







“The impact of public investment on enrollment and innovation: Strategic management insights from Kazakhstan”

AUTHORS	Dina Ashirbekova  Akan Nurbatsin   Anel Kireyeva  
ARTICLE INFO	Dina Ashirbekova, Akan Nurbatsin and Anel Kireyeva (2025). The impact of public investment on enrollment and innovation: Strategic management insights from Kazakhstan. <i>Problems and Perspectives in Management</i> , 23(2), 736-749. doi: 10.21511/ppm.23(2).2025.53
DOI	http://dx.doi.org/10.21511/ppm.23(2).2025.53
RELEASED ON	Wednesday, 18 June 2025
RECEIVED ON	Sunday, 23 March 2025
ACCEPTED ON	Wednesday, 04 June 2025
LICENSE	 This work is licensed under a Creative Commons Attribution 4.0 International License
JOURNAL	"Problems and Perspectives in Management"
ISSN PRINT	1727-7051
ISSN ONLINE	1810-5467
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”



NUMBER OF REFERENCES

39



NUMBER OF FIGURES

2



NUMBER OF TABLES

5

© The author(s) 2025. This publication is an open access article.



BUSINESS PERSPECTIVES



LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine
www.businessperspectives.org

Received on: 23rd of March, 2025

Accepted on: 4th of June, 2025

Published on: 18th of June, 2025

© Dina Ashirbekova, Akan Nurbatsin,
Anel Kireyeva, 2025

Dina Ashirbekova, Ph.D. Candidate,
Turan University, Kazakhstan.

Akan Nurbatsin, Ph.D., Director,
Department of Scientific Activity,
University of International Business,
Kazakhstan. (Corresponding author)

Anel Kireyeva, Ph.D. in Economics,
Professor, Department of Scientific
Activity, University of International
Business, Kazakhstan.

Dina Ashirbekova (Kazakhstan), Akan Nurbatsin (Kazakhstan),
Anel Kireyeva (Kazakhstan)

THE IMPACT OF PUBLIC INVESTMENT ON ENROLLMENT AND INNOVATION: STRATEGIC MANAGEMENT INSIGHTS FROM KAZAKHSTAN

Abstract

Despite ongoing efforts to modernize the higher education sector in Kazakhstan, the integration of strategic management and the effective allocation of public investment continue to pose significant challenges. This study aims to assess the relationship between public investment in higher education, enrollment dynamics, and innovation activity measured through the share of innovative organizations. Official statistical data for 2004–2024 were obtained from the Bureau of National Statistics of Kazakhstan and the World Bank. The study employs econometric analysis methods, including the evaluation of multiple linear regression models, vector autoregressive models, and Granger causality tests. According to the ordinary least squares (OLS) regression results, the impact of public investment in higher education on the number of students was not statistically significant ($\beta = -0.00035$; $p = 0.507$), suggesting insufficient targeting of funding and inefficient channels of distribution of funds. However, the number of higher education institutions shows a statistically significant positive effect on enrollment ($\beta = 8048.5$; $p = 0.002$), indicating that institutional infrastructure and territorial accessibility play a more significant role in expanding access to higher education than the overall level of funding. In addition, the constructed regression model is characterized by a high explanatory power ($R^2 = 0.8665$), which indicates the estimates' reliability and the correctness of the choice of explanatory factors. The findings highlight the importance of coordinating investment policy in higher education with the goals of innovative development.

Keywords

education, higher education, educational institutions, public investment, strategic management, strategic policy, Kazakhstan

JEL Classification

I22, H52, O38

INTRODUCTION

The higher education system in modern times faces the challenge of increasing resource efficiency with limited budgets. Economic instability, which has been increasing due to global crises, growing competition among universities, and increasing complexity in managing development tasks, necessitates transitioning from traditional administration to strategic management. Universities are not only training centers but also key players in innovative growth, making it necessary for them to adapt to new demands, search for innovative management solutions, and focus on measurable outcomes regarding personnel training.

Large-scale reforms in higher education are being implemented in countries with economies in transition, including Kazakhstan. Among other priorities, attempts are being made to modernize the sector, increase the managerial autonomy of universities, and expand measures to support academic mobility. Despite active reforms, uni-



This is an Open Access article, distributed under the terms of the [Creative Commons Attribution 4.0 International license](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Conflict of interest statement:

Author(s) reported no conflict of interest

versities' level of innovation and contribution remains lower than in more developed countries, limiting flexibility in resource allocation and strategic goals. The growth in student numbers is not always accompanied by a corresponding increase in quality and scientific productivity, indicating an imbalance between system expansion and sustainable development.

Therefore, studying the effectiveness of investments in higher education is crucial in Kazakhstan, where universities play a pivotal role in shaping human capital and fostering innovation. Improving public investment in education is important both economically and socially, as it creates jobs, reduces regional inequality, and strengthens the sustainability of the economy. This requires an analysis of factors affecting the effectiveness of funding, institutional capacity, and university strategic management.

1. LITERATURE REVIEW

The higher education sector operates under growing competition for resources and the need to achieve measurable results. University management and financing are strategically important elements of national policy that determine efficiency, inclusiveness, and innovative potential. In countries with transition economies, the issue of balanced development is becoming more pressing; the need for modernization is accompanied by institutional limitations, fragmentation of reforms, and a high degree of dependence on centralized decisions.

Some studies showed that public spending, governance models, and global challenges influence the quality of higher education and broader socio-economic outcomes (Psacharopoulos & Patrinos, 2004; Fadeeva & Mochizuki, 2010). For instance, Psacharopoulos and Patrinos (2004) estimated that the average return on education is approximately 10%, with particularly high rates in low- and middle-income countries. Fadeeva and Mochizuki (2010) criticized traditional university rankings for prioritizing quantitative metrics over dimensions of sustainability, while M. Shrivastava and S. Shrivastava (2014) warned that reduced funding may exacerbate inequality and undermine the social value of higher education.

Other studies focused on the role of intellectual capital and strategic management. Powers (2003) and Hatch and Dyer (2004) found that human and organizational resources are critical for successful technology transfer and increased productivity. Sánchez and Elena (2006) emphasized the importance of intangible asset management for the modernization of universities.

Taylor et al. (2008) demonstrated that leadership and strategic planning are directly related to efficient resource allocation. Similarly, Somsuk and Laosirihongthong (2014) showed that intellectual capital management enhances institutional adaptability and competitiveness. Hayter and Cahoy (2016) argued that universities must align internal resources with societal demands through dynamic capabilities. A growing body of research confirms that public investment alone cannot achieve systemic improvements. Its effectiveness depends on universities' internal capacities to strategically allocate resources and manage intangible assets.

Studies on academic governance emphasized the tension between market-driven reforms and university autonomy. Under neoliberal policies, institutions often shift their focus from public missions to efficiency metrics; yet, autonomy alone does not guarantee effectiveness (Olssen & Peters, 2005; Enders et al., 2013). Universities can act as agents of sustainable change if they adapt strategically to funding structures and regional demands (Rodríguez-Pose & Crescenzi, 2008; Lepori et al., 2009; Pinheiro et al., 2015). The long-term sustainability of a higher education system is determined by the amount of resources and internal capacity, organizational identity, and the effectiveness of its governance mechanisms (Fumasoli et al., 2020; Heaton et al., 2023).

Empirical studies have shown that the institutional context shapes the relationship between funding and research output. While increased funding does not necessarily result in more publications, models with substantial institutional funding tend to perform better (Leydesdorff & Wagner, 2009; Auranen & Nieminen, 2010). The Danish case exemplifies how balancing funding

and academic autonomy can support research success (Aagaard & Schneider, 2016). With the rise of the “impact agenda”, the focus has shifted to measurable outputs, potentially suppressing innovation (Whitley et al., 2018; Gunn & Mintrom, 2016). To align investment with actual outcomes, studies advocate for a more holistic evaluation of performance (Jacob & Gokbel, 2018), noting that while quantitative goals dominate in some systems (e.g., China), broader social impacts remain central in others (Wang et al., 2020). Universities with a social mission, which may lack the agility to respond to funding cuts, are particularly vulnerable (Martínez-Campillo & Fernández-Santos, 2020). Finally, the positive influence of enrollment, STEM focus, and researcher numbers on innovation underscores the importance of sustained academic investment (Szczepanska-Woszczyna et al., 2024).

Recent studies have focused on internal university structures, faculty motivation, and organizational mechanisms in shaping educational outcomes. Kim et al. (2018) found that academic integration and supervisor support influence Ph.D. students’ intentions to pursue academic careers, though interest declines over time. Rabossi (2017) adds that formal and informal governance, including contract types and institutional climate, affect faculty behavior and may generate agency-related issues. Research on faculty roles shows that tenure-track instructors focused on teaching often yield better student outcomes than research-oriented junior faculty (Tian et al., 2019; Xu & Solanki, 2019). Despite their key role, tenure-track faculty often lack access to resources and development opportunities, while managerial discretion over academic work remains substantial (Rhoades, 2020). Overall, faculty working conditions alongside academic performance are crucial for maintaining educational quality in increasingly stratified academic environments.

Economic instability exacerbates social inequalities in access to higher education. Students from privileged backgrounds tend to consolidate their enrollment advantage, particularly in regions with high unemployment rates (Cozzolino et al., 2018). At the same time, educational expectations are also becoming more stratified: economic difficulties do not reduce but rather increase social differences

in ambitions (Salazar et al., 2020). Despite income growth during the crisis period, representatives of privileged groups with significant resource capital gain an advantage (Pöyliö, 2019). This highlights the importance of a comprehensive education policy that addresses social barriers and strives to reduce inequality sustainably.

The effectiveness of public R&D spending in fostering innovation depends less on the volume of investment and more on the quality of institutions. Stable institutions and predictable research policies enhance the capacity of public funding to attract private investment (Becker, 2015). Broader governance factors such as legal stability, economic freedom, and administrative effectiveness shape a country’s ability to convert innovation goals into actual outcomes (Kawabata & Camargo, 2020). Su et al. (2021) found that university R&D spending in Chinese provinces correlates with reduced CO₂ emissions only when effective innovation mechanisms are in place. However, despite increasing public investment in higher education in transition economies such as Kazakhstan, its impact on stimulating innovative economic growth remains negligible (Ashirbekova & Nurmukhanova, 2022). Moreover, the complex and fragmented structure of the Kazakh educational system indicates the need to develop new approaches to solving accumulated problems and ensuring its sustainable development (Saparova et al., 2023; Kenzheali et al., 2024).

Although numerous studies examine the relationship between public investment and higher education performance, they focus on short-term effects and are concentrated mainly in developed countries. In contrast, transition economies like Kazakhstan lack systematic research on the long-term interplay between financial investment, institutional change, and innovation outcomes within the higher education sector. Existing literature also tends to treat expenditure, access, and innovation as isolated elements rather than as components of a dynamic system shaped by governance and policy coherence. Moreover, many prior studies rely on static econometric models that overlook time lags, causality, and feedback loop factors essential for understanding strategic decision-making and long-term impact. Prior research has yielded valuable insights into financing

mechanisms, enrollment trends, and innovation metrics. However, the fragmented nature of this body of work leaves unanswered questions about how these dimensions interact over time, particularly under conditions of institutional transition and governance fragmentation.

Thus, this study aims to assess the relationship between public investment in higher education, enrollment dynamics, and innovation activity measured through the share of innovative organizations.

2. METHODOLOGY

The methodology adopts a strategic perspective, considering public investment in higher education not merely as a financial input, but as a policy instrument intended to enhance institutional development and national innovation performance. The data used include time series obtained from the annual statistical reports of the Bureau of National Statistics of the Republic of Kazakhstan and the World Bank. The selected variables include total government expenditure on higher education, faculty size, student enrollment, the number of higher education institutions, average income levels, unemployment rate, and innovation indicators. The selection of these variables is

supported by prior research confirming their relevance in analyzing the dynamics of education systems and innovation performance (Leydesdorff & Wagner, 2009; Jacob & Gokbel, 2018; Szczepanska-Woszczyna et al., 2024).

While the majority of analyses rely on general or indirect proxies, this analysis employs a more precise and context-based definition of innovation, specifically the proportion of innovatively active organizations within the economy. This indicator measures the share of firms and institutions for which data on their participation in innovation activities such as product, process, organizational, or marketing innovations are collected systematically by national statistical offices. In contrast to macro proxies that are sector-biased or lack longitudinal consistency in transition economies, for instance, R&D spending as a ratio of GDP or patents granted captures the institutional coverage of practice in innovation. It also aligns better with the strategic management approach, as it measures the responsiveness and capacity of firms and institutions to organize and implement innovative responses in various sectors, including higher education institutions. Using the above indicator ensures a closer theoretical and empirical match for the institutional nature of the performance of higher education to isolate the interaction of investment, infrastructure, and labor market out-

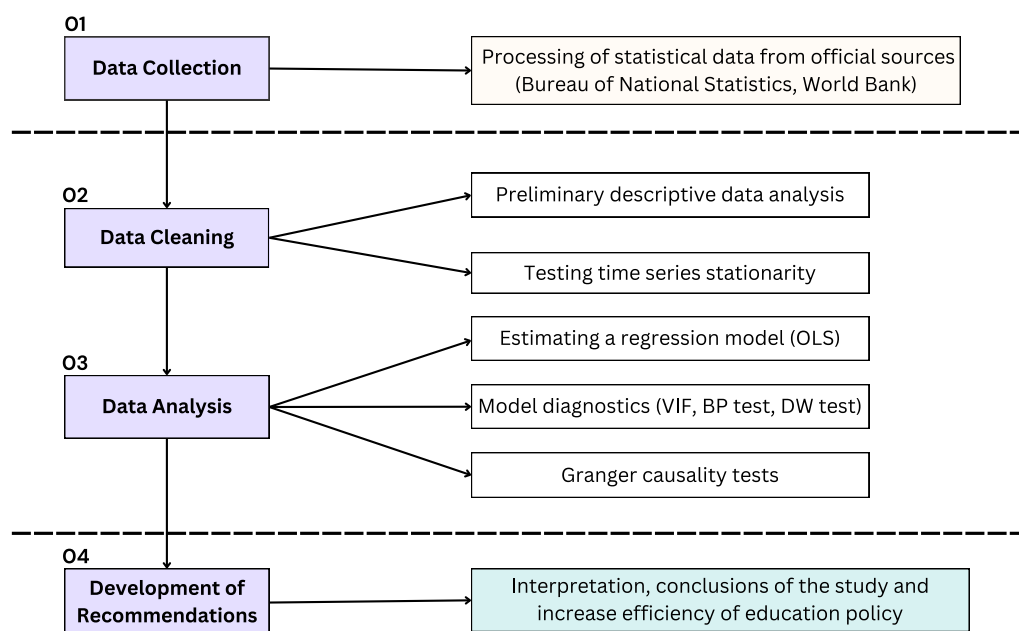


Figure 1. Flowchart of the econometric methods used in the study

Table 1. Description of variables and summary statistics

Variable	Description	Mean	Std. dev.	Min	Max
HE_expenditure	Total government expenditure on higher education (constant prices)	3.13e+08	2.23e+08	4.92e+07	8.38e+08
HEIs	Number of higher education institutions (universities and colleges)	141.0476	23.02493	112	181
Faculty_count	Total number of academic faculty in higher education	39463.14	2156.08	36307	43382
Enrollment	Total number of students enrolled in higher education institutions	601869.1	92802.02	459369	775762
Exp_per_student	Higher education expenditure per student (HE_expenditure / Enrollment)	553.7521	398.2492	74.75023	1414.691
Student_faculty_ratio	Student-to-faculty ratio (Enrollment / Faculty_count)	15.22431	1.923895	11.83996	17.95929
Avg_income	Average household income (adjusted for inflation)	129168	92945.23	23128	364295
Unemployment	National unemployment rate	5.92381	1.361214	4.7	8.8
Innovation	The share of innovatively active organizations	7.180952	3.272861	2.1	11.7

comes to affect innovation engagement in the system. In the model employed in this analysis, innovation activity is a share of the economy that has actively engaged organizations as a policy-relevant indicator of the responsiveness of the national system of innovation to education and improvement in the institutions.

The flowchart of the econometric methods used in the study is presented in Figure 1.

Table 1 presents the summary statistics for the variables analyzed, which include the mean, standard deviation, and range, depicting the magnitude and range of variation in higher education funding and outcomes in Kazakhstan for the analysis period.

The first stage of the empirical estimation employed an OLS regression to represent student enrollment as a function of the relevant explanatory variables. The functional specification in the model is as follows:

$$Enroll_t = \beta_0 + \beta_1 Exp_t + \beta_2 Faculty_t + \beta_3 Infra_t + \beta_4 Innov_t + \beta_5 Econ_t + \varepsilon_t, \tag{1}$$

where: β_0 – intercept term; β_1 - β_5 – estimated coefficients for each explanatory variable; ε_t – error term capturing unobserved factors at time t .

Pre-model estimation diagnostic tests were carried out routinely. Multicollinearity was checked using Variance Inflation Factors (VIFs), which were all less than the standard cut-off of 10 for all the regressors, indicating acceptable degrees of multicollinearity. The Breusch-Pagan test was

run to check heteroscedasticity and yielded no significant indication contrary to homoscedasticity. Ramsey RESET confirmed functional specification adequacy, and Durbin–Watson statistics were within the accepted range, rejecting first-order autocorrelation of residuals.

In an effort to check whether data were stationary and to avoid the risk of spurious regression, a common issue in the case of the analysis of time series – an Augmented Dickey-Fuller (ADF) test was run on all the variables. First-differencing was performed where appropriate unit roots were identified, and log transformation was preserved for the purposes of interpreting elasticities. A VAR model was estimated to test the dynamic relationship, accounting for intertemporal links among the variables of concern. VAR models each variable within the system as endogenous. It models its path as a linear function of its lagged values and the lagged values of all the other variables within the system. For the case of a two-variable VAR system, the general equations are:

$$Enroll_t = a_0 + a_{11}Enroll_{t-1} + a_{12}Exp_{t-1} + \dots + a_{1p}Enroll_{t-p} + a_{2p}Exp_{t-p} + u_{1t}, \tag{2}$$

$$Exp_t = b_0 + b_{11}Enroll_{t-1} + b_{12}Exp_{t-1} + \dots + b_{1p}Enroll_{t-p} + b_{2p}Exp_{t-p} + u_{2t}, \tag{3}$$

where: a_0, b_0 – intercepts of the respective equations; a_{11}, \dots, a_{2p} – coefficients representing the effects of past values (lags) of student enrollment and higher education expenditure on current enrollment; b_{11}, \dots, b_{2p} – coefficients representing the effects of past values of student enrollment and

higher education expenditure on current expenditure; p – the number of lags included in the model; u_{1t}, u_{2t} – error terms.

The Akaike Information Criterion (AIC) and Schwarz-Bayesian Criterion (SBC) determined optimal lag length pp . To maintain the spirit of parsimony without curtailing explanatory capability, the baseline was established as lag order one (VAR(1)). The VAR was pre-whitened using first-order differencing for all the series to render them stationary. OLS estimation for every equation was done in the spirit of the Seemingly Unrelated Regression (SUR) approach, and the stability of the model was determined using the companion matrix's eigenvalue – all the roots were within the unit circle. Tests for the existence of autocorrelated residuals (Ljung-Box Q-test) confirmed the white noise nature of the residuals.

IRFs were obtained from the estimated VAR to trace the dynamic effect of a one-off innovation shock in higher education spending on higher education enrollment and vice versa. This provides a structural interpretation of the intertemporal relationship and allows one to analyze the propagation mechanism in higher education. For testing forecasting relationships and potential causality, the Granger causality tests were implemented in the VAR framework. The Granger test is expressed as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^p \alpha_i Y_{t-i} + \sum_{i=1}^p \beta_i X_{t-i} + v_t, \quad (4)$$

where: Y_t – dependent variable at time t , representing the outcome; X_{t-i} – independent variable at time t , representing the potential predictor; α_0 – intercept term; α_i – coefficients of the lagged values of Y , capturing its autoregressive effects; β_i – coefficients of the lagged values of X , measuring how past values of X influence Y ; p – number of lags used in the model; v_t – error term, capturing unobserved factors affecting Y_t .

The hypothesis that $\beta_i = 0$ for all i is then tested using an F -statistic. The null hypothesis is rejected when lagged values of X contain statistically significant information about future values of Y beyond that in the past values of Y itself. Although not strictly a test of true causality in the classical sense, Granger causality does indi-

cate the direction of the ordering of events and the predictability content of policy variables.

By combining OLS for static inference, VAR for dynamic system modeling, and Granger causality tests to ascertain directional inference, the present approach provides an integrated and robust framework to determine the long-run effect of public investment and strategic management practices on the higher education performance of Kazakhstan. The three combined tools disentangle direct, indirect, and lagged effects between investment categories and educational outcomes and inform policy-making with an evidence base in transition economies. The estimations were all completed using Stata 18 and, as such, are replicable and in line with contemporary econometric standards.

3. RESULTS

Data analysis revealed key patterns in the dynamics of higher education funding, its impact on student enrollment rates, as well as the interaction of other factors with educational policy. The study included an assessment of trends in government spending on higher education, their relationship to enrollment dynamics, and the results of econometric modeling within a strategic management framework to support long-term decision-making and policy effectiveness. In line with the strategic management perspective adopted in this study, public investment in higher education is evaluated not as isolated budgetary input but as a policy tool intended to build long-term institutional capacity and promote innovation, as measured by the share of innovatively active organizations.

First, the dynamics of government spending on higher education and their potential impact on enrollment rates are considered. The regression results highlight the factors influencing enrollment, notably the role of educational infrastructure and higher education accessibility. Finally, the results of Granger's tests are analyzed to determine the directional predictive relationships between funding and student enrollment. The results showed the degree of influence of educational policy on the development of higher education and the prospects for improving management mechanisms within the higher education system.

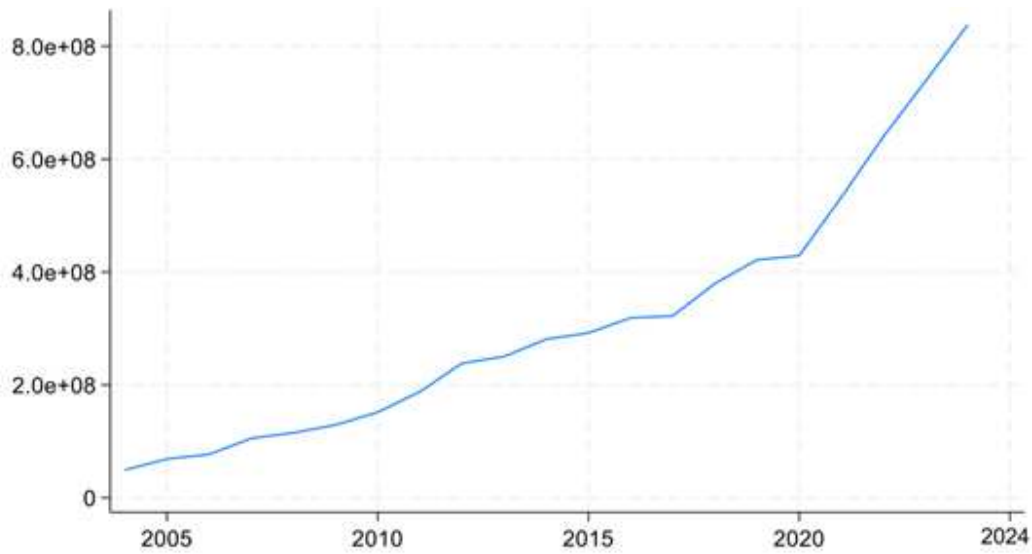


Figure 2. Government spending on higher education for 2004–2024

Figure 2 presents public investment in higher education for 2004–2024. Between 2004 and 2015, government spending on higher education increased gradually, aligning with policies to expand access and infrastructure development. Since 2016, however, public investment in higher education has accelerated, reflecting a shift in policy toward more aggressive investment measures. The growth is likely in conformity with rising demand in enrollments, institution-level modernization plans, and measures of global competitiveness. Particularly between 2020 and 2024, funding increases spectacularly, possibly due to post-pandemic recovery policies, digitalization, and long-term funding support for students and institutions.

higher education system. The model is highly explanatory ($R^2 = 0.8665$, $F = 19.46$, $p < 0.0001$), accounting for approximately 86.65% of the variance in student enrollment. The OLS regression indicates that government expenditure on higher education does not significantly affect student enrollment ($\beta = -0.00035$, $p = 0.507$). This finding suggests that investments may fail to yield measurable participation gains without a strategic management system to align funding with enrollment drivers such as student needs, faculty capacity, and infrastructure planning. It may be due to time lags in the investment impact, inefficiency in distribution, or qualitative improvement rather than quantity increase in admission being sought.

The OLS regression model explains the determinants of student admission into Kazakhstan’s

Table 2 presents the determinants of student enrollment in higher education. Faculty size, as indi-

Table 2. Determinants of student enrollment in higher education

Variable	Coefficient	Std. err.	t-statistics	P>t	[95% conf. interval]	
He_expendit~e	-.0003533	.0005203	-0.68	0.507	-.0014622	.0007556
Faculty_count	-3.071923	7.811685	-0.39	0.700	-19.72214	13.57829
Avg_income	1.535301	1.230606	1.25	0.231	-1.087674	4.158276
Unemployen~e	-38,872.98	29,769.1	-1.31	0.211	-102,324.3	24,578.35
Higher_ed	8,048.475	2,116.875	3.80	0.002	3,536.463	12,560.49
Constant	-269,678.6	268,982.4	-1.00	0.332	-843,001	303,643.8
Source	SS	df	MS			
Model	1.4924e+11	5	2.9848e+10	Observations = 21		
Residual	2.3003e+10	15	1.5335e+09	F(5, 15) = 19.46		
Total	1.7224e+11	20	8.6122e+09	Prob > F = 0.0000		
				R-squared = 0.8665		
				Adj R-squared = 0.8219		
				Root MSE = 39,160		

cated by *faculty_count*, is not a significant predictor (coefficient = -3.071923 , $p = 0.700$), suggesting other factors such as infrastructure, academic level, or economic level would be suitable. However, HEIs are the strongest predictor of student registration (coefficient = 8048.475 , $p = 0.002$). The finding suggests that institutional growth is a forceful predictor in impacting student registration, supporting the contention that accessibility is one of the major factors driving growth in registration. This further emphasizes the need for strategic management in resource allocation to support institutional expansion in a balanced, demand-responsive manner.

Moreover, although positive, the coefficient of average income (1.535301 , $p = 0.231$) is not statistically significant, meaning that economic factors per se do not influence the choice of going to higher learning. The unemployed rate (coefficient = -38872.98 , $p = 0.211$) is also not statistically significant, meaning that higher rates of unemployment do not necessarily drive individuals to higher learning, a situation contrary to what is expected in some industrialized countries where education is being used as a cushioning instrument in the event of an economic slump.

Figure 3, the scatter plot of higher education expenditure and level of innovations, indicates a

positive correlation, meaning that public investment in education is related to higher output in terms of innovations.

This threshold effect underscores the strategic importance of maintaining sufficient investment levels to activate innovation potential within the higher education system. When higher education expenditure is below 200 billion KZT, the share of innovatively active organizations is low, ranging between 2% and 5%. This means that research facilities and capacities remain at low levels of investment, and thus, the level of technological and scientific advancement is also low. Once expenditure surpasses 300 billion KZT, the share of such organizations rises sharply above 10%, suggesting a potential threshold effect whereby government investment significantly boosts innovation engagement. However, when spending exceeds 600 billion KZT, the relationship becomes more erratic, suggesting that while higher funding can enhance innovation, institutional efficiency, and strategic allocation also play critical roles. Some universities may effectively utilize the funds, while others may experience diminishing returns due to inefficiencies or misaligned research priorities.

The OLS regression line of the innovation activity shows a positive but statistically insignificant effect of tertiary education expenditure (coefficient

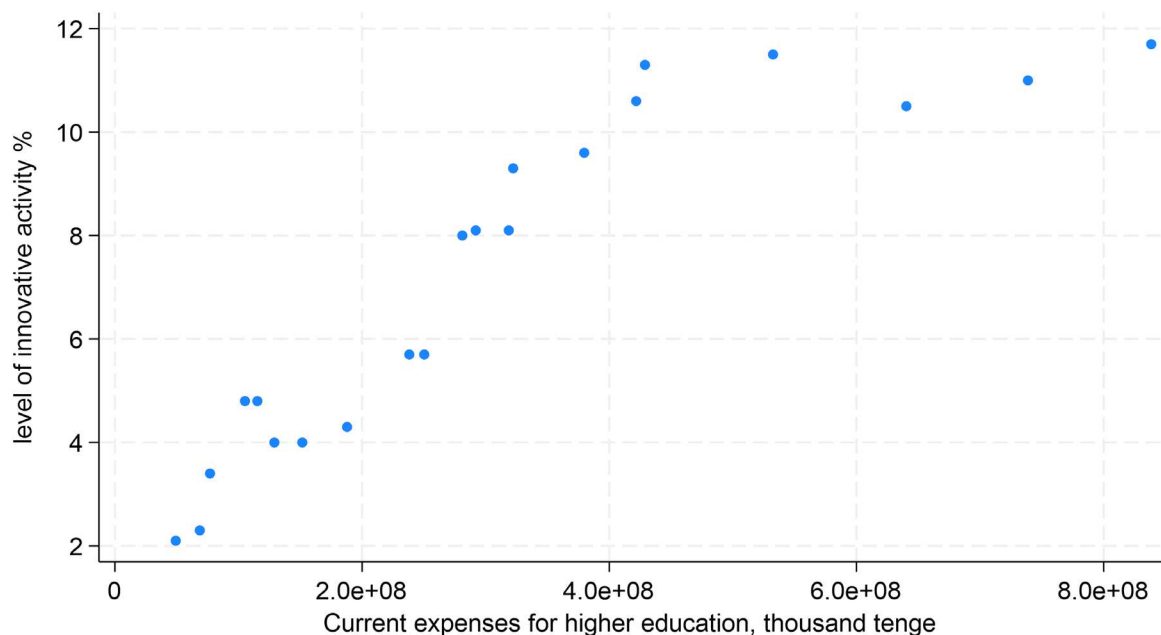


Figure 3. Relationship between innovation activity and public investment in higher education

Table 3. Determinants of innovation activity in higher education

Variable	Coefficient	Std. err.	t-statistics	P>t	[95% conf. interval]	
He_expendit*e	2.28e-08	1.68e-08	1.36	0.194	-1.29e-08	5.85e-08
Enrollment	-9.24e-06	4.21e-06	-2.19	0.044	-.0000182	-3.04e-07
Faculty_count	.0000549	.0002453	0.22	0.826	-.0004651	.0005749
Avg_income	-.0000268	.0000401	-0.67	0.513	-.0001117	.0000581
Constant	6.899176	9.458612	0.73	0.476	-13.15218	26.95054
Source	SS	df	MS			
Model	184.449094	4	46.1122736	Observations = 21		
Residual	29.783292	16	1.86145575	F(4, 16) = 24.77		
Total	214.232386	20	10.7116193	Prob > F = 0.0000		
				R-squared = 0.8610		
				Adj R-squared = 0.8219		
				Root MSE = 1.3644		

= 2.28e-08, $p = 0.194$). This suggests that while investment may foster innovation readiness, the effect is likely indirect, mediated by factors such as research funding structure, faculty incentives, and university-industry partnerships. Notably, student enrollment shows a statistically significant negative effect on innovation (coefficient = $-9.24e-06$, $p = 0.044$), reflecting a potential resource dilution effect: as enrollment grows, institutional resources may shift toward teaching, reducing the focus and investment in research, thereby lowering overall innovation activity.

Table 3 presents the determinants of innovation activity in higher education. The coefficient on the number of faculty (0.0000549 , $p = 0.826$) is positive yet not statistically significant, suggesting that having additional faculty per se is not necessarily fueling innovation activity as measured by the share of innovatively active organizations. Such incentives for faculty to conduct research, scholarly interaction, and organizational backing might be more relevant driving forces. Similarly, the coefficient on average income (-0.0000268 , $p = 0.513$) is not statistically significant and is negative, suggesting that macroeconomic conditions alone do not necessarily fuel measurable innovation outcomes at the institutional level. This explains more targeted research policies, which channel funding

into institution research areas of priority and sector needs. The regression equation considers how past changes in the level of the two variables have affected the current levels. Hence, it provides a clearer view of short-run changes and trends. First-differenced regression results in Table 4 reflect the dynamic effects of higher education expenditure and student enrollments in Kazakhstan.

To explain short-run adjustment and responsiveness to policy, a first-difference regression was run. The findings indicate that past increases in enrollment have a strong carryover effect and a statistically significant coefficient on LD. enrollment (0.5394 , $p = 0.003$) is evidence. It suggests that increases in enrollment in a period cause further increases in subsequent periods, perhaps due to rising institutional capacities and rising demand for education. Conversely, L1. enrollment (-0.1948 , $p = 0.013$) is negative and statistically significant, suggesting that overgrowth in enrollment is usually followed by a period of adjustment, perhaps due to constraints in terms of space or finance. It suggests a need for adaptive strategic management strategies, including real-time data tracking and scenario planning, to improve system responses to enrollment surges or financial changes. The findings validate the presence of commitment to expenditure for increased educational expenditure.

Table 4. First-differenced regression results: Dynamic effects of enrollment and higher education expenditure

Variable	Coefficient	Std. err.	t-statistics	P>t	[95% conf. interval]	
Lag 1 Enrollment	-.1948257	.0698847	-2.79	0.013	-.3429746	-.0466767
Lag Diff Enrollment	.5394032	.1550073	3.48	0.003	.2108024	.8680039
Constant Enrollment	110,917.6	42519.9	2.61	0.019	20,779.45	201055.8
Lag 1 HE Expenditure	.1368479	.0500103	2.74	0.015	.0308308	.2428651
Lag Diff HE Expenditure	.0372414	.2844795	0.13	0.897	-.5658282	.640311
Constant HE Expenditure	-1737072	1.12e+07	-0.16	0.878	-2.54e+07	2.20e+07

The level of expenditure with a one-legged value (L1. expenditure = 0.1368, $p = 0.015$) is positive and statistically significant, suggesting that government educational expenditure is on a stable policy path. The first-difference lag (LD. expenditure = 0.0372, $p = 0.897$) is not statistically significant, suggesting that short-run changes in expenditure have no impact on the level of enrollment.

From the VAR model, further information is provided on the dynamic interaction between public investment in higher education and enrollment. The findings provide evidence of a robust autoregressive trend in the enrollment level with L1. Enrollment (1.3272, $p < 0.0001$) is positive and highly significant, demonstrating robust persistence in the enrollment pattern. The second lag (L2. enrollment = -0.5908 , $p < 0.0001$) is negative, which means that years of high enrollment growth are corrected by a correction year, again demonstrating the significance of well-proportionate capacity growth. Table 5 displays vector autoregression (VAR) results.

The effect of spending on higher education on enrollment is not robust in the short run, with L1. he_expenditure (0.0004507, $p = 0.080$) on the margin of insignificance. This suggests that there is time for adjustments in funding to be converted into institutional changes that can influence the enrollment trend. The spending equation also indicates high persistence with significant L1. he_expenditure (0.9833, $p < 0.0001$), consistent with the observation that funding decisions are path-dependent and driven by long-run policy cycles instead of short-run enrollment shifts.

These results provide an econometric validation of the strategic management view, where long-term effects, institutional inertia, and system-wide adaptability matter more than immediate linear responses to investment. The Granger causality Wald test results indicate that higher education expenditure does not Granger-cause student enrollment ($\chi^2 = 3.0774$, $p = 0.215$), nor does enrollment Granger-cause expenditure ($\chi^2 = 4.3533$, $p = 0.113$). The outcome of the Granger causality test further suggests that student enrollment is not predictive of government expenditure, nor is government expenditure predictive of student enrollment, and that higher education expenditure is driven primarily by overall fiscal policy rather than short-run movements in student enrollment. This implication suggests that higher education in Kazakhstan should be guided based on a long-term, evidence-driven strategic plan incorporating predictive modeling to drive funding and institutional growth. The fact that higher education expenditure is fixed also suggests that funding policies linked to performance are required to drive incentives in research, faculty growth, and public-private partnerships. Consolidating the governance structures, providing greater institutional autonomy, and linking funding targets with country-level economic ambitions will make Kazakhstan's higher education system competitive and sustainable in shifting global requirements.

The findings of this study provide evidence of the complex interlinks between higher education funding, student enrollments, and innovation activity. While the increase in higher education institutions is a major driver of student enrollment, government spending has no im-

Table 5. Dynamic interactions between enrollment and public investment in higher education

Variable	Coefficient	Std. err.	z	P>z	[95% conf. interval]	
Lag 1 Enrollment	1.327247	.1336509	9.93	0.000	1.065296	1.589198
Lag 2 Enrollment	-.5907872	.1398207	-4.23	0.000	-.8648308	-.3167437
Lag 2 HE Expenditure	.0004507	.0002576	1.75	0.080	-.0000542	.0009556
Lag 1 HE Expenditure	-.0005416	.0003095	-1.75	0.080	-.0011481	.0000649
Constant	159,837.4	59,475.96	2.69	0.007	43,266.69	276,408.2
Lag 1 Enrollment	117.643	117.6783	1.00	0.317	-113.0022	348.2882
Lag 2 Enrollment	31.57981	123.1107	0.26	0.798	-209.7128	272.8724
Lag 1 HE Expenditure	.9833306	.226826	4.34	0.000	.5387599	1.427901
Lag 2 HE Expenditure	.2320876	.2724738	0.85	0.394	-.3019512	.7661265
Constant	-1.05e+08	5.24e+07	-2.01	0.045	-2.08e+08	-2381889

mediate or statistically observable impact. This indicates that funding per se is insufficient to realize increased participation, attesting to the role of institutional and structural factors such as the nature of syllabi, research funding efficiency, and labor markets correspondence that require alignment with strategic management principles to optimize system-wide efficiency. Additionally, the empirical inverse correlation between student enrollment and innovation activity suggests the potential presence of a trade-off situation, where an increase in student enrollment may consume institutional resources and reduce per-student investment in research activities. All these findings attest to the need for an equilibrium strategic plan so that the increase in higher education will not disintegrate the institution's research efficiency and productivity.

4. DISCUSSION

The study results demonstrate that government spending on higher education in Kazakhstan has no statistically significant impact on the number of students. However, institutional factors, such as the number of higher education institutions, positively and significantly influence enrollment. This result is consistent with research on transition economies, where top-down financial injections often do not lead to systemic improvements without a simultaneous evolution of institutional structures and governance (Leydesdorff & Wagner, 2009; Auranen & Nieminen, 2010). In this context, public investment in higher education should be interpreted through the lens of strategic management, where expenditures are aligned with long-term goals in innovation and capacity development rather than short-term spending cycles.

Additional analysis revealed that the growth in the number of students is negatively correlated with the level of innovation activity ($p = 0.044$). Sustainable growth in higher education requires parallel improvements in academic staffing and research infrastructure to maintain quality standards. There is no significant link between government spending on education and innovation ($p = 0.194$), which could be due to inefficient allocation of funds or insufficient integration of universities into national innovation ecosystems. However,

this study approaches innovation as a measurable outcome based on the share of innovatively active organizations, which serves as a structured and internationally comparable indicator used in Kazakhstan's statistical system. This metric reflects the extent to which institutions engage in innovation activities and provides insight into the broader innovation environment within the education sector. This supports previous literature pointing to the necessity of absorptive capacity and institutions' ability to effectively utilize funding as a prerequisite for innovation-led growth (Becker, 2015; Kawabata & Camargo, 2020).

In the international context, similar problems are observed in other post-Soviet countries, where increased funding does not always lead to sustained improvements in performance. In such cases, reform strategies aimed at enhancing managerial capacity, fostering internal motivation within universities, and implementing performance assessment mechanisms play a crucial role (Fumasoli et al., 2020; Heaton et al., 2023).

Similar trends are observed at the international level, where the sharp increase in costs after reforms often did not lead to a proportional increase in the number of students or the introduction of innovations due to insufficient institutional readiness and a lack of autonomous management systems (Olssen & Peters, 2005; Lepori et al., 2009). These findings confirm the need to move from input-based strategies to integrated strategic management ecosystems, including data-driven decision-making, performance monitoring, and long-term scenario planning.

The results obtained are practical, as they show that financial support and targeted institutional reforms are needed to increase the higher education system's effectiveness. This includes developing a regional network of universities, increasing organizational autonomy, creating incentives for research activity, and implementing accountability mechanisms. Strategic management approaches should consider regional differences, the level of organizational maturity, and the potential of universities for institutional growth.

CONCLUSION

This study aimed to evaluate the relationship between government spending on higher education, enrollment dynamics, and innovation activity, as measured by the share of innovative organizations. The results showed that direct financing of the higher education sector has no statistically significant impact on the number of students. However, institutional factors, such as the number of universities, have a positive and significant effect. It was also revealed that an increase in the number of students is associated with a decrease in innovation activity, indicating a possible redistribution of resources and a reduction in research effectiveness under demographic pressure. These findings underscore the necessity of treating public investment in higher education as a strategic lever within a broader policy framework to enhance institutional readiness and innovation capacity.

The analysis also revealed a statistically significant negative relationship between the growth in the number of students and the level of innovation activity. This may indicate a redistribution of resources in response to increasing demographic pressure. In addition, there is no significant causal relationship between government spending and student enrollment, as indicated by the Granger causality test. This suggests that the funding policy is not highly sensitive to changes in the dynamics of the educational system. Given this, innovation activity, measured in this study by the share of innovative organizations engaged in innovation-related activities, emerges as a vital indicator for tracking the strategic outcomes of higher education investments over time.

The practical significance of these results lies in the need to rethink higher education management strategies. Effective policy in this area should be based on increased investment, the development of institutional infrastructure, the introduction of performance assessment mechanisms, increased organizational autonomy for universities, and the implementation of data-driven management principles. These measures will improve budgetary efficiency, stimulate innovation, and contribute to Kazakhstan's sustainable and inclusive higher education system.

AUTHOR CONTRIBUTIONS

Conceptualization: Anel Kireyeva, Akan Nurbatsin, Dina Ashirbekova.

Data curation: Akan Nurbatsin.

Formal analysis: Anel Kireyeva, Dina Ashirbekova.

Funding acquisition: Anel Kireyeva.

Investigation: Akan Nurbatsin, Dina Ashirbekova.

Methodology: Akan Nurbatsin.

Project administration: Anel Kireyeva.

Resources: Dina Ashirbekova.

Software: Akan Nurbatsin.

Supervision: Anel Kireyeva.

Validation: Akan Nurbatsin, Dina Ashirbekova.

Visualization: Akan Nurbatsin.

Writing – original draft: Anel Kireyeva.

Writing – review & editing: Anel Kireyeva, Akan Nurbatsin, Dina Ashirbekova.

ACKNOWLEDGMENTS

This paper has been funded by the Science Committee MSHE RK (Grant “Modernization of the quality assurance system of higher education in Kazakhstan based on digitalization: development of approaches, mechanisms and information base” BR24992974).

REFERENCES

1. Aagaard, K., & Schneider, J. W. (2016). Research funding and national academic performance: Examination of a Danish success story. *Science and Public Policy*, 43(4), 518-531. <https://doi.org/10.1093/scipol/scv058>
2. Ashirbekova, D. A., & Nurmukhanova, G. Z. (2022). Financing high education in the context of new challenges. *Bulletin of Turan University*, 1, 297-305. <https://doi.org/10.46914/1562-2959-2022-1-1-297-305>
3. Auranen, O., & Nieminen, M. (2010). University research funding and publication performance – An international comparison. *Research Policy*, 39(6), 822-834. <https://doi.org/10.1016/j.respol.2010.03.003>
4. Becker, B. (2015). Public R&D policies and private R&D investment: A survey of the empirical evidence. *Journal of Economic Surveys*, 29(5), 917-942. <https://doi.org/10.1111/joes.12074>
5. Cozzolino, E., Smith, C., & Crosnoe, R. L. (2018). Family-related disparities in college enrollment across the great recession. *Sociological Perspectives*, 61(5), 689-710. <https://doi.org/10.1177/0731121418760542>
6. Enders, J., De Boer, H., & Weyer, E. (2013). Regulatory autonomy and performance: The reform of higher education re-visited. *Higher Education*, 65, 5-23. <https://doi.org/10.1007/s10734-012-9578-4>
7. Fadeeva, Z., & Mochizuki, Y. (2010). Higher education for today and tomorrow: University appraisal for diversity, innovation and change towards sustainable development. *Sustainability Science*, 5, 249-256. <https://doi.org/10.1007/s11625-010-0106-0>
8. Fumasoli, T., Barbato, G., & Turri, M. (2020). The determinants of university strategic positioning: A reappraisal of the organisation. *Higher Education*, 80(2), 305-334. <https://doi.org/10.1007/s10734-019-00481-6>
9. Gunn, A., & Mintrom, M. (2016). Higher education policy change in Europe: Academic research funding and the impact agenda. *European Education*, 48(4), 241-257. <https://doi.org/10.1080/10564934.2016.1237703>
10. Hatch, N. W., & Dyer, J. H. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, 25(12), 1155-1178. <https://doi.org/10.1002/smj.421>
11. Hayter, C. S., & Cahoy, D. R. (2016). Toward a strategic view of higher education social responsibilities: A dynamic capabilities approach. *Strategic Organization*, 16(1), 12-34. <https://doi.org/10.1177/1476127016680564>
12. Heaton, S., Teece, D., & Agronin, E. (2023). Dynamic capabilities and governance: An empirical investigation of financial performance of the higher education sector. *Strategic Management Journal*, 44(2), 520-548. <https://doi.org/10.1002/smj.3444>
13. Jacob, W. J., & Gokbel, V. (2018). Global higher education learning outcomes and financial trends: Comparative and innovative approaches. *International Journal of Educational Development*, 58, 5-17. <http://dx.doi.org/10.1016/j.ijedudev.2017.03.001>
14. Kawabata, M. K., & Camargo, A. S. (2020). Innovation and institutions' quality: A comparative study between countries. *International Journal of Innovation Science*, 12(2), 169-185. <https://doi.org/10.1108/IJIS-10-2019-0100>
15. Kenzheali, Y., Kenzhegulova, G. K., Kireyeva, A. A., & Ainakul, N. (2024). Assessing gender differences in managerial roles, wages, education, and soft skills in Kazakhstan. *Problems and Perspectives in Management*, 22(3), 341-357. [https://doi.org/10.21511/ppm.22\(3\).2024.27](https://doi.org/10.21511/ppm.22(3).2024.27)
16. Kim, E., Benson, S., & Alhaddab, T. A. (2018). A career in academia? Determinants of academic career aspirations among PhD students in one research university in the US. *Asia Pacific Education Review*, 19, 273-283. <https://doi.org/10.1007/s12564-018-9537-6>
17. Lepori, B., Masso, J., Jabłęcka, J., Sima, K., & Ukrainski, K. (2009). Comparing the organization of public research funding in central and eastern European countries. *Science and Public Policy*, 36(9), 667-681. <https://doi.org/10.3152/030234209X479494>
18. Leydesdorff, L., & Wagner, C. (2009). Macro-level indicators of the relations between research funding and research output. *Journal of Informetrics*, 3(4), 353-362. <https://doi.org/10.1016/j.joi.2009.05.005>
19. Martínez-Campillo, A., & Fernández-Santos, Y. (2020). The impact of the economic crisis on the (in) efficiency of public Higher Education institutions in Southern Europe: The case of Spanish universities. *Socio-Economic Planning Sciences*, 71, Article 100771. <https://doi.org/10.1016/j.seps.2019.100771>
20. Olssen, M., & Peters, M. A. (2005). Neoliberalism, higher education and the knowledge economy: From the free market to knowledge capitalism. *Journal of Education Policy*, 20(3), 313-345. <https://doi.org/10.1080/02680930500108718>
21. Pinheiro, R., Langa, P. V., & Pausits, A. (2015). One and two equals three? The third mission of higher education institutions. *European Journal of Higher Education*, 5(3), 233-249. <https://doi.org/10.1080/21568235.2015.1044552>
22. Powers, J. B. (2003). Commercializing academic research: Resource effects on performance of university technology transfer. *The Journal of Higher Education*, 74(1), 26-50. <https://doi.org/10.1080/00221546.2003.11777186>
23. Pöyliö, H. (2019). Something good out of the bad times? The impacts of reduced opportunity costs on the intergenerational inequalities in college enroll-

- ment. *Sociological Research Online*, 25(1), 23-45. <https://doi.org/10.1177/1360780419846516>
24. Psacharopoulos, G., & Patrinos, H. A. (2004). Returns to investment in education: A further update. *Education Economics*, 12(2), 111-134. <https://doi.org/10.1080/0964529042000239140>
 25. Rabossi, M. (2017). Agency costs in higher education: Evaluating an institution through a comprehensive framework. *Higher Education Policy*, 30, 319-339. <https://doi.org/10.1057/s41307-016-0025-5>
 26. Rhoades, G. (2020). Taking college teachers' working conditions seriously: Adjunct faculty and negotiating a labor-based conception of quality. *The Journal of Higher Education*, 91(3), 327-352. <https://doi.org/10.1080/00221546.2019.1664196>
 27. Rodríguez-Pose, A., & Crescenzi, R. (2008). Research and development, spillovers, innovation systems, and the genesis of regional growth in Europe. *Regional Studies*, 42(1), 51-67. <https://doi.org/10.1080/00343400701654186>
 28. Salazar, L., Cebolla-Boado, H., & Radl, J. (2020). Educational expectations in the great recession: Has the impact of family background become stronger? *Socio-Economic Review*, 18(2), 465-491. <https://doi.org/10.1093/ser/mwy046>
 29. Sánchez, P. M., & Elena, S. (2006). Intellectual capital in universities: Improving transparency and internal management. *Journal of Intellectual Capital*, 7(4), 529-548. <https://doi.org/10.1108/14691930610709158>
 30. Saporova, N., Kireyeva, A. A., Orynbet, P., Alimbekova, G., & Amirova, A. (2023). Analysis of the development level of higher educational institutions in the regions of Kazakhstan. *Problems and Perspectives in Management*, 21(2), 244-256. [http://dx.doi.org/10.21511/ppm.21\(2\).2023.26](http://dx.doi.org/10.21511/ppm.21(2).2023.26)
 31. Shrivastava, M., & Shrivastava, S. (2014). Political economy of higher education: Comparing South Africa to trends in the world. *Higher Education*, 67(6), 809-822. <https://doi.org/10.1007/s10734-013-9709-6>
 32. Somsuk, N., & Laosirihongthong, T. (2014). A fuzzy AHP to prioritize enabling factors for strategic management of university business incubators: Resource-based view. *Technological Forecasting and Social Change*, 85, 198-210. <https://doi.org/10.1016/j.techfore.2013.08.007>
 33. Su, Y., Jiang, Q., Khattak, S. I., Ahmad, M., & Li, H. (2021). Do higher education research and development expenditures affect environmental sustainability? New evidence from Chinese provinces. *Environmental Science and Pollution Research*, 28, 66656-66676. <https://doi.org/10.1007/s11356-021-14685-w>
 34. Szczepanska-Woszczyna, K., Lyulyov, O., Pimonenko, T., Infante-Moro, A., Zimbroff, A., & Solodovnikov, S. (2024). The contribution of higher education to innovation development: Long-term and short-term analysis. *Forum Scientiae Oeconomia*, 12(4), 8-29. https://doi.org/10.23762/FSO_VOL12_NO4_1
 35. Taylor, J. S., de Lourdes Machado, M., & Peterson, M. W. (2008). Leadership and strategic management: Keys to institutional priorities and planning. *European Journal of Education*, 43(3), 369-386. <https://doi.org/10.1111/j.1465-3435.2008.00363.x>
 36. Tian, Z., Wei, Y., & Li, F. (2019). Who are better teachers? The effects of tenure-track and part-time faculty on student achievement. *China Economic Review*, 53, 140-151. <https://doi.org/10.1016/j.chieco.2018.08.014>
 37. Wang, L., Wang, X., Piro, F. N., & Philipsen, N. J. (2020). The effect of competitive public funding on scientific output: A comparison between China and the EU. *Research Evaluation*, 29(4), 418-429. <https://doi.org/10.1093/reseval/rvaa023>
 38. Whitley, R., Gläser, J., & Laudel, G. (2018). The impact of changing funding and authority relationships on scientific innovations. *Minerva*, 56, 109-134. <https://doi.org/10.1007/s11024-018-9343-7>
 39. Xu, D., & Solanki, S. (2019). Tenure-track appointment for teaching-oriented faculty? The impact of teaching and research faculty on student outcomes. *Educational Evaluation and Policy Analysis*, 42(1), 66-86. <https://doi.org/10.3102/0162373719882706>