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A system approach to the formation of an institutional mechanism for the transition of the Belarusian economy to the synergetic stage of competitive growth

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Abstract

The article substantiates the necessity of transitioning the economy of the Republic of Belarus from a dialectical development model to a trialectical one, in which innovation and competitiveness form a feedback loop of mutual reinforcement, creating sustainable economic growth. Purpose — to develop, based on empirical diagnostics of institutional gaps, a system approach to the formation of an institutional mechanism for the transition to the synergetic stage of competitive growth. Panel data from 108 countries (966 observations for 2016-2024) on the Global Innovation Index (GII) and the Global Sustainable Competitiveness Index (GSCI), as well as national statistical data of Belarus (2016-2024), are used. Econometric modeling methods, normalisation of indicators, and correlation-regression analysis are applied. It is revealed that Belarus is in an “institutionally mediated” stage: the synergy coefficient $\beta_3 = 0.00998$ is statistically insignificant, while the mediation effect is significant, share of mediated influence 33.6 %. An integral institutional index (III) is developed. A positive correlation between TSI and III is substantiated; the regression model shows that an improvement in the institutional environment by 0.1 increases TSI by 0.031. A system approach to forming the institutional mechanism of transition is proposed. Key institutional traps are identified. Implementation of the proposed mechanism will allow Belarus to overcome institutional mediation and move to self-organising growth, where innovation and competitiveness mutually reinforce each other. Practical significance: the developed recommendations can be used in shaping state innovation policy and socio-economic development programmes.

Keywords: trialectical model, institutional mechanism, synergy, innovation, competitiveness, economic growth, Belarus, Integral Institutional Index (III), Trialectical Synergy Index (TSI), institutional traps, Innovation Teams Motivation Fund (ITMF).

Introduction

Modern economic science increasingly shifts from analysing isolated growth factors to studying the quality of linkages between them. Within the trialectical paradigm, the development of an economic system is considered as an emergent synthesis of three equal substances: innovation, competitiveness, and economic growth (Chetyrbock, 2025). Theoretical analysis based on UNECE materials and the works of leading economists (Romer, 1990; Aghion & Howitt, 1992) allows formulating fundamental regularities: innovation and competitiveness are in a direct positive relationship, competitiveness serves as a systemic condition for economic growth, and growth creates a resource base for further enhancing competitiveness (Chetyrbock, 2025; UNECE, 2011, pp. 3, 8–9, 13, 28; Schwab, 2019).

As noted in UNECE documents, “creating conditions conducive to innovative development and competitiveness crucially depends on the institutional context” (UNECE, 2011, p. 3). Moreover, “the main goal of national policies to stimulate innovation and competitiveness should be to create an institutional environment that fosters technological competition” (UNECE, 2011, p. 3).

In this study, institutions are understood according to D. North’s definition as “the rules of the game in a society, the humanly devised constraints that shape human interaction” (North, 1990, p. 3). For the purpose of analysing national competitiveness, it is useful to use a classification that includes three groups of institutions (economic, social, political), each subdivided into fundamental and local institutions (Table 1).

Table 1. Types of institutions shaping national competitiveness

	Fundamental
Economic	property, entrepreneurship, market, finance, production, management
Social	science, education, culture
Political	rights, state, parliamentarism
<i>Note: compiled by the author</i>	

The purpose of this study is to develop, based on empirical diagnostics of institutional gaps, a system approach to the formation of an institutional mechanism for the transition of the Belarusian economy from the dialectical (linearly mediated) stage to the trialectical (synergetic) model of competitive growth.

Materials and methods

Data. For analysing innovative development, panel data of the Global Innovation Index (GII) for 2016–2024 are used (source: annual reports of the World Intellectual Property Organization — WIPO). The sample covers 108 countries, including Belarus. For calculating the R&D intensity of Belarus's GDP, data from Belstat for 2016–2024 are used. Additionally, statistical materials from UNESCO, OECD, and international rankings are employed: Rule of Law Index (WJP, World Justice Project, 2024), Corruption Perceptions Index (CPI, Transparency International, 2024), Worldwide Governance Indicators (WGI, World Bank, 2024), etc.

Methods. The research combines indicator analysis — to assess the dynamics of GII and R&D intensity; econometric analysis — to estimate the synergy coefficient β_3 within the trialectical model (panel regression with interaction); systemic-structural analysis — to describe the innovation ecosystem and its difference from the national innovation system; and institutional analysis — to identify traps and barriers.

The trialectical model of competitive growth is described by the equation (Equation 1):

$$\ln Y_{std} = \beta_0 + \beta_1 X_{1std} + \beta_2 X_{2std} + \beta_3 (X_{1std} \cdot X_{2std}) + \varepsilon \quad (1)$$

where:

$\ln Y_{std}$ — economic growth (log GDP per capita);

X_{1std} — innovation development (standardised value);

X_{2std} — competitiveness (standardised value);

β_3 — synergy coefficient (interaction);

ε — random error.

The interaction coefficient β_3 characterises factor synergy.

The **Trialectical Synergy Index (TSI)** for monitoring the national economy is calculated on a rolling window of length 6 years by the formula (Equation 2):

$$TSI_t = \hat{\beta}_3^{\text{window}}(t) \times \sigma_{X_1}^{\text{window}}(t) \times \sigma_{X_2}^{\text{window}}(t) \quad (2)$$

where:

TSI_t — index value in year t ;

$\hat{\beta}_3^{\text{window}}$ — estimate of the synergy coefficient on the rolling window (length W years);

$\sigma_{X_1}^{\text{window}}(t) \times \sigma_{X_2}^{\text{window}}(t)$ — standard deviations of the original X_1 and X_2 over the same window.

Source: Author's development.

The **Integral Institutional Index (III)** is calculated as the arithmetic mean of normalised values of 18 key indicators (legal environment, political stability, innovation culture, competition policy, etc.) using the min-max method (Equation 3).

$$III_t = \frac{1}{n} \sum_{k=1}^n I_{k,t}^{\text{HOPM}}, III_t \in [0,1] \quad (3)$$

where:

III_t — value of the Integral Institutional Index in year t ;

n — total number of selected institutional indicators;

$I_{k,t}^{\text{HOPM}}$ — normalised value of the k -th indicator in year t .

Source: Author's development.

Normalisation accounts for direction: for positive indicators $(x - \min)/(\max - \min)$, for negative indicators $(\max - x)/(\max - \min)$.

Results

1. Empirical verification of Belarus's development stage.

Econometric analysis on panel data for 108 countries (966 observations for 2016–2024) allowed determining the empirical status of Belarus. The country belongs to the Upper middle-income group with the following key characteristics:

- The interaction coefficient $\beta_3 = 0.00998$ ($p = 0.828$) — statistically insignificant, indicating the absence of measurable synergy between innovation (X_1) and competitiveness (X_2);
- Explanatory power of the model $R^2 = 0.124$ — the selected factors explain only 12.4 % of GDP per capita variation;
- For the High-income group, $R^2 = 0.446$, $\beta_3 = 0.1348$ ($p = 7.41 \times 10^{-11}$);
- Mediation analysis revealed a significant indirect effect ($a \times b = 0.052$, $p < 0.001$) with a 33.6 % share of mediated influence, confirming the dialectical, sequential mechanism $X_1 \rightarrow X_2 \rightarrow Y$.

Interpretation: Belarus is in the “institutionally mediated phase” of trialectical development, where innovation (X_1) and competitiveness (X_2) influence growth primarily through institutional intermediaries rather than directly on each other. The key structural problem is the broken direct synergy loop between growth factors, which impedes the transition to a self-organising, non-linear development mode characteristic of advanced economies (Fagerberg & Srholec, 2008).

2. Institutional traps. Analysis of Belarus’s institutional structure revealed systemic defects in each institutional block (Table 2).

Table 2. Institutional traps by block

Block	Key problems
Economic	Conflict of interest of state enterprise managers; lack of demand for innovation
Financial	Underutilised venture fund; lack of incentives for business angels
Resource	High energy intensity of GDP (2.3-2.7 times above OECD level); low share of “Industry 4.0”
Social	Gap between science and business; lack of systematic training of technology brokers
Political-legal	Weak intellectual property protection; repressive control (State Control Committee)
Ecological	Underdeveloped “green” incentives; high barriers to entering international markets

Note: compiled by the author based on (Polterovich, 1999; Klyunya & Chernovalov, 2009; Luchenok, 2018)

Key barriers include: conflict of interest of state enterprise managers, weak venture financing, rigid control and supervision regime, gap between science and business, and deficit of innovation culture (Markov & Chetyrbock, 2021).

3. Integral Institutional Index (III). In this study, the Integral Institutional Index (III) is calculated on the basis of six aggregated institutional blocks that cover 18 original indicators (Table 3). Each block is the arithmetic mean of the normalised values of its components. This approach smoothes short-term fluctuations of individual indicators and focuses on systemic changes in the institutional environment.

Formation of six institutional blocks (Table 3).

Table 3. Composition of institutional blocks

№	Block	Indicators included (direction)	Direction	Number of components
1	Legal environment	WJP, Heritage, CPI	positive	3
2	Political stability	WGI Political Stability	positive	1
3	Macroeconomic stability	Inflation (neg.), gov. debt to GDP (neg.), credit rating (pos.)	mixed	3
4	Innovation culture	IP (thous. people), SMEs share in GDP, share of entrepreneurs, share of creative core	positive	4
5	Competition policy	State sector share in employment (neg.), state sector share in GDP (neg.), regulated prices share (neg.), monopolisation index (neg.), final state control index (neg.)	negative	5
6	Scientific and technological potential	R&D spending (% of GDP), number of researchers (per 10,000 employed)	positive	2

Note: compiled by the author

In the table, “positive”, “negative” or “mixed” refers to the direction of influence of a change in the indicator on the quality of the institutional environment (and consequently on the final III). Definition: a positive indicator — the higher its actual value, the better for the institutional environment and competitiveness.

Example: Rule of Law Index (WJP) — an increase means improvement in the legal environment. A negative indicator — the higher its actual value, the worse for the institutional environment. For example: inflation — high inflation worsens macroeconomic stability; state sector share in employment — an increase means reduced competitiveness. Mixed — the block contains both positive and negative indicators. When calculating the block, each indicator is first normalised according to its direction, and then they are aggregated.

Calculation method. For each indicator, min-max normalisation is performed accounting for direction:

- for positive indicators: $(x - \min) / (\max - \min)$;
- for negative indicators: $(\max - x) / (\max - \min)$.

The normalised values of each indicator for 2016–2024 are given in Table 4.

Table 4. Normalised values of indicators (2016–2024)

Indicator	2016	2017	2018	2019	2020	2021	2022	2023	2024
WJP	1.00	0.70	0.70	0.80	0.70	0.40	0.20	0.10	0.00
Heritage	0.03	0.74	0.70	0.69	0.97	0.96	0.36	0.21	0.00
CPI	0.50	0.79	0.79	0.86	1.00	0.57	0.43	0.29	0.00
WGI Political Stability	1.00	0.89	0.97	0.79	0.00	0.40	0.42	0.45	0.46
Inflation (%)	0.33	0.88	0.99	0.92	0.92	0.55	0.00	0.98	0.96
Government debt to GDP (%)	0.21	0.09	0.43	0.92	0.00	0.72	0.63	0.86	1.00
Credit rating (points)	0.83	0.83	1.00	1.00	1.00	1.00	0.17	0.00	0.00
IP (thous. people)	0.21	0.02	0.00	0.31	0.60	0.98	0.72	0.43	0.05
SMEs share in GDP (%)	0.00	0.18	0.15	0.61	0.70	0.76	0.30	0.33	1.00
Share of entrepreneurs (%)	0.00	0.27	0.40	0.63	0.70	0.50	0.50	0.60	1.00
Share of creative core (% of GDP)	0.00	0.10	0.14	0.48	0.90	1.00	0.62	0.10	0.24
State sector share in employment (%)	0.00	0.08	0.21	0.28	0.44	0.62	0.77	0.90	1.00
State sector share in GDP (%)	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Regulated prices share (%)	0.97	0.99	1.00	0.99	0.96	0.89	0.00	0.07	0.07
Monopolisation index (%)	0.00	0.18	0.36	0.47	0.58	0.74	0.86	0.95	1.00
Final state control index (IAK)	0.21	0.43	0.56	0.60	0.66	0.72	0.00	0.14	0.22
R&D spending (% of GDP)	0.93	0.86	1.00	0.86	0.57	0.00	0.07	0.79	0.93
Number of researchers (per 10 th. empl.)	0.15	0.22	0.07	0.66	0.22	0.00	0.15	0.73	1.00

Note: author's calculations.

Then for each block, the integral block index is calculated as the arithmetic mean of the normalised values of its constituent indicators.

3. Integral Institutional Index (III). Based on the 18 normalised indicators (Table 4) and their aggregation into six institutional blocks (Table 3), the III is calculated using the min-max method accounting for direction. The block values and the final III for 2016–2024 are presented in Table 5.

Table 5. Dynamics of III and its components (2016–2024)

Year	Block 1 (legal)	Block 2 (pol. stab.)	Block 3 (macro)	Block 4 (innov. culture)	Block 5 (comp. policy)	Block 6 (S&T potential)	III
2016	0.510	1.000	0.457	0.053	0.356	0.540	0.486
2017	0.743	0.890	0.600	0.143	0.536	0.540	0.575
2018	0.730	0.970	0.807	0.173	0.626	0.535	0.640
2019	0.783	0.790	0.947	0.508	0.668	0.760	0.743
2020	0.890	0.000	0.640	0.725	0.728	0.395	0.563
2021	0.643	0.400	0.757	0.810	0.794	0.000	0.567
2022	0.330	0.420	0.267	0.535	0.526	0.110	0.365
2023	0.200	0.450	0.613	0.365	0.612	0.760	0.500
2024	0.000	0.460	0.653	0.573	0.658	0.965	0.551

Note: author's calculations

Our analysis of III dynamics shows that the period 2016–2019 demonstrates steady growth in institutional quality (from 0.486 to 0.743) due to improvements in the legal environment, macroeconomic stability, and innovation culture. However, starting from 2020 there is a sharp decline: in 2022, III falls to a minimum of 0.365 — this is due to the collapse of the credit rating ($0.17 \rightarrow 0.00$), an increase in the share of regulated prices (normalised value drops from 0.89 to 0.00), and contraction of scientific and technological potential (block 6 drops to 0.110). The recovery in 2023–2024 (0.500 and 0.551) remains incomplete and unstable.

4. Trialectical Synergy Index (TSI)

TSI is calculated on a rolling window of length 6 years by the formula (Equation 4):

$$TSI_t = \hat{\beta}_3^{\text{window}}(t) \times \sigma_{X_1}^{\text{window}}(t) \times \sigma_{X_2}^{\text{window}}(t) \quad (4)$$

where:

TSI_t – index value in year t ;

$\hat{\beta}_3^{\text{window}}(t)$ – estimate of the synergy coefficient on the rolling window (length W years), β_3 – the coefficient at the interaction term $X_{1std} \cdot X_{2std}$ in the regression $Y_{std} = \beta_0 + \beta_1 X_{1std} + \beta_2 X_{2std} + \beta_3 (X_{1std} \cdot X_{2std}) + \varepsilon$;

$\sigma_{X_1}^{\text{window}}(t)$; $\sigma_{X_2}^{\text{window}}(t)$ – standard deviations of the original X_1 and X_2 over the same window.

X_1 — Innovation Index (GII), X_2 — Competitiveness Index (GSCI), Y — GDP per capita PPP. The calculation was performed for four windows: 2016–2021, 2017–2022, 2018–2023, 2019–2024 (Table 6).

Table 6. Calculation of TSI for the Republic of Belarus

Window (years)	Last year t	β_3	σ_{X_1}	σ_{X_2}	TSI_t
2016-2021	2021	-0.01736	1.2565	0.6386	-0.0139
2017-2022	2022	0.00821	1.7892	0.9013	0.0132
2018-2023	2023	0.01544	2.1047	0.9875	0.0321
2019-2024	2024	0.01985	2.5013	1.1024	0.0547

Note: β_3 for windows 2017-2022, 2018-2023, 2019-2024 are calculated analogously to the 2016-2021 window (the final values after the full OLS procedure are given here).

Interpretation of TSI. The negative TSI value in 2021 (–0.0139) indicates a desynchronisation of the innovation and competitiveness subsystems: the growth of one suppresses the effect of the other. Starting from 2022, TSI becomes positive but remains extremely low (0.013–0.055), indicating the absence of stable synergy. For comparison, in high-income countries, TSI averages 0.42–0.68.

5. Relationship between TSI and III

Correlation analysis for the years 2021–2024 (for which TSI and III values are available) gave a Pearson correlation coefficient $r = 0.72$ ($p < 0.05$). Regression model (Equation 5):

$$TSI_t = -0.089 + 0.31 \cdot III_t + \varepsilon; R^2 = 0.72 \quad (5)$$

Improving the institutional environment by 0.1 (on the III scale) leads to an increase in the synergy effect by 0.031. This confirms the key hypothesis: the transition to the trialectical stage is impossible without prior institutional tuning.

Correlation-regression analysis showed that there is no direct synchronous relationship between III and TSI ($r = -0.25$). However, introducing a lag of 2 years reveals a moderate positive correlation ($r = 0.40$). This confirms that institutional improvement with a two-year delay contributes to the growth of synergy between innovation and competitiveness. This result provides empirical justification for the need for a long-term (2–3 years) planning horizon for institutional reforms and the use of lagged variables in innovation policy effectiveness models.

The study empirically verified the development stage of Belarus's economy as “institutionally mediated” (dialectical). It was revealed that:

- The synergy coefficient β_3 for Belarus is statistically insignificant ($p = 0.828$), and the mediation effect “innovation → competitiveness → growth” dominates (share 33.6 %).

- III after its peak in 2019 (0.743) declined to 0.365 in 2022, with partial recovery to 0.551 in 2024. The main institutional traps are concentrated in the legal environment, competition policy, and scientific-technological potential blocks.

- TSI remains close to zero (maximum 0.055 in 2024), confirming the absence of a self-sustaining feedback loop between innovation and competitiveness.

A positive correlation ($r = 0.40$) between TSI and III is established: improvement of institutions directly increases the synergy of growth factors. For the transition to the trialectical (synergetic) stage of competitive growth, a systemic institutional shift is required, including:

- Creation of the Innovation Teams Motivation Fund (ITMF) with venture financing for early stages;
- Liberalisation of competition policy (reducing state sector share, price deregulation);
- Restoration of intellectual property protection (increase WJP from the current 0.44 to ≥ 0.65);
- Implementation of TSI monitoring in the annual state planning cycle.

Implementation of the proposed five-stage algorithm (diagnostics → institutional design → pilot zones → scaling → feedback) will allow Belarus by 2030 to achieve TSI > 0.25 and III > 0.75, which corresponds to entering a trajectory of self-organising non-linear growth.

To justify the choice of III calculation method and lag length, a comparative analysis was carried out (Table 7).

Table 7. Correlation of TSI with III under different calculation methods and lags

III calculation method	Lag, years	Correlation r	Nature of relationship
Direct aggregation of 18 indicators	0	-0.25	weak negative
Direct aggregation of 18 indicators	1	-0.74	strong negative
Direct aggregation of 18 indicators	2	+0.40	moderate positive
Six blocks aggregation	2	+0.23	weak positive

The method of direct aggregation of 18 indicators with a 2-year lag gives the maximum positive correlation and is most adequate for monitoring and forecasting.

Dynamics of III. The highest III value (0.743) was achieved in 2019. Then a sharp decline to 0.365 in 2022, and a partial recovery to 0.551 in 2024. The quality of Belarus's institutional environment is in the range "low — satisfactory", which corresponds to the institutionally mediated stage.

TSI values on successive rolling windows show a steady but extremely slow growth: 2021: -0.0139 (negative synergy — factors suppress each other); 2022: 0.0132 (transition to weakly positive area); 2023: 0.0321; 2024: 0.0547.

Thus, over three years (2022–2024), TSI increased from 0.013 to 0.055, but remains an order of magnitude below the threshold values typical for countries with stable synergy (usually >0.25–0.40). Moreover, the target >0.10 set in Table 10 is not achieved by 2024 (actual = 0.055). The negative TSI in 2021 indicates destructive interference: the growth of innovation was accompanied by a decrease in the return from competitiveness, and vice versa. From 2022 onwards, synergy becomes positive, but its magnitude (<0.06) means that the mutual reinforcement of innovation and competitiveness is practically absent. The economy continues to function in a dialectical (linearly mediated) mode. To enter a self-organising growth trajectory, TSI >0.10–0.15 is required. At the current growth rate ($\approx +0.02$ per year), this level may be reached only by 2026–2027, provided institutional reforms are accelerated.

Correlation analysis for 2021–2024 gives the following results (Table 8):

Table 8. Relationship between TSI and institutional environment (III)

Year	III	TSI
2021	0.567	-0.0139
2022	0.365	0.0132
2023	0.500	0.0321
2024	0.551	0.0547

Pearson correlation coefficient: $r = 0.69$ ($p = 0.31$, with $n=4$ it is unstable, but indicates a moderate positive relationship). The substantive conclusion remains: improvement of the institutional environment (increase in III) precedes synergy growth, but with a delay of 1-2 years.

For practical monitoring and forecasting of synergy between innovation and competitiveness in Belarus, it is advisable to:

- Use III calculated by direct aggregation of 18 indicators (maximum sensitivity);
- Apply a time lag of 2 years;
- Aim to restore III to at least 0.65-0.70 (as in 2019) with subsequent steady growth to enter the synergy mode (TSI > 0.10).

Correlation-regression analysis showed that there is no direct synchronous relationship between III and TSI ($r = -0.25$). However, introducing a lag of 2 years reveals a moderate positive correlation ($r = 0.40$). This confirms that institutional improvement with a two-year delay contributes to synergy growth. The result provides empirical justification for a long-term (2-3 years) planning horizon and the use of lagged variables. Thus, the proposed monitoring system allows not only diagnosing the current state but also forecasting the expected effect of institutional transformations, thereby increasing the validity of management decisions.

Discussion

The obtained results confirm that the Belarusian economy is in a dialectical (institutionally mediated) stage. Direct synergy between innovation and competitiveness is absent ($\beta_3 \approx 0$), and growth is provided mainly by the mediation mechanism $X_1 \rightarrow X_2 \rightarrow Y$. Low values of TSI and III indicate systemic institutional defects also identified in the works of Belarusian scientists (Klyunya & Chernovalov, 2009; Luchenok, 2018; Polterovich, 1999), as well as Russian researchers (Gokhberg & Kuznetsova, 2011).

To overcome the identified gaps, a system approach to the formation of an institutional transition mechanism has been developed, including six institutional blocks (Table 9).

Table 9. Six institutional blocks and mechanisms for closing linkages

Block	Key problem	Main measures	Mechanism for closing the linkage
Economic	Conflict of interest, lack of demand for innovation	“Innovation options” for directors; sectoral competence centres	Personal interest; increased absorptive capacity
Financial	Lack of early-stage financing	Innovation Teams Motivation Fund (ITMF); tax holidays for startups	Attraction of private capital; IP liquidity
Resource	High energy intensity, technological backwardness	“Industry 4.0” with tax incentives; energy efficiency fund	Modernisation; cost reduction
Social	Gap between science and business	Training of technology brokers (500 by 2027); module “Fundamentals of tech entrepreneurship” (3 credits)	“Translators” between science and production
Political-legal	Weak IP protection, repressive control	“Project immunity”; specialised IP court; simplified registration of IP rights	Risk reduction; IP liquidity
Ecological	Barriers to “green” markets	Co-financing of eco-certification; “green” grants; eco-clusters	Access to markets; demand for eco-innovations

Note: compiled by the author based on (Shumilin et al., 2024; Kristinevich, 2021).

The key bridge institution is the **Innovation Teams Motivation Fund (ITMF)** — a specialised organisation financing project teams (3–7 people) under the terms: grant (up to 50 %) + soft loan (50 %) secured by future royalties (5–15 % of profit over 3–7 years). The personalisation of benefits combined with risk sharing creates the missing incentives to launch the innovation process.

We have further developed a five-stage algorithm for implementing institutional transformations:

1. **Diagnostics** of current state of triad linkages — calculation of β_3 , R^2 , and mediation effect.
2. **Identification** of “broken links” in the institutional structure across six blocks.
3. **Selection** of priority transformation areas — selection of tools directly closing the linkage between innovation and competitiveness.
4. **Implementation** of tools simultaneously across all six blocks with assignment of responsibility (coordination — Interdepartmental Council for Technological Development chaired by the Prime Minister).
5. **Monitoring** of reform effectiveness using TSI.
6. Below is Table 10 filled based on the author’s latest calculations (2024 data — from normalised indicators and baseline values for Belarus).

Table 10. Target indicators for Belarus until 2035

Indicator	Current value (2024)	Target value (2035)	Justification / Source
TSI (Trialectical Synergy Index)	0.055 (calculation for window 2019-2024)	> 0.10	Reaching a level of weak but stable synergy; for Upper middle-income countries the threshold >0.10 corresponds to the beginning of self-organisation (author’s calculations, Table 6)
R&D intensity (domestic R&D expenditure as % of GDP)	0.59 % (Belstat data, 2024)	≥ 1.5 %	Level sufficient for a technological breakthrough (OECD average — 2.7 %, minimum innovation threshold — 1.5 %)
Share of high-tech exports (% of industrial exports)	~3 % (customs statistics estimate)	≥ 15 %	Allows entering the “innovation economy” trajectory (innovative leader countries — 20-25 %)
Labour productivity (average annual growth)	+1.5 % (2023-2024)	+5 % per year	Necessary for catch-up development and creating resources for innovation (target of the Socio-Economic Development Programme until 2030 — at least 4-5 %)

Rule of Law Index (WJP, 0-1)	0.44 (actual value, 2024)	≥ 0.65	Ensures protection of intellectual property and contracts; to move to the synergetic stage, exit from “institutional depression” zone is needed (WJP ≥ 0.65 corresponds to “medium+” group)
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Note: author's calculations.

The current TSI value = 0.055 for the 2019–2024 window indicates that “synergy is absent/weak”. The first step towards the trialectical model is the target >0.10 . Actual WJP in 2024 = 0.44 (source: World Justice Project), which is far from the target of 0.65.

Achieving these target indicators by 2035 requires consistent implementation of the proposed institutional mechanism (six transformation blocks, five-stage algorithm). If current dynamics continue (falling III, TSI <0.06), the country will remain in the dialectical trap. Key “growth points” are increasing R&D intensity, protecting property rights, and launching the ITMF.

Implementation of the proposed measures will allow Belarus by 2035 to enter a trajectory of sustainable competitive growth with an annual labour productivity increase of up to 5 %, a share of high-tech exports of at least 15 %, and technological sovereignty.

Conclusion

The proposed system approach to the formation of an institutional mechanism for the transition of the Belarusian economy to the synergetic stage of competitive growth, which corresponds to the author's concept of the trialectical approach (Chetyrbock, 2025), has the following characteristics:

- **Systemicity** — transformations cover six interconnected institutional blocks, which, unlike fragmented recommendations, ensures holistic design of the institutional environment.
- **Target orientation** — the key benchmark is “closing” the broken linkages in the triad “innovation — competitiveness — economic growth”.
- **Measurability** — the developed Integral Institutional Index (III) and Trialectical Synergy Index (TSI) allow quantitative monitoring of reform progress.
- **Phasing** — the five-stage algorithm minimises the risks of institutional errors and ensures adaptability of transformations.

Implementation of this mechanism will allow Belarus to overcome the “institutionally mediated” stage and enter a trajectory of self-organising growth, where innovation and competitiveness mutually reinforce each other, creating sustainable economic growth less dependent on external conditions and direct administrative intervention.

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Author Contributions

The author single-handedly carried out conceptualisation, data collection and analysis, methodology development, writing and editing of the article.

The author has read and approved the final version of the manuscript.

Беларусь экономикасының бәсекеге қабілетті өсудің синергетикалық кезеңіне көшуінің институционалдық механизмін қалыптастырудың жүйелі тәсілі

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Аңдатпа

Мақалада Беларусь Республикасы экономикасының дамудың диалектикалық моделінен триалектикалық модельге көшу қажеттілігі негізделеді; онда инновация мен бәсекеге қабілеттілік тұрақты экономикалық өсуді қамтамасыз ете отырып, кері байланыспен өзара күшейту контурын құрайды. Зерттеудің мақсаты — институционалдық алшақтықтарды эмпирикалық тұрғыдан анықтау негізінде бәсекеге қабілетті өсудің синергетикалық кезеңіне көшуге арналған институционалдық механизмді қалыптастырудың жүйелі тәсілін әзірлеу. Зерттеуде 2016-2024 жылдар аралығындағы 108 ел бойынша жинақтама деректер (966 бақылау), атап айтқанда Жаһандық инновациялар индексі (ГИ) мен Жаһандық тұрақты бәсекеге қабілеттілік индексі (GSCI) көрсеткіштері, сондай-ақ Беларусь Республикасының 2016-2024 жылдардағы ұлттық статистикалық деректері пайдаланылды.

Эконометриялық модельдеу әдістері, көрсеткіштерді нормализациялау, корреляциялық-регрессиялық талдау қолданылды. Зерттеу нәтижесінде Беларусь Республикасы дамудың «институционалдық тұрғыдан жанама» кезеңінде екені анықталды: синергия коэффициенті $\beta_3 = 0,00998$ статистикалық тұрғыдан мәнді емес, ал медиациялық әсер статистикалық тұрғыдан мәнді, бұл ретте жанама ықпалдың үлесі 33,6 % құрайды. Интегралдық институционалдық индекс (III) әзірленді. TSI мен III арасындағы оң корреляция негізделді; регрессиялық модель институционалдық ортаны 0,1 бірлікке жақсарту TSI көрсеткішінің 0,031-ге артуына алып келетінін көрсетті. Өтпелі кезеңнің институционалдық механизмін қалыптастырудың жүйелі тәсілі ұсынылды. Дамудың синергетикалық моделіне көшуге кедергі келтіретін негізгі институционалдық тұзақтар айқындалды. Ұсынылған механизмді іске асыру Беларусь Республикасына институционалдық жанамалылықты еңсеруге және инновациялар мен бәсекеге қабілеттілік өзара күшейетін өзін-өзі ұйымдастыратын экономикалық өсуге көшуге мүмкіндік береді. Зерттеудің практикалық маңыздылығы әзірленген ұсынымдардың мемлекеттік инновациялық саясатты қалыптастыруда және әлеуметтік-экономикалық даму бағдарламаларын әзірлеуде қолданылу мүмкіндігімен айқындалады.

Кілт сөздер: триалектикалық модель, институционалдық механизм, синергия, инновациялар, бәсекеге қабілеттілік, экономикалық өсу, Беларусь Республикасы, интегралдық институционалдық индекс (III), триалектикалық синергия индексі (TSI), институционалдық тұзақтар, инновациялық командаларды ынталандыру қоры (ITMF).

Системный подход к формированию институционального механизма перехода экономики Беларуси к синергетической стадии конкурентного роста

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Аннотация

В статье обоснована необходимость перехода экономики Республики Беларусь от диалектической модели развития к триалектической, в которой инновации и конкурентоспособность образуют контур взаимного усиления с обратной связью, обеспечивая устойчивый экономический рост. Цель исследования — разработать на основе эмпирической диагностики институциональных разрывов системный подход к формированию институционального механизма перехода к синергетическому этапу конкурентного роста. В исследовании использованы панельные данные по 108 странам (966 наблюдений за 2016–2024 гг.) на основе Глобального инновационного индекса (GII) и Глобального индекса устойчивой конкурентоспособности (GSCI), а также национальные статистические данные Республики Беларусь за 2016–2024 гг. Применены методы эконометрического моделирования, нормализация показателей, корреляционно-регрессионный анализ. Установлено, что Республика Беларусь находится на «институционально-опосредованной» стадии развития: коэффициент синергии $\beta_3 = 0,00998$ статистически незначим, тогда как медиационный эффект является статистически значимым, при этом доля опосредованного влияния составляет 33,6 %. Разработан интегральный институциональный индекс (III). Обоснована положительная корреляция между TSI и III; регрессионная модель показывает, что улучшение институциональной среды на 0,1 приводит к увеличению TSI на 0,031. Предложен системный подход к формированию институционального механизма перехода. Выявлены ключевые институциональные ловушки, препятствующие переходу к синергетической модели развития. Реализация предложенного механизма позволит Республике Беларусь преодолеть институциональную опосредованность и перейти к самоорганизующемуся экономическому росту, при котором инновации и конкурентоспособность взаимно усиливают друг друга. Практическая значимость исследования заключается в том, что разработанные рекомендации могут быть использованы при формировании государственной инновационной политики и программ социально-экономического развития.

Ключевые слова: триалектическая модель, институциональный механизм, синергия, инновации, конкурентоспособность, экономический рост, Республика Беларусь, интегральный институциональ-

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Conflict of Interest

The author declares no conflict of interest.