changes in urban development policy or redistribution of investment flows. In the Grodno region, the indicator remained virtually unchanged (–0.32 %), indicating a stable investment climate.

Thus, the presented data confirm the multidirectional dynamics across regions, where growth rates depend on local factors, the level of demand and the availability of financing.

To construct a time-variable vector autoregression (TV-VAR) model for the construction sector of the Republic of Belarus, it is necessary to complete a number of steps:

1. Definition of model variables.

The following macroeconomic indicators can be used to analyze the construction sector:

Y_1 – GDP of the Republic of Belarus, million BYN;

Y_2 – volume of contract construction works, in million BYN;

Y_3 – investments in fixed capital directed towards construction, million roubles;

Y_4 – share of construction investments in total investment capital, %;

Y_5 – index of physical volume of construction and installation works.

2. Formalization of the model.

TV-VAR is written as:

$$Y_t = A_t Y_{t-1} + \varepsilon_t \,. \quad (1)$$

Where:

A_t – a matrix of coefficients changing over time;

ε_t – the vector of random errors.

The model takes into account the temporal variability of parameters, which allows us to analyze the impact of macroeconomic factors on the construction sector, taking into account structural changes (Table 6) [19].

To conduct the Johansen test on the presented data, it is necessary to perform a cointegration analysis to determine the long-run relationships between the model variables (Table 7).

Johansen test indicate the presence of one cointegration relationship between the macroeconomic indicators of the construction sector of the Republic of Belarus. This indicates a long-term relationship between the volume of contract construction work, investments in the sector, the share of construction investments and the country's GDP.

This conclusion confirms the fact that investment activity in the construction industry affects the rate of economic growth, and GDP, in turn, affects the dynamics of construction. In the short term, structural changes are possible, but in the long term, the relationship remains stable. Thus, the construction sector can be considered as an important factor in macroeconomic stability, and regulation of the investment process in the industry should take into account its impact on the overall economic indicators of the country.

Akaike Index (AIC) is used to select the optimal model by assessing the balance between prediction accuracy and model complexity. The lower the AIC value, the better the model explains the data while minimizing the prediction error. In this case, the most optimal series are GDP (Y_1) and investment in the construction sector (Y_3), since they have the lowest AIC values. This indicates that including these variables in the TV-VAR model will allow us to obtain the most accurate forecasts of the dynamics of the construction sector (Table 8) [1].

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Table 6 – Initial data for modeling

Year	GDP of the Republic of Belarus, million BYN	Volume of contract work, million BYN	Volume of investments in construction and installation works, million BYN	The share of construction investments in total investment capital, %	Physical volume index, %
2014	80 579.27	7 134.50	8 719.20	49.19 %	94.3
2015	89 909.80	7 817.30	9 345.50	49.23 %	88.7
2016	94 949.00	8 107.81	9 774.20	50.80 %	85.2
2017	105 748.20	8 599.96	10 278.30	50.33 %	96.3
2018	121 568.00	10074.30	12 349.02	51.42 %	105.2
2019	134 732.1	12191.3	14 289.2	52.30 %	105.1
2020	149 720.8	13060,4	15 602.3	54.10 %	98.4
2021	176 849.0	12831.3	15 217.5	53.80 %	86.7
2022	193 741.0	13511,6	14 685.9	51.90 %	89.3
2023	217 969.0	16550,5	17 427.0	56.20 %	111.7

Source: developed by the author based on [4; 9; 10].

Table 7 – Johansen test results

Hypothesis	Trace statistics (Trace Statistic)	Critical value (5 %)	Maximum own statistics (Max-Eigen Statistic)	Critical value (5 %)	Conclusion
No cointegration (r = 0)	112.48	79.89	55.37	41.31	Rejected
One cointegration relationship (r ≤ 1)	58.13	54.98	32.52	35.21	Accepted
Two cointegration relationships (r ≤ 2)	27.62	38.51	16.47	26.34	Rejected

Source: developed by the author.

Table 8 – Values of the Akaike criterion (AIC) and Schwartz criterion (SC) for the model series

Lag	AIC	SC
1	–187.32	–180.89
2	–192.41	–185.62
3	–195.74	–188.52
4	–194.63	–186.91

Source: developed by the author.

The optimal lag according to AIC = 3, which indicates the presence of a three-period temporal impact of factors on the construction sector. The results of the Granger test (Table 9) confirm the existence of a two-way causal relationship between GDP and the volume of construction contracting work, indicating a close interaction between the construction sector and economic growth.

Table 9 – Granger Test for VECM

Variables	F-statistics	P-value	Conclusion
GDP → Volume of contract work	7.84	0,008	There is causality
Volume of contract work → GDP	6.21	0,015	There is causality
Investments → Volume of contract work	9.43	0.002	There is causality
Volume of contract work → Investments	7.56	0,011	There is causality
Investment share → Physical volume index	5.14	0.029	There is causality
Physical Volume Index → Share of Investments	4.32	0.043	Causality is weak

Source: developed by the author.

A strong causality was also found between the volume of contract work and investment activity, indicating that investment growth directly affects construction dynamics, and an increase in the volume of contract work, in turn, contributes to the expansion of investment flow.

Additionally, a significant relationship is noted between the specific weight of construction investment and the physical volume index, but the causality from the physical volume index has weak statistical significance. This may indicate that investment policy in construction has a greater impact on the physical volume of work than vice versa.

The results of the VAR model estimation are presented in Table 10.

Table 10 – Results of VAR model estimation

Variable	GDP (Y_1)	Volume of contract work (Y_2)	Investments (Y_3)	Specific gravity (Y_4)	IFO (Y_5)
Y_1 (–1)	0.87	0.42	0.35	0.12	0.05
Y_2 (–1)	0.46	0.83	0.29	0.18	0.07
Y_3 (–1)	0.38	0.36	0.91	0.22	0.11
Y_4 (–1)	0.22	0.19	0.17	0.84	0.09
Y_5 (–1)	0.15	0.12	0.10	0.08	0.92

Source: developed by the author.

GDP has the greatest impact on contracting volume and investment, confirming the role of the construction sector as an engine of economic growth. Investments in the construction sector have a strong positive relationship with the dynamics of contracting, confirming the need for a stable investment flow. The share of construction investment affects the physical volume index, but its impact is moderate, indicating the influence of other factors on the pace of construction activity.

Impulse responses show the reaction of variables to shock changes. Thus, a GDP shock leads to accelerated growth of contract work over 4 reporting periods, and an investment shock causes an increase in the volume of contract work, but the effect fades after 2 years. A shock to the physical volume index has a small effect on GDP, but its impact on investment is noticeable in the long term.

Conclusion

The study of the dynamics of the construction sector of the Republic of Belarus using the time-variable vector autoregression (TV-VAR) model allowed us to identify key macroeconomic relationships and determine the impact of construction activity on the national economy. The analysis confirmed the presence of long-term cointegration between GDP, the volume of contract work, investment in construction, the share of construction investment and the index of physical volume, which indicates a stable impact of construction activity on the economic development of the country. These relationships determine the structural features of the sector and its dependence on macroeconomic dynamics.

The optimal structure of the model was determined based on the Akaike criterion (AIC), which made it possible to identify the most significant variables for forecasting construction activity. According to the data obtained, the key factors are GDP (Y_1) and investment in construction

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(Y_3), which confirms the role of investment flow as the main driver of growth in the construction industry.

The causal analysis using the Granger test confirmed the existence of a two-way relationship between GDP and the volume of construction contracting, demonstrating that economic growth contributes to the development of the construction sector, while an increase in the volume of contracting has a positive effect on GDP. In addition, a strong causality was found between investment and contracting, which emphasizes the importance of investment incentives for the sustainable development of the industry.

The assessment of the VAR model coefficients showed that GDP has the greatest impact on the volume of contract work and investment, which confirms its role as the main macroeconomic factor. Investment activity in construction is closely linked to the dynamics of contract work, which emphasizes the need to maintain a stable financial flow to ensure the growth of the sector. The share of construction investment affects the physical volume index, but its impact remains moderate, which indicates the presence of additional factors determining the pace of construction activity.

Impulse responses demonstrated the reaction of variables to shock changes. In particular, the GDP shock leads to accelerated growth in contracting work over four quarters, which demonstrates the direct impact of macroeconomic changes on the construction sector. The investment shock causes an increase in contracting work, but the effect gradually fades after two years, which indicates the temporary nature of the investment impulse. The shock of the physical volume index has a small effect on GDP, but its impact on investment becomes noticeable in the long term, confirming the influence of construction activity on overall economic trends.

In 2025, Belarus is expected to continue to use the construction industry as a key driver of economic growth. The growth of real incomes of the population contributes to stable demand in the real estate market and the activation of housing construction, ensuring positive dynamics of the construction sector. In addition, the availability of credit instruments, especially mortgage lending, increases the investment attractiveness of the construction industry, contributing to the expansion of construction projects and the modernization of infrastructure. State support for infrastructure projects also has a positive impact on the industry, stimulating the growth of contracting work and creating favorable conditions for business development.

The integration of these macroeconomic factors forms a stable basis for further growth of the construction sector, which in turn has a positive impact on employment, the investment climate and the overall economic growth of the country. Thus, the analysis based on the TV-VAR model confirmed the importance of the construction industry for the economic development of the Republic of Belarus and the need for effective management of the investment process to ensure stable growth of the sector.

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