ISSN 1997-9967 (PRINT)
ISSN 2663-550X (ONLINE)

VOL 21, NO 1 (2026)

ESP

Economy: strategy and practice

JOURNAL OF THE INSTITUTE OF ECONOMICS

Journal «Economy: strategy and practice»
Volume 21, No.1, 2026

«Экономика: стратегия және практика» журналы
Томы 21, № 1, 2026 ж.

Журнал «Экономика: стратегия и практика»
Том 21, № 1, 2026 г.

Научное издание
Свидетельство о постановке на учет № 7158-Ж от 27.04.2006 г.
Министерства культуры и информации Республики Казахстан

Международным центром в Париже журнал «Экономика: стратегия и практика»
зарегистрирован под номером ISSN 1997-9967 (print), ISSN 2663-550X (online)

Журнал входит в Перечень научных изданий, рекомендуемых КОКНВО МНВО РК
для публикации основных результатов научной деятельности.

Год основания – 2006

Периодичность издания журнала – 4 номера в год

Языки издания: английский, казахский, русский

© Институт экономики КН МНВО РК, 2026

Aims and Scope
Economy: strategy and practice is a double-blind peer-reviewed journal dedicated to publishing high-quality articles on economics, economic development, strategic policy and practical solutions. The three words in the title of the journal "economics", "strategy" and "practice" are key to the journal's vision. The journal provides an international platform for interdisciplinary research that integrates economic theory, policy analysis, and practical applications. It seeks to contribute to global academic discourse by addressing contemporary challenges related to sustainable development, digital transformation, and socio-economic resilience The journal aims to advance theoretical and empirical research and to promote evidence-based policy analysis and practical solutions in the context of economic development at national, regional, and global levels.

Key topics covered in the journal: economic development;sustainable economic growth; macro– and microeconomic analysis; strategic management;strategic planning; social and economic issues; practical solutions in economics.

EDITOR-IN-CHIEF

Mira Nurmakhanova – PhD, Professor, KIMEP University, Almaty, Kazakhstan, Scopus Author ID: 55938709700, ORCID ID: https://orcid.org/0000-0002-1399-7773

DEPUTY EDITOR-IN-CHIEF

Anel Kireyeva – Cand. Sc. (Econ.), Associate Professor, Leading Researcher, Institute of Economics Committee of Science MSHE RK, Almaty, Kazakhstan, Scopus Author ID: 56530815200, ORCID ID: https://orcid.org/0000-0003-4208-6167

SCIENTIFIC EDITOR

Zaure Chulanova – Cand. Sc. (Econ.), Deputy Director of Science, Institute of Economics Committee of Science MSHE RK, Almaty, Kazakhstan. Scopus Author ID: 57208496185, ORCID ID: https://orcid.org/0000-0001-9333-7582

EDITORIAL COUNCIL

Mohamed Elheddad – PhD, Professor, University of Greater Manchester, Business School, Manchester, UK. Scopus Author ID: 57195032630, ORCID ID: https://orcid.org/0000-0002-4175-4808

Laszlo Vasa - PhD, Professor, Széchenyi István University, Győr, Hungary, Scopus Author ID: 16317891500, ORCID ID: https://orcid.org/0000-0002-3805-0244

Myoung-Kil Youn – PhD, Professor, KODISA Fondation, Seoul, Republic of Korea. Scopus Author ID: 36085620200, ORCID ID: https://orcid.org/0000-0001-8524-5012

Leyla Gamidullaeva – Doc. Sc. (Econ.), Professor, University of Penza, Penza, Russia. Scopus Author ID: 56436586400, ORCID ID: 0000-0003-3042-7550

Lau Chikeung Keung Marco – PhD, Professor, Zhejiang Yuexiu University of Foreign Languages, Shaoxing, Zhejiang, CN. Scopus Author ID: 59420871000, ORCID ID: https://orcid.org/0000-0002-6550-132X

Sebastien Peyrouse – PhD, Professor, Director of the Central Asia Program, George Washington University, Washington, DC, USA. Scopus Author ID: 21234013400 ORCID ID: https://orcid.org/0000-0001-8318-3102

Khan Nohman – PhD, Professor, Asia Pacific University of Technology and Innovation, Kuala Lumpur, Malaysia. Scopus ID: 57214892519, ORCID ID: 0000-0001-9714-6273

Tunc Medeni – PhD, Associate Professor, Ankara Yildirim Beyazit University, Turkey, Scopus Author ID: 34880553000, ORCID ID: https://orcid.org/0000-0002-2964-3320

Peter Karacsony – PhD, Professor, Obuda University, Budapest, Hungary, Scopus Author ID: 25825158100, ORCID ID: https://orcid.org/0000-0001-7559-0488

Stephen Pratt – PhD, Professor, University of Central Florida, Florida, USA. Scopus Author ID: 55627411500, ORCID ID: https://orcid.org/0000-0002-6550-132X

Lodhi Rab Nawaz – PhD, Professor, Hailey College of Commerce, Lahore, Pakistan, Scopus Author ID: 55698650600, ORCID ID: https://orcid.org/0000-0001-5330-4962

Andrei Shelomentsev – Doc. Sc. (Econ.), Professor, head of the Department for the Study of Regional Socio-Economic Systems of the Institute of Economics of the Ural Branch of the Russian Academy of Sciences, Russia, Scopus Author ID: 56288580900, ORCID ID: https://orcid.org/0000-0003-1904-9587

Frequency: 4 issues per year DOI Prefix: 10.51176
ISSN: 1997-9967 (Print)/ 2663-550X (Online)
Distribution: content is distributed under Creative Commons Attribution 4.0 International License (CC BY 4.0)
Published online: 30 January 2018
Price and Charges of Publication: 100 000 KZT Website: https://esp.ieconom.kz
E-mail: esp@ieconom.kz
Founder/Publisher: Institute of Economics CS MSHE RK
©Economy: strategy and practice, 2026

CONTENTS

МАЗМҰНЫ

СОДЕРЖАНИЕ

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-6-20
МРНТИ 06.52.13
JEL: H51, H52, O15

Check for updates
BY-NC 4.0

Impact of Human Capital Development on Economic Growth in Nigeria

Iya Abershi Musa[a], Sarah Anyanwu[a], Peterson K. Ozili[b]*

[a] Nile University of Nigeria, Plot 681, Cadastral Zone C-OO, Research & Institution Area, Jabi Airport Bypass, Abuja FCT, Nigeria; [b] Central Bank of Nigeria, Abuja, Federal Capital Territory, Nigeria

For citation: Musa, I.A. Anyanwu, S. & Ozili, P.K. (2026). Impact of Human Capital Development on Economic Growth in Nigeria. Economy: strategy and practice, 21(1), 6-20. https://doi.org/10.51176/1997-9967-2026-1-6-20

ABSTRACT

Human capital development is considered as one of the key factors of sustainable economic growth, however, for Nigeria, the issue of the comparative impact of government spending on health and education in terms of current and capital expenditures remains poorly understood. The purpose of this study is to assess the impact of human capital development on economic growth in Nigeria. The methodological basis is the distributed lag autoregression model (ARDL), which makes it possible to evaluate the short- and long-term effects between variables with a mixed order of their integration. The empirical base covers annual data for Nigeria from 1970-2024 on GDP growth rate, government current health expenditure, Government capital expenditure on health, Government current education expenditure and Government capital expenditure on education. The results showed that the economic growth variable is stationary at the level, while the other variables are stationary in the first differences, which confirms the applicability of the ARDL approach. ARDL's long-term estimates showed that current education expenditures have a positive and statistically significant impact on economic growth (β = 0.039955; p = 0.0067), as do capital expenditures on education (β = 0.072462; p = 0.0030), while the impact of healthcare costs turned out to be statistically insignificant: for capital expenditures β = -0.03087 (p = 0.6185), for current expenditures β = -0.06336 (p = 0.1414). The results show that educational expenditures, especially capital investments in educational infrastructure, make the greatest contribution to Nigeria's economic growth.

KEYWORDS: Economy, Economic Growth, Healthcare, Education, Economics of Education, Government Spending, Human Capital, Public Strategy, Nigeria

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT. The study did not receive any financial support (conducted via authors' own resources)

Article history:
Received 06 January 2026
Accepted 10 March 2026
Published 30 March 2026

*** Corresponding author: Ozili P.K.** – Senior Economist, Central Bank of Nigeria, Abuja, Federal Capital Territory, Nigeria, email: petersonkitakogelu@yahoo.com

Влияние развития человеческого капитала на экономический рост в Нигерии

Муса И.А.[a], Аньянву С.И.[a], Озили П.К.[b]*

[a] *Университет Нила Нигерии, участок 681, кадастровая зона С-00, район исследований и учреждений, объездная дорога аэропорта Джаби, Абуджа, Федеральная столичная территория, Нигерия;* [b] *Центральный банк Нигерии, Абуджа, Федеральная столичная территория, Нигерия*

Для цитирования: Муса И.А., Аньянву С.И. Озили П.К. (2026). Влияние развития человеческого капитала на экономический рост в Нигерии. Экономика: стратегия и практика, 21(1), 6-20. https://doi.org/10.51176/1997-9967-2026-1-6-20

АННОТАЦИЯ

Развитие человеческого капитала рассматривается как один из ключевых факторов устойчивого экономического роста, однако для Нигерии вопрос о сравнительном влиянии государственных расходов на здравоохранение и образование в разрезе текущих и капитальных затрат остается недостаточно изученным. Целью данного исследования является оценка влияния развития человеческого капитала на экономический рост в Нигерии. Методологическую основу составляет модель авторегрессии с распределенными лагами (ARDL), позволяющая оценить краткосрочные и долгосрочные эффекты между переменными при смешанном порядке их интеграции. Эмпирическая база охватывает годовые данные по Нигерии за 1970–2024 гг. по темпу роста ВВП, государственным текущим расходам на здравоохранение, государственным капитальным расходам на здравоохранение, государственным текущим расходам на образование и государственным капитальным расходам на образование. Результаты показали, что переменная экономического роста стационарна на уровне, тогда как остальные переменные стационарны в первых разностях, что подтверждает применимость ARDL-подхода. Долгосрочные оценки ARDL показали, что текущие расходы на образование оказывают положительное и статистически значимое влияние на экономический рост (β = 0,039955; p = 0,0067), как и капитальные расходы на образование (β = 0,072462; p = 0,0030), тогда как влияние расходов на здравоохранение оказалось статистически незначимым: для капитальных расходов β = -0,03087 (p = 0,6185), для текущих расходов β = -0,06336 (p = 0,1414). Полученные результаты показывают, что наибольший вклад в экономический рост Нигерии вносят именно образовательные расходы, особенно капитальные вложения в образовательную инфраструктуру.

КЛЮЧЕВЫЕ СЛОВА: экономика, экономический рост, здравоохранение, образование, экономика образования, государственные расходы, человеческий капитал, государственная стратегия, Нигерия

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ. Исследование не имело спонсорской поддержки (собственные ресурсы).

История статьи:
Получено 06 января 2026
Принято 10 марта 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Озили П.К.** – старший экономист, Центральный банк Нигерии, Абуджа, Федеральная столичная территория, Нигерия, email: petersonkitakogelu@yahoo.com

INTRODUCTION

The economic literature identifies several factors affecting economic growth (Suparman & Muzakir, 2023; Jemiluyi & Jeke, 2024; Opoku et al., 2024; Rajab & Zouheir, 2024; Chaabouni & Mbarek, 2024; Zhang et al., 2023; Dahmani & Mabrouki, 2025). Human capital development has been identified as a critical factor influencing growth (Acemoglu et al., 2014, Romer, 1994; Duan et al., 2022). Human capital development focuses on investing in people's knowledge, skills, and health to increase their productivity and value (Son, 2010; Acemoglu et al., 2014). Human capital development can also refer to the development of human capabilities through education and training as a means of human capital accumulation (Adelakun, 2011). This view is supported by the theory of endogenous growth, which argues that economic growth is driven by internal factors such as worker training, investment in human capital, and research and development (Romer, 1994). This has led several studies to investigate the effects of human capital development on economic growth across countries and regional contexts (Wirajing et al., 2023; Matousek & Tzeremes, 2021; Sultana et al., 2022; Sarwar et al., 2021; Fukao et al., 2021; Yormirzoev, 2023). However, most existing studies focus on developed countries, whereas studies on developing countries are scarce in the economic literature.

This study revisits the relationship between human capital development and economic growth, with a focus on Nigeria. It investigates the effect of human capital development on Nigeria's economic growth. Nigeria has significant human capital development challenges that have lingered for many years. The nation faces significant underfunding in healthcare, skills acquisition and formal education (Agbai et al., 2021). The rate of out-of-school children is very high, reaching 18.3 million in 2025. Post-education employment levels are low, there is a high level of unskilled labour , and there is significant brain drain, as many skilled, young, and educated adults emigrate to seek employment abroad (Ogbu, 2019; Martin, 2023; Etete, 2026). These challenges are exacerbated by inadequate infrastructure, poor policy implementation, and high poverty rates. These issues, together with weak human capital development institutions, make it difficult to ascertain the contribution of human capital development to Nigeria's economic growth. Therefore, it is important to determine the role of human capital development in driving growth in Nigeria.

Understanding how human capital influences economic growth in Nigeria is crucial because the development of human capital can increase the number of healthy, skilled, and educated workers, thereby raising productivity and innovation in the economy (Abdelgany & Saleh, 2022). This can lead to higher output, better wages, and increased competitiveness, especially for resource-poor countries. Human capital development can also transform labour into a high-value asset, driving long-term prosperity for countries (Manuelli & Seshadri, 2014).

Previous research has yielded mixed evidence on the influence of human capital development on economic growth (Sultana et al., 2022; Sarwar et al., 2021; Fukao et al., 2021; Yormirzoev, 2023; Adedeji & Bamidele, 2003). However, previous studies have not provided an in-depth analysis of the impact of human capital development on economic growth using extensive data from Nigeria. Also, previous studies utilise existing human development indicators to assess human capital development (Kraay, 2019). However, these studies did not consider ‘government recurrent and capital expenditure on education and health’ as proxies of human capital development. Previous studies also did not divide government expenditure data on education and health into capital expenditure and recurrent expenditure. Furthermore, previous studies used past sample periods without incorporating recent time periods into the dataset from 2020 to 2024.

In this paper, we explore the impact of human capital development, in terms of government recurrent and capital expenditure on education and health, on economic growth in Nigeria. The results suggest that government capital expenditure on education exerts a significant positive effect on economic growth in both the short run and long run. In contrast, recurrent health expenditure shows an insignificant impact. The results indicate that accelerating government capital and recurrent education spending can yield positive economic growth outcomes in Nigeria.

This study contributes to the literature in several ways. This study is the first study to use government expenditure on health and education as a proxy for human capital development and to disaggregate it into ‘government recurrent expenditure on health

and education' and 'government capital expenditure on health and education' in Nigeria. Secondly, this study contributes to the literature by providing additional evidence on the potential influence of human capital development on economic growth in Nigeria using an extended and recent sample period. Thirdly, the study improves our understanding of the role of health on economic growth by showing that improvements in health outcomes, such as higher government capital and recurrent health expenditure, can positively impact economic growth, thereby highlighting the importance of investing in the health sector to promote economic growth. Lastly, the findings of the study contribute to a better understanding of the complex relationship between health, education expenditure, and economic growth.

The remaining section of this paper is divided into four sections. Section two focuses on conceptual background, theory and the empirical literature review. Section three presents the methodology, which comprises research design, model specification, data collection sources, and estimation techniques. Section four focuses on results. Finally, section five presents the article's conclusion.

LITERATURE REVIEW

In Nigeria in the pre-1970s era, much of the national development planning was centred on the accumulation of physical capital for rapid economic growth and development, without recognition of the important role of human capital in the development process (Alenoghena et al., 2016). In the post-1970s era, the Nigerian government began to allocate substantial financial resources to human capital development. These can be seen in the increasing government budgetary expenditure on health and education. This led to an increasing number of schools being established in the country and to the establishment of many primary health centres across many states (Alenoghena et al., 2016). Several programs and policies have also been developed in the education and health care sectors that help increase skill acquisition and labour productivity, contributing to greater economic output and higher economic growth (Fofana, 2001). Despite this, several factors continue to weaken the contribution of human capital development to economic growth in Nigeria, including inefficient resource utilisation, poor governance, lack of government commitment, and inadequate job training, thereby likely leading to a negative effect on economic growth. Given these two conflicting predictions, it remains unclear exactly how human capital development might affect economic growth in Nigeria.

Several theories explain the relationship between human capital and economic growth. For instance, the endogenous growth theory posits that economic growth, or prosperity, is driven by internal factors rather than external ones (Romer, 1994). The theory further states that internal factors influencing economic growth include worker training, skills acquisition, investment in research and development, and innovation (Romer, 1994). Modernisation theory describes the role of education in shaping individuals' values, beliefs, and behaviour (Alayande et al., 2001). It posits that education could be used as a tool to modernise institutions that shape modern values and attitudes. As more people are exposed to modernised institutions, they will be transformed, thereby increasing the number of modernised individuals in society. Once a large segment of the population changes in this way, it can accelerate the pace of modernisation and economic development in society (Alayande et al., 2001). Human capital theory describes the role of education in increasing workers' efficiency and productivity by enhancing their cognitive skills (Mincer, 1958). The theory considers human capital to be the stock of useful human capabilities that produce innate abilities in workers. Human capital theorists further argue that basic literacy is crucial to increase the productivity of workers in low-skill occupations (Bellew & King, 1991). There is also the Harrods theory of economic growth, which posits that a higher level of savings and investment contributes significantly to economic growth because investment will ultimately increase people's income (demand) and a firm's capital stock (supply) (Orlando et al., 2021). The classical theory of economic growth, proposed by Adam Smith, David Ricardo, and Thomas Malthus, posits that economic growth is driven by capital accumulation, an increase in the labour force, and technological progress. However, such economic growth is limited by scarce resources and population growth.

Previous empirical studies examining the relationship between human capital development and economic growth have shown conflicting evidence. For example, Wirajing et al. (2023) analysed how

human capital might influence economic growth in 48 African countries from 2000 to 2019. They were interested in determining whether human capital development stimulates growth. In their analysis, they employ the system GMM regression method and find evidence that human capital development influences economic growth in Africa. They also find that internet penetration and foreign direct investment jointly lead to higher economic growth. Their analyses reinforce the urgent need for policymakers in African countries to commit additional fiscal resources to the education and health sectors to accelerate human capital development toward sustainable economic growth across the continent. In a cross-country study, Matousek and Tzeremes (2021) examined how human capital affects economic growth across 100 countries from 1970 to 2014. They find that human capital positively and statistically significantly affects countries' economic growth rates. Duan et al. (2022) sought to understand the relationships among human capital, governance performance, economic freedom, and economic growth. They also investigate whether institutional factors, such as governance performance and economic freedom, mediate the association between human capital and economic growth. They use panel data regression to analyse data for China, India, Russia, Brazil, and South Africa (BRICS) from 2000 to 2018 and find that the influence of human capital on economic growth is not linear but inverted U-shaped. They also find that human capital has a positive effect on economic growth only for a limited period, and that governance quality increases the influence of human capital on economic growth in BRICS.

Sultana et al. (2022) examined the relationship between human capital and economic growth across 141 countries, divided into 93 developing and 48 developed countries. They analyse the data using the System Generalized Methods of Moments (SGMM) for the period 1980–2008. They find that human capital positively impacts economic growth in developing countries. Sarwar et al. (2021) examined how economic growth is impacted by financial development and human capital. They analysed 83 emerging countries from 2002 to 2017. They analyse the data using the two-step system, generalised method of moments, and find that economic growth is positively impacted by both financial development and human capital in emerging economies. Fukao et al. (2021) examined the impact of human capital on economic growth in Japan for 130 years from 1885 to 2015. They find that over the 130-year period, Japan's labour productivity rose 46-fold, with increases in the capital-labour ratio accounting for 40%, improvements in labour quality accounting for 35%, and total factor productivity (TFP) growth accounting for 36%. They further find that labour productivity growth accelerated substantially in the postwar period and was twice that of the prewar period. Yormirzoev (2023) examined the long-term economic performance of the former Soviet republics of Central Asia over the last three decades. They examine sources of economic growth based on the extended neoclassical growth model, and the author aims to determine whether human capital, in the form of education and health inputs, affects growth rates in the Central Asian region. They find that the growth rates of total factor productivity (TFP) were notably higher in Tajikistan than in Kazakhstan and the Kyrgyz Republic. However, a reduction in TFP in Tajikistan in the 1990s is attributed to the country's dire civil war.

Other studies, such as Zhang et al. (2023), have described how economic growth in China is affected by high-quality human capital, using provincial-level macro data and individual labourers' micro data from 2008 to 2017. They find that the rate of economic growth in China is elevated by an improvement in high-quality human capital. Suparman and Muzakir (2023) analysed the association between human capital, the open unemployment rate, and economic growth across 32 Indonesian provinces from 2010 to 2020, using data from these provinces. They find that Indonesia's economic growth is affected by human capital development. Jemiluyi and Jeke (2024) examined the moderating effect of human capital development on the relationship between urbanisation and economic growth in Nigeria from 1991 to 2022. They adopt the autoregressive distributed lag error-correction model and analyse their data using the dynamic ordinary least squares estimator. They find that, on its own, urbanisation does not promote economic growth, but its interaction with human capital development does, producing a positive effect on Nigeria's economic growth. Opoku et al. (2024) examined how economic growth in Africa is affected by financial inclusion and the moderating role of human capital development, using a sample of 40 African countries from 2005 to 2018. They analyse the data using the GMM

estimation technique and find that a non-linear U-shaped relationship between financial inclusion and economic growth, and between financial inclusion and human capital development, strengthens the positive influence of financial inclusion on economic growth in African countries. Their findings suggest that the growth-enhancing benefits of financial inclusion are transmitted through human development. Rajab and Zouheir (2024) analysed the mediating effect of human capital on the relationship between foreign direct investment and economic growth across 15 least developed African countries from 2000 to 2019. They find that economic growth is not significantly influenced by foreign direct investment and human capital. Chaabouni & Mbarek (2024) examine how economic growth is affected by human capital in 17 European countries during the COVID-19 pandemic (2019 to 2022) and find no significant causal effect of human capital development on economic growth. Dahmani and Mabrouki (2025) explained the influence of human capital, innovation, governance, and economic growth in the Middle East and North Africa region from 1996 to 2020. They find that economic growth is positively impacted by human capital in the short run, while its long-term effect is complex.

Previous Nigerian studies also analysed how the level of human capital development impacts economic growth. Adedeji and Bamidele (2023) assessed the extent to which Nigeria's economic growth was affected by the level of human capital development from 1990 to 2023. Using OLS, the authors find that economic growth is affected by human capital development, implying that economic growth can be accelerated in Nigeria through human capital development. Odusola (2021) also analysed the impact of human capital development on economic growth in Nigeria. Using ordinary least squares regression, the author finds that economic growth is positively affected by human capital development. Adamu (2021) explored how economic growth in Nigeria can be accelerated through human capital formation from 1990 to 2023. The result indicates that economic growth in Nigeria can be accelerated through investment in human capital, specifically education and training. Chete and Adeoye (2019) explored the association between human capital investment and economic growth in Nigeria over the 1986-2022 period, using an impulse-response regression method. They find a mismatch between the country's manpower needs and the skills produced by the educational system.

Although previous studies examined the relationship between human capital development and economic growth, they did not account for the heterogeneity of government spending, which can affect investment in human capital. Previous Nigerian studies, such as Adedeji and Bamidele (2003), Chete and Adeoye (2019), Adamu (2021), examined the effects of human capital on economic growth. However, they did not disaggregate government expenditure on education and health into capital and recurrent expenditure when investigating the impact of human capital development on economic growth in Nigeria. This omission creates a gap in the literature. Also, Assane (2024) used the school enrollment rate as a proxy for human capital but did not control for government education expenditure. Assane (2024) also failed to control for crucial factors affecting economic growth in Nigeria, such as the poverty rate, employment levels, and capacity utilisation. This omission creates a gap in the literature. Furthermore, few studies used the actual monetary value of gross domestic product as a proxy for economic growth, which can bias the results due to skewness in gross domestic product values.

The gap we aim to fill in the literature is to disaggregate government expenditure on education and health into capital and recurrent expenditure and examine their effect on economic growth in Nigeria. Two, we control for crucial factors affecting economic growth in Nigeria that previous studies did not account for, such as the poverty rate, employment level, and capacity utilisation. Third, we use an extended 55-year sample period from 1970 to 2024, which accommodates three full economic cycles. Fourth, the inclusion of the years 2020 to 2024 in the recent data helps capture the recent evolution in human capital development and economic growth in Nigeria. Finally, we use the annual change in gross domestic product as a better measure of economic growth, rather than the actual monetary value.

RESEARCH DESIGN

The section reveals the logic of empirical research and describes how the verification of the hypothesis regarding the impact of human capital development on economic growth in Nigeria was organised. This section consistently presents the

characteristics of the data used, the study's time scope, the composition of variables, and the rationale for choosing econometric tools. This approach makes it possible to ensure the transparency of the research procedure and show how the chosen methodology aligns with the purpose of the work. The empirical part of the study is based on annual time series for Nigeria, 1970-2024, drawn from official secondary sources. The rate of economic growth is used as the dependent variable, and the key explanatory variables are indicators of government spending on education and healthcare, divided into capital and current spending. The data is a time series with an annual trend.

Table 1. Description of variables

No.	Variable	Variable symbol	A priori expectations	Source
1	Economic growth rate	EGR	Positive	CBN
2	Government recurrent expenditure on health	GRH	Positive	NBS
3	Government capital expenditure on health	GCH	Positive	NBS
4	Government recurrent expenditure on education	GRE	Positive	NBS
5	Government capital expenditure on education	GCE	Positive	CBN

Note: compiled by the authors

Regarding the model specification, we develop a model that estimates the extent to which human capital development impacts economic growth in Nigeria. The adopted model is a modified form of the ARDL model, which was used in Qamruzzaman et al. (2021), with the addition of government recurrent expenditure on health and government recurrent expenditure on education as part of the independent variables. The ARDL model is specified by formula (1):

$$\Delta EGR_t = \beta_0 + \beta_1 \Delta EGR_{t-i} + \\ + \beta_2 \Delta EGR_{t-2} + \beta_3 \Delta EGR_{t-3} + \\ + \beta_4 \Delta GCH_t + \beta_5 \Delta GRH_t + \beta_6 \Delta GRE_t \\ + \beta_7 \Delta GCE_{t-i} + \beta_8 \Delta GCE_{t-i} + \mu_t \quad (1)$$

where:

$\beta_1, \beta_2 \ldots\ldots \beta_n$ – estimated coefficients of the explanatory variables;

β_0 – intercept;

EGR – economic growth rate;

GRH – government recurrent expenditure on health;

GCH – government capital expenditure on health;

GRE – government recurrent expenditure on education;

GCE – government capital expenditure on education;

ECM – error correction term;

μ – stochastic error term.

The dependent variable is the economic growth rate, while the independent variables include government recurrent expenditure on health, government capital expenditure on health, government recurrent expenditure on education, and government capital expenditure on education. These variables are measured in billion naira. With respect to a priori expectations, the estimated coefficients on the explanatory variables are expected to be positive and related to economic growth, as presented in Table 1. This implies that an increase in each independent variable is expected to lead to a corresponding increase in the economic growth rate. The error term is assumed to have a zero mean and constant variance.

The autoregressive distributed lag (ARDL) technique is employed in this study because it can be applied to variables integrated of order I(0) and I(1), provided that none of the variables is integrated of order I(2) (Kripfganz & Schneider, 2023). The ARDL approach is also suitable for relatively small sample sizes and allows the simultaneous estimation of short- and long-run relationships. In addition, it provides a flexible framework for incorporating lag structures and deriving an error-correction representation from a single reduced-form equation, making it particularly useful for analysing dynamic economic relationships (Kripfganz & Schneider, 2023).

The dependent variable, EGR, is measured by the gross domestic product growth rate. Previous studies have used the gross domestic product

growth rate as a proxy for economic growth (Henderson et al., 2011). The explanatory variable GRH is an indicator of human capital development and measures government recurrent health expenditure. Prior studies suggest that public spending on healthcare can reduce disease burdens, improve human capital, and enhance labour productivity. These improvements may, in turn, stimulate economic output and promote higher economic growth (Yang, 2020). Accordingly, the predicted relationship is that economic growth will be positively impacted by government recurrent health expenditure (GRH).

The explanatory variable GCH is another indicator of human capital development and is measured by government health capital expenditure. The literature shows that government capital spending on healthcare can create supportive health infrastructure, thereby increasing access to healthcare, improving human capital, increasing labour productivity, and leading to higher economic growth (Yang, 2020). This suggests a positive effect of government capital health expenditure (GCH) on economic growth (EGR).

The explanatory variable GCE is also used as an indicator of human capital development and is measured by government capital expenditure on education. The literature shows that government capital spending on education creates supportive educational infrastructure, thereby increasing labour quality, improving human capital, increasing labour productivity, and leading to higher economic growth (Paudel, 2023). This suggests a positive effect of government capital education expenditure (GCE) on economic growth (EGR).

The explanatory variable, GRE, is another indicator of human capital development and is measured by government recurrent expenditure on education. The literature shows that government recurrent spending on education leads to higher training and skill acquisition, thereby improving human capital, increasing labour productivity, and promoting economic growth (Paudel, 2023). Hence, a positive relationship is expected between government capital expenditure on education (GCE) and economic growth (EGR).

RESULTS

The descriptive statistics present summaries of the individual variables. Each variable of interest has 55 observations. It can be observed that government recurrent expenditure on education (GRE) has the highest mean score, closely followed by government recurrent expenditure on health (GRH). Next is the mean score for government capital expenditure on education (GCE), followed closely by the mean score for government capital expenditure on health (GCH). The economic growth rate (EGR) recorded the lowest mean score during the period under review. Similarly, the median values showed that government recurrent expenditure on education (GRE) had the highest median score, closely followed by government recurrent expenditure on health (GRH). Next is the median score for government capital expenditure on education (GCE), followed closely by the median score for government capital expenditure on health (GCH). Economic growth rate (EGR) recorded the lowest median score during the period under review. Each variable consists of 55 observations (Table 2).

Table 2. Descriptive statistics of all variables for 1970-2024

Statistic	EGR	GCH	GRH	GRE	GCE
Mean	2.963451	28.79388	111.2046	163.8615	38.05962
Median	3.258541	6.484600	9.980000	24.73000	10.05000
Maximum	15.32916	111.7000	667.2500	882.8100	118.6000
Minimum	-13.12790	0.001000	0.020000	0.100000	0.010000
Std. Dev.	5.041257	38.98793	175.5652	242.1535	42.92918
Skewness	-1.124654	1.098449	1.637117	1.491592	0.495429
Kurtosis	5.973899	2.586537	4.605950	4.084014	1.477399
Observation	55	55	55	55	55

EGR = Economic growth rate. GRH = Government recurrent expenditure on health.
GCH = Government capital expenditure on health. GRE = Government recurrent expenditure on education.
GCE = Government capital expenditure on education.

Note: compiled by the authors

The results of the Augmented Dickey–Fuller (ADF) unit root test were conducted to examine the stationarity properties of the variables and to guide the choice of an appropriate estimation technique, thereby avoiding spurious regression results. The findings show that the economic growth rate variable (EGR) is stationary at the level, whereas government recurrent expenditure on education (GRE), government recurrent expenditure on health (GRH), government capital expenditure on education (GCE), and government capital expenditure on health (GCH) become stationary after first differencing. These results suggest that the variables are integrated of mixed orders, thereby justifying the use of the ARDL approach (Table 3).

Table 3. ADF unit root test results

Variable	ADF-Statistic	Critical value 1%	Critical value 5%	Critical value 10%	Order of integration	Interpretation
EGR	-3.656499	-3.557472	2.916566	-2.596116	I(0)	Stationary at Level
GRH	3.446237	-3.584743	-2.928142	-2.602225	I(1)	Stationary at 1st difference
GCH	-6.600829	-3.562669	-2.918778	-2.597285	I(1)	Stationary at 1st difference
GRE	4.238247	-3.562669	-2.918778	2.597285	I(1)	Stationary at 1st difference
GCE	-6.008856	-3.577723	-2.925169	2.600658	I(1)	Stationary at 1st difference

EGR = Economic growth rate. GRH = Government recurrent expenditure on health.
GCH = Government capital expenditure on health. GRE = Government recurrent expenditure on education.
GCE = Government capital expenditure on education.

Note: compiled by the authors

The ARDL short-run result in Table 4 shows that the government recurrent expenditure on health variable (GRH) has an insignificant short-run impact on economic growth in Nigeria. The insignificant result is inconsistent with Yang (2020), who argues that government recurrent spending on healthcare can reduce disease burden, improve human capital, and increase labour productivity, leading to healthier, more productive workers, higher economic output, and higher economic growth. Also, the government capital expenditure on health variable (GCH) has an insignificant short-run impact on economic growth in Nigeria. The insignificant result is also inconsistent with Yang (2020), who shows that fiscal health spending lowers disease risk, increases labour force productivity, and increases economic output and growth.

Furthermore, the government recurrent expenditure on education variable (GRE) has a positive coefficient of 0.33 and is statistically significant at the 5% level, indicating that GRE has a significant positive impact on Nigeria's economic growth in the short run. The economic significance of the result is that a one percent increase in government recurrent expenditure on education will increase GDP growth by 0.33 percent in the short term. This suggests that the fiscal authorities in Nigeria should increase and sustain government recurrent spending on education to stimulate short-term economic growth. The significant positive result is consistent with Paudel (2023), who argues that government recurrent spending on education leads to higher training and skill acquisition, which improves human capital, increases labour productivity, and leads to higher economic growth.

The government capital expenditure on education variable (GCE) has a positive coefficient of 0.23 and is statistically significant at the 5% level, indicating a positive impact of GCE on Nigeria's economic growth in the short run. The economic significance of the result is that a one percent increase in government capital expenditure on education will increase GDP growth by 0.23 percent in the short term. This suggests that the fiscal authorities in Nigeria should increase and sustain government capital spending on education to stimulate short-term economic growth. The significant positive result is consistent with Paudel (2023), who argues that government capital spending on education creates supportive educational infrastructure, thereby increasing labour quality, improving human capital, increasing labour productivity, and resulting in higher economic growth.

Table 4 further revealed that the coefficient of determination is about 0.60.

Table 4. ARDL short-run regression analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
EGR_{t-1}	0.46	0.16	2.93	0.01
EGR_{t-2}	0.14	0.18	0.75	0.46
EGR_{t-3}	-0.31	0.17	-1.89	0.07
GCH	-0.02	0.04	-0.49	0.63
GRH	-0.05	0.03	-1.59	0.12
GRE	0.33	0.14	2.31	0.01
GCE	0.23	0.08	2.89	0.01
GCE_{t-1}	-0.16	0.10	-1.50	0.14
β_0	0.70	0.94	0.74	0.46
R-squared	0.60242			
Adjusted R-squared	0.57661			
S.E. of regression	4.13906			
F-statistic	3.19869			
Prob(F-statistic)	0.00712			
Selected model: ARDL (3, 0, 0, 0, 1)				

Note: compiled by the authors

This suggests that 60 percent of the fluctuation in economic growth is accounted for by variations in all the independent variables, while the remaining 40 percent unaccounted for is captured by the error term. It implies the estimated model has a good fit. The F-statistic p-value (F=0.0071) is also significant, suggesting that all independent variables are jointly statistically significant. Finally, the DW statistic (D-W=2.1), approximately two (2), shows an absence of autocorrelation in the model.

The ARDL long-run result in Table 5 shows that the government recurrent expenditure on health variable (GRH) has an insignificant long-run impact on economic growth in Nigeria.

Table 5. ARDL long-run regression estimation (cointegrating and long-run form)

Variable	Coefficient	Std. Error	T-statistic	Prob.
$D(EGR_{(t-1)})$	0.175504	0.19075	0.920074	0.3633
$D(EGR_{(t-2)})$	0.312527	0.16555	1.887834	0.0667
D(GCH)	-0.02216	0.045	-0.49248	0.6252
D(GRH)	-0.04549	0.02867	-1.58686	0.1208
D(GRE)	0.028686	0.02193	1.308152	0.1987
D(GCE)	0.207489	0.1095	1.894958	0.0657
$CointEq_{(t-1)}$	-0.71796	0.20126	-3.5673	0.001
Cointeq = EGR - (-0.0309*GCH - 0.0634*GRH + 0.0400*GRE + 0.0725*GCE + 0.9726)				
Long Run Coefficients				
GCH	-0.03087	0.06147	-0.50214	0.6185
GRH	-0.06336	0.04219	-1.5019	0.1414
GRE	0.039955	0.01793	2.228823	0.0067
GCE	0.072462	0.0299	2.42269	0.003
Selected model: ARDL (3, 0, 0, 0, 1).				

Note: compiled by the authors

The insignificant result is inconsistent with Yang (2020), who argues that government recurrent spending on healthcare can reduce disease burden, improve human capital, and increase labour productivity, leading to healthier, more productive workers, higher economic output, and higher economic growth in the long run. Also, the government capital expenditure on health variable (GCH) has an insignificant long-run impact on economic growth in Nigeria. The insignificant result is inconsistent with

Yang (2020), who shows that fiscal health spending lowers disease risk, increases labour force productivity, and increases economic output and growth.

The government recurrent expenditure on education variable (GRE) has a positive coefficient of 0.039 and is statistically significant at the 1% level, indicating that GRE positively influence economic growth in Nigeria in the long run. However, the coefficient is not economically significant because a one percent increase in government recurrent expenditure on education will increase GDP growth by 0.039 percent (which is equivalent to zero) in the long term. Notwithstanding, the significant positive result is consistent with Paudel (2023), who argues that government recurrent spending on education leads to greater training, which improves human capital, increases labour productivity, and results in higher economic growth in the long run.

The government capital expenditure on education variable (GCE) has a positive coefficient of 0.072 and is statistically significant at the 1% level, indicating that GCE positively influence economic growth in Nigeria in the long run. The GCE coefficient is also economically significant because a one percent increase in government capital expenditure on education will increase GDP growth by 0.072 percent (which is equivalent to 0.1 percent) in the long term. The significant positive result is consistent with Paudel (2023), who argues that government capital spending on education creates supportive educational infrastructure, which increases the quality of the labour force and stimulates long-run growth.

The reliability of the regression results from our dynamic model was assessed using various diagnostic checks, with the results presented in Table 6.

Table 6. Diagnostic Analysis

Type	Diagnostic Test	F-statistic	Probability
Breusch-Godfrey LM Test	Serial correlation	0.189909	0.8279
Breusch-Pagan-Godfrey Test (BPG)	Heteroskedasticity	0.479718	0.8628
Ramsey RESET Test	Specification	2.385095	0.1310
Jarque-Bera Test	Normality	30.75867	0.0000

Note: compiled by the authors

The specific tests carried out are as follows. The first test is the Breusch-Godfrey test, which checks for serial correlation. The second test is the Breusch-Pagan-Godfrey test, which checks for heteroskedasticity. The third test is the Ramsey Reset Test, which checks for the validity of the model specification. The fourth test is the Jarque-Bera test, which evaluates the normality of the variables. These tests were conducted to ensure the robustness of the regression results. The F-statistic and probabilities obtained indicate positivity, as they all suggest rejecting the null hypothesis for each diagnostic test category. Also, the serial correlation test result shows the absence of serial correlation as an econometric problem. BPG test shows that the model is not characterised by homoskedasticity. Ramsey RESET test result justifies the model specification's goodness of fit as previously established, and, given that the probability values for each variable are greater than 0.05, the Jarque-Bera test indicates that the variables are normally distributed, with their probability values less than 0.05.

Table 7 presents the Granger causality test result.

Table 7. Granger causality test

Null hypothesis	Observation	F-Statistic	Prob.
GCH does not Granger-cause EGR	53	0.34049	0.7131
EGR does not Granger-cause GCH		0.38208	0.0045
GRH does not Granger-cause EGR	53	0.16457	0.8487
EGR does not Granger-cause GRH		0.44592	0.6429
GRE does not Granger-cause EGR	50	0.13811	0.8714
EGR does not Granger-cause GRE		0.20338	0.8167
GCE does not Granger-cause EGR	47	0.17356	0.8413
EGR does not Granger-cause GCE		0.19424	0.8242

GRH does not Granger-cause GCH	53	6.13032	0.0043
GCH does not Granger-cause GRH		0.42904	0.6536
GRE does not Granger-cause GCH	50	5.07538	0.0103
GCH does not Granger-cause GRE		1.68195	0.1975
GCE does not Granger-cause GCH	47	3.39817	0.0429
GCH does not Granger-cause GCE		7.23286	0.002
GRE does not Granger-cause GRH	50	0.01355	0.9865
GRH does not Granger-cause GRE		8.44250	0.0008
GCE does not Granger-cause GRH	47	0.69807	0.5032
GRH does not Granger-cause GCE		0.32796	0.7222
GCE does not Granger-cause GRE	44	1.18693	0.3159
GRE does not Granger-cause GCE		0.82121	0.4474

Note: compiled by the authors

The paper attempts to establish the causal relationship among the variables and the direction of the causality, if any. The results report a unidirectional causality between the government's health capital expenditure and economic growth in Nigeria. This implies that the unidirectional causality runs from the government's health capital expenditure to economic growth. In contrast, there is no bidirectional or unidirectional causality between economic growth and the following independent variables: government recurrent expenditure on health, government recurrent expenditure on education and government capital expenditure on education.

In other words, past values of economic growth do not forecast future government recurrent health expenditure (GRH). Also, past values of government recurrent health expenditure (GRH) do not forecast future economic growth rates. Furthermore, past values of economic growth do not forecast future government recurrent expenditure on education. Past values of government recurrent expenditure on education also do not forecast future economic growth rates. Economic growth does not Granger-cause government capital expenditure on education, and government capital expenditure on education does not Granger-cause economic growth. This is evidenced by the p-values of the variables as shown in Table 7 above.

CONCLUSION

In this paper, the extent to which economic growth is impacted by human capital was examined for the period of 1970 to 2024. The major findings are the following. The unit root test indicated that the economic growth rate was stationary in levels. In contrast, the explanatory variables were stationary in first differences.

The ARDL short-run results consistently indicated that fiscal capital and recurrent health spending do not significantly affect economic growth in Nigeria. In contrast, government recurrent and capital expenditure on education had a significant positive effect on economic growth in Nigeria during the period examined. Similarly, the ARDL long-run result indicates that government recurrent expenditure on health and government capital expenditure on health had no significant impact on economic growth in Nigeria, whereas government recurrent expenditure on education and government capital expenditure on education had a positive and significant impact on economic growth in Nigeria.

Lastly, the Granger causality test results showed a unidirectional relationship running from government capital expenditure on health to economic growth in Nigeria, while there is no causality between economic growth and the following independent variables: government recurrent expenditure on health, government recurrent expenditure on education, and government capital expenditure on education.

The implication of the findings is that government capital expenditure on education and health matters for economic growth in Nigeria, and the government should increase its spending on these indicators to improve human capital development and boost economic growth. It is therefore recommended that the government at all levels in Nigeria should formulate policies aimed at boosting capital expenditure on education and healthcare. Policymakers and relevant stakeholders should also initiate measures to strengthen public-private partnerships to increase education and health sector financing and enhance human capital development in Nigeria. Furthermore, policymakers should adopt appropriate fiscal policy measures to address the challenges

of insufficient health and education expenditures in Nigeria. They should also increase budgetary capital allocation to the health and education sectors in order to increase spending on human capital development and stimulate economic growth in Nigeria.

This study is not without limitations. The lack of available quarterly and monthly data for the crucial variables was a limitation. Another limitation is the lack of available data for developing a human capital development index. Another limitation of the study is that it did not compare Nigeria with other developing countries.

Some suggestions for future research are offered. One, future studies can use qualitative research methods, such as interviews and case studies, to provide a more nuanced understanding of how economic growth is impacted by human capital development in Nigeria. Two, future studies can undertake comparative analyses of Nigeria with other countries or regions to gain valuable insights into cross-country differences in how economic growth is impacted by human capital development. Three, it would be interesting for future studies to evaluate how economic growth is affected by specific health interventions, such as vaccination programs, maternal and child health initiatives, and disease prevention strategies. Understanding the effectiveness of these interventions can provide valuable insights to policymakers.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: IAM; research design: SA and PO; data collection: IAM and SA; analysis and interpretation: IAM, SA and PO; writing draft preparation: IAM, SA and PO; supervision: SA; correction of article: IAM, SA and PO; proofread and final approval of article: SA and PO. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Abdelgany, M., & Saleh, A. (2022). Human capital and labour productivity: Empirical evidence from developing countries. *International Journal of Economics, Finance and Management Sciences, 10*(4), 173–184. https://doi.org/10.11648/j.ijefm.20221004.13

Acemoglu, D., Gallego, F. A., & Robinson, J. A. (2014). Institutions, human capital, and development. *Annual Review of Economics, 6*(1), 875–912. https://doi.org/10.1146/annurev-economics-080213-041119

Adamu, P. O. (2021). *Human resources, high-level manpower and the development of the Nigerian economy.* Nigerian Economic Society.

Adedeji, S. O., & Bamidele, R. O. (2003). Economic impact of tertiary education on human capital development in Nigeria. In *Human resource development in Africa: Selected papers for the 2002 annual conference* Nigerian Economic Society.

Adelakun, O. J. (2011). Human capital development and economic growth in Nigeria. *European Journal of Business and Management, 3*(9), 29–38.

Agbai, E., Okafor, A., & Egbedoyin, F. S. (2021). Comparative study of education funding in Nigeria. Journal of Education and Practice, 12(5), 1–12. https://doi.org/10.7176/JEP/12-5-01

Alayande, B. A., Olayiwola, K. W., & Olaniyan, O. (2001). *Nutrition and productivity of women: Evidence from Nigeria.* African Economic Research Consortium (AERC).

Alenoghena, I. O., Isah, E. C., & Isara, A. R. (2016). Availability and type of human resource for health in public primary health care facilities in selected communities, Edo State. *Journal of Community Medicine and Primary Health Care, 28*(2), 11–18.

Bellew, R., & King, E. M. (1991). *Promoting girls' and women's education* (Policy Research and External Affairs Working Paper No. 715). World Bank.

Chaabouni, S., & Mbarek, M. B. (2024). What will be the impact of the COVID-19 pandemic on human capital and economic growth? Evidence from the Eurozone. *Journal of the Knowledge Economy, 15*(1), 2482–2498. https://doi.org/10.1007/s13132-023-01328-3

Chete, L. N., & Adeoye, B. W. (2019). Human capital and economic growth: The Nigerian experience. In *Human resource development in Africa: Selected papers for the 2018 annual conference of the Nigerian Economic Society* (pp. 79–102). Nigerian Economic Society.

Dahmani, M., & Mabrouki, M. (2025). Human capital, innovation, governance and economic growth in resource-rich and resource-poor MENA countries: New evidence from the CS-ARDL approach. *Journal of the Knowledge Economy, 16*(5), 16152–16186. https://doi.org/10.1007/s13132-024-02408-8

Duan, C., Zhou, Y., Cai, Y., Gong, W., Zhao, C., & Ai, J. (2022). Investigate the impact of human capital, economic freedom and governance performance on the economic growth of the BRICS. *Journal of Enterprise Information Management, 35*(4–5), 1323–1347. https://doi.org/10.1108/JEIM-04-2021-0179

Etete, U. B. (2026). Reimagining education in Nigeria: A curriculum-based approach to reducing out-of-school children. *Rivers State University Educational Foundations Journal, 1*(1), 230–240.

Fofana, N. Z. F. (2001). Employment and economic growth in the Côte d'Ivoire: An analysis of structural determinants. *African Development Review, 13*(1), 98–113. https://doi.org/10.1111/1467-8268.00032

Fukao, K., Makino, T., & Settsu, T. (2021). Human capital and economic growth in Japan: 1885–2015. *Journal of Economic Surveys, 35*(3), 710–740. https://doi.org/10.1111/joes.12419

Henderson, V., Storeygard, A., & Weil, D. N. (2011). A bright idea for measuring economic growth. *American Economic Review, 101*(3), 194–199. https://doi.org/10.1257/aer.101.3.194

Jemiluyi, O. O., & Jeke, L. (2024). The role of human capital development in the urbanization–economic growth nexus: A new insight on Nigeria. *Sustainable Futures, 8*, 100266. https://doi.org/10.1016/j.sftr.2024.100266

Kraay, A. (2019). The World Bank human capital index: A guide. *The World Bank Research Observer, 34*(1), 1–33. https://doi.org/10.1093/wbro/lkz001

Kripfganz, S., & Schneider, D. C. (2023). ardl: Estimating autoregressive distributed lag and equilibrium correction models. *The Stata Journal, 23*(4), 983–1019. https://doi.org/10.1177/1536867X231212434

Manuelli, R. E., & Seshadri, A. (2014). Human capital and the wealth of nations. *American Economic Review, 104*(9), 2736–2762. https://doi.org/10.1257/aer.104.9.2736

Martin, C. (2023). Skill-building or unskilled labour for female youth: A Bauchi case. In *Female and male in West Africa* (pp. 223–235). Routledge.

Matousek, R., & Tzeremes, N. G. (2021). The asymmetric impact of human capital on economic growth. *Empirical Economics, 60*(3), 1309–1334. https://doi.org/10.1007/s00181-019-01789-z

Mincer, J. (1958). Investment in human capital and personal income distribution. *Journal of Political Economy, 66*(4), 281–302. https://doi.org/10.1086/258055

Odusola, A. F. (2021). Human capital investment and the empirics of economic growth in Nigeria. In *Rekindling investment for economic development in Nigeria: Selected papers for the annual conference of the Nigerian Economic Society*. Nigerian Economic Society.

Ogbu, E. (2019). Migration and the philosophy of brain drain in Nigeria. *Journal of African Studies and Sustainable Development, 2*(4), 44–60.

Opoku, E., Poku, K., & Domeher, D. (2024). Financial inclusion, human capital development and economic growth in Africa: An examination of the transmission channel. *SAGE Open, 14*(3), 21582440241271285. https://doi.org/10.1177/21582440241271285

Orlando, G., Sportelli, M., & Rossa, F. D. (2021). The Harrod model. In *Nonlinearities in economics: An interdisciplinary approach to economic dynamics, growth and cycles* (pp. 177–189). Springer. https://doi.org/10.1007/978-3-030-70982-2_13

Paudel, R. C. (2023). Capital expenditure and economic growth: A disaggregated analysis for Nepal. *Cogent Economics & Finance, 11*(1), 2191449. https://doi.org/10.1080/23322039.2023.2191449

Qamruzzaman, M., Jianguo, W., Jahan, S., & Yingjun, Z. (2021). Financial innovation, human capital development, and economic growth of selected South Asian countries: An application of the ARDL approach. *International Journal of Finance & Economics, 26*(3), 4032–4053. https://doi.org/10.1002/ijfe.2003

Rajab, B., & Zouheir, A. (2024). Complementarity relationship between foreign direct investment, human capital threshold and economic growth: State of the 15 least developed African countries. *Journal of the Knowledge Economy, 15*(2), 7216–7236. https://doi.org/10.1007/s13132-023-01314-9

Romer, P. M. (1994). The origins of endogenous growth. *Journal of Economic Perspectives, 8*(1), 3–22. https://doi.org/10.1257/jep.8.1.3

Sarwar, A., Khan, M. A., Sarwar, Z., & Khan, W. (2021). Financial development, human capital and its impact on economic growth of emerging countries. *Asian Journal of Economics and Banking, 5*(1), 86–100. https://doi.org/10.1108/AJEB-06-2020-0015

Son, H. H. (2010). Human capital development. *Asian Development Review, 27*(2), 29–56. https://doi.org/10.1142/S0116110510500083

Suparman, S., & Muzakir, M. (2023). Regional inequality, human capital, unemployment, and economic growth in Indonesia: Panel regression approach. *Cogent Economics & Finance, 11*(2), 2251803. https://doi.org/10.1080/23322039.2023.2251803

Sultana, T., Dey, S. R., & Tareque, M. (2022). Exploring the linkage between human capital and economic growth: A look at 141 developing and developed countries. *Economic Systems, 46*(3), 101017. https://doi.org/10.1016/j.ecosys.2022.101017

Wirajing, M. A. K., Nchofoung, T. N., & Etape, F. M. (2023). Revisiting the human capital–economic growth nexus in Africa. *SN Business & Economics, 3*(7), 115. https://doi.org/10.1007/s43546-023-00494-5

Yang, X. (2020). Health expenditure, human capital, and economic growth: An empirical study of developing countries. *International Journal of Health Economics and Management, 20*(2), 163–176. https://doi.org/10.1007/s10754-019-09275-w

Yormirzoev, M. (2023). Human capital and economic growth in Central Asia. *Post-Communist Economies, 35*(6), 533–545. https://doi.org/10.1080/14631377.2023.2196872

Zhang, Y., Kumar, S., Huang, X., & Yuan, Y. (2023). Human capital quality and regional economic growth: Evidence from China. *Journal of Asian Economics, 86*, 101593. https://doi.org/10.1016/j.asieco.2023.101593

Information about the authors

Iya Abershi Musa – PhD Candidate, Nile University of Nigeria, Abuja FCT, Nigeria, email: 20233611@nileuniversity.edu.ng

Sarah Anyanwu – Professor of Economics, Nile University of Nigeria, Abuja FCT, Nigeria, email: sarahanyanwu2003@yahoo.com

***Peterson K. Ozili** – Senior Economist, Central Bank of Nigeria, email: petersonkitakogelu@yahoo.com, ORCID ID: https://orcid.org/0000-0001-6292-1161

Авторлар туралы мәліметтер

Муса И.А.– PhD докторанты, Нигерияның Ніл университеті, Абуджа, Федералды митрополит аумағы, Нигерия, email: 20233611@nileuniversity.edu.ng

Аньянву С.И. – экономика профессоры, Нигерияның Ніл университеті, Абуджа, Федералды митрополит аумағы, Нигерия, email: sarahanyanwu2003@yahoo.com

***Озили П.К.** – аға экономист, Нигерияның Орталық Банкі, Абуджа, федералды астаналық территория, Нигерия, email: petersonkitakogelu@yahoo.com, ORCID ID: https://orcid.org/0000-0001-6292-1161

Сведения об авторах

Муса И.А. – PhD докторант, Нильский университет Нигерии, Абуджа, Федеральная столичная территория, Нигерия,, email: 20233611@nileuniversity.edu.ng

Аньянву С.И. – профессор по экономике, Нигерияның Ніл университеті, Абуджа, Федералды митрополит аумағы, Нигерия, email: sarahanyanwu2003@yahoo.com

***Озили П.К.** – старший экономист, Центральный банк Нигерии, Абуджа, Федеральная столичная территория, Нигерия, email: petersonkitakogelu@yahoo.com, ORCID ID: https://orcid.org/0000-0001-6292-1161

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-21-38
МРНТИ 06.73.15
JEL: E52, I32, G01

Check for updates
BY-NC 4.0

Monetary Policy and Its Impact on Consumer Spending and Poverty in Kazakhstan

Aliya B. Mukhamediyeva[a], Azimzhan A. Khitakhunov[b], Zhansaya S. Temerbulatova[a], Assem Ye. Kaliyeva[c]*

[a] Almaty Management University, 227 Rozybakiyev str., Almaty, Kazakhstan; [b] Central Asian Policy Studies, 111a Zheltoksan str., Almaty, Kazakhstan; [c] Al-Farabi Kazakh National University, 71 Al-Farabi ave., Almaty, Kazakhstan

For citation: Mukhamediyeva, A.B., Khitakhunov, A.A., Temerbulatova, Zh.S. & Kaliyeva, A.Ye. (2026). Monetary Policy and Its Impact on Consumer Spending and Poverty in Kazakhstan. Economy: strategy and practi ce, 21(1), 21-38. htt ps://doi.org/10.51176/1997-9967-2026-1-21-38

ABSTRACT

Given the high external volatility and structural vulnerability of the Kazakh economy, there is an increasing need to assess the macroeconomic and social effects of monetary policy. The purpose of this study is to study the relationship between monetary policy, consumer demand, poverty and income inequality in Kazakhstan during the crisis and post-crisis periods. The empirical analysis is based on quarterly macroeconomic data for 2006-2023 and annual social indicators for 2001-2023. Time series models with lag structures and multiple linear regression were used to evaluate transmission mechanisms. The results show that an increase in the base rate has a statistically significant disinflationary effect with a lag of two quarters (coefficient -0.059; $p < 0.01$) and reduces economic growth with a lag of three quarters (coefficient -0.030; $p < 0.01$). Economic growth has a positive effect on consumption (coefficient 1,093; $p < 0.05$), while inflation has a restraining effect (coefficient -0.871; $p < 0.10$). The results obtained indicate that the influence of monetary policy on social indicators is mainly indirect and is implemented through the channels of inflation, economic growth and income dynamics, which justifies the need for coordination of monetary and fiscal instruments to achieve the goals of inclusive development. The findings of this study provide policy makers with valuable information for developing a balanced monetary policy that simultaneously ensures macroeconomic stability and promotes inclusive social development.

KEYWORDS: Consumer Demand, Base Rate, Economic Growth, Inflation, Poverty, Income Inequality, Macroeconomic Stability, Financial Strategy

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT. This study was funded by the National Bank of the Republic of Kazakhstan (a scientific project on the topic “Consumer demand in the post-crisis period (international and Kazakhstani experience)”.

Article history:
Received 25 September 2025
Accepted 14 February 2026
Published 30 March 2026

*** Corresponding author: Kaliyeva A.Ye.** - PhD, Associate Research Professor, Al-Farabi Kazakh National University, 71 Al-Farabi ave., Almaty, Kazakhstan, 87019889668, email: assemkalieva@gmail.com

Денежно-кредитная политика и её влияние на потребительские расходы и бедность в Казахстане

Мухамедиева А.Б.[a], Хитахунов А.А.[b], Темербулатова Ж.С.[a], Калиева А.Е.[c]*

[a] Алматы Менеджмент Университет, ул. Розыбакиева 227, Алматы, Казахстан; [b] Central Asian Policy Studies, ул. Желтоксан 111а, Алматы, Казахстан; [c] Казахский национальный университет им. аль-Фараби, пр. аль-Фараби 71, Алматы, Казахстан

Для цитирования: Мухамедиева А.Б., Хитахунов А.А., Темербулатова Ж.С., Калиева А.Е. (2026). Денежно-кредитная политика и её влияние на потребительские расходы и бедность в Казахстане. Экономика: стратегия и практика, 21(1), 21-38. https://doi.org/10.51176/1997-9967-2026-1-21-38

АННОТАЦИЯ

В условиях высокой внешней волатильности и структурной уязвимости экономики Казахстана возрастает необходимость оценки макроэкономических и социальных эффектов денежно-кредитной политики. Целью данного исследования является изучение взаимосвязи между денежно-кредитной политикой, потребительским спросом, бедностью и неравенством доходов в Казахстане в кризисный и посткризисный периоды. Эмпирический анализ основан на квартальных макроэкономических данных за 2006–2023 гг. и годовых социальных показателях за 2001–2023 гг. Для оценки трансмиссионных механизмов использованы модели временных рядов с лаговыми структурами и множественная линейная регрессия. Результаты показывают, что рост базовой ставки оказывает статистически значимое дезинфляционное воздействие с лагом два квартала (коэффициент −0,059; $p < 0,01$) и снижает темпы экономического роста с лагом три квартала (коэффициент −0,030; $p < 0,01$). Экономический рост положительно влияет на потребление (коэффициент 1,093; $p < 0,05$), тогда как инфляция оказывает сдерживающее воздействие (коэффициент −0,871; $p < 0,10$). Полученные результаты свидетельствуют о том, что влияние денежно-кредитной политики на социальные показатели носит преимущественно косвенный характер и реализуется через каналы инфляции, экономического роста и доходной динамики, что обосновывает необходимость координации монетарных и фискальных инструментов для достижения целей инклюзивного развития. Выводы данного исследования предоставляют политикам ценную информацию для разработки сбалансированной денежно-кредитной политики, которая одновременно обеспечивает макроэкономическую стабильность и способствует инклюзивному социальному развитию.

КЛЮЧЕВЫЕ СЛОВА: потребительский спрос, базовая ставка, экономический рост, инфляция, бедность, неравенство доходов, макроэкономическая стабильность, финансовая стратегия

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ. Исследование было профинансировано Национальным банком Республики Казахстан (научный проект на тему «Потребительский спрос в посткризисный период (международный и казахстанский опыт)»).

История статьи:
Получено 25 сентября 2025
Принято 14 февраля 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Калиева А.Е.** – PhD, доцент-исследователь, Казахский национальный университет им. аль-Фараби, пр. аль-Фараби 71, Алматы, Казахстан, 87019889668, email: assemkalieva@gmail.com

INTRODUCTION

During periods of economic instability, monetary policy plays a central role in macroeconomic regulation by influencing inflation, economic activity, and financial conditions. Changes in the base rate affect aggregate demand through transmission channels such as credit availability, investment activity, and household consumption. As a result, monetary policy decisions have important implications for macroeconomic stabilization.

Kazakhstan represents a relevant case for studying these mechanisms. As an emerging, commodity-dependent economy, it is highly exposed to external shocks, including global financial crises, oil price fluctuations, and pandemic-related disruptions. Over the past two decades, the country has experienced several major crisis episodes – notably the global financial crisis of 2008–2009, the oil price shock of 2014–2016, and the COVID-19 pandemic of 2019–2021 – which have significantly affected inflation dynamics, economic growth, consumer demand, and household incomes.

Despite a broad international literature on monetary policy transmission, existing studies predominantly focus on developed economies and emphasize macroeconomic outcomes such as inflation and output. Far less attention has been paid to the social dimension of monetary policy, particularly in emerging economies, where poverty and income inequality persist. Moreover, the indirect nature of monetary transmission complicates the identification of the channels through which changes in the policy rate ultimately affect household welfare.

The objective of this study is to examine the relationship between monetary policy, consumer demand, poverty, and income inequality in Kazakhstan during the crisis and post-crisis periods. The analysis focuses on the impact of the base rate on inflation, economic growth, household income dynamics, and distributional outcomes, with particular attention to indirect transmission channels.

This study contributes to the existing literature by providing a comprehensive empirical assessment of the social effects of monetary policy in Kazakhstan. Unlike previous research focused on inflation or output, this paper explicitly links changes in interest rates to poverty and inequality indicators. The analysis employs a combined-frequency data approach, integrating quarterly macroeconomic variables with annual social indicators, allowing for the identification of lagged monetary transmission effects and longer-term social impacts.

To address these objectives, the following research questions are examined:

RQ1. How does monetary policy, reflected in changes in the base rate, affect inflation, economic growth, and consumer spending in Kazakhstan during crisis and post-crisis periods?

RQ2. Is the effect of monetary policy on consumer demand primarily direct or mediated through macroeconomic variables?

RQ3. To what extent do changes in the base rate influence poverty and income inequality through indirect transmission mechanisms?

LITERATURE REVIEW

International experience indicates that crises have different effects on demand dynamics. Global financial crises have a negative impact on key macroeconomic indicators such as GDP, employment, and inflation, which in turn have a direct impact on consumer demand. Lee et al. (2010) argued that household consumption in the US fell sharply in late 2008 amid the deepening financial crisis. Personal consumption expenditure, which exceeded 95% of disposable personal income in 2005, fell below 92% by the second quarter of 2009. Consistent with these findings, Konstantinou & Corsetti (2009) showed that consumption in the US responds only to permanent shocks. In contrast, temporary fluctuations are fully smoothed out, including through external borrowing and lending.

These studies are also supported by the work of Gerlach-Kristen et al. (2013), who found that during a financial crisis, household consumption declines due to reduced permanent income, credit constraints, and liquidity constraints. Consumption growth slows during banking crises and post-credit boom crises. High interest rates on debt depress consumption growth in both normal and crisis periods. Building on this theme, Gerlach-Kristen and Merola (2019) estimated a DSGE model, showing that highly indebted households smooth their consumption less during a crisis.

The impact of crises also extends to the labor market. Financial crises have a significant negative impact on employment and income levels, which, in turn, has a noticeable effect on consumer demand.

In this context, Ganong and Noel (2019) used bank account data to find that consumer demand is highly dependent on the level of unemployment benefits and falls sharply when they are reduced. Job search also appears to be sensitive to the level of social support. An important finding of this study is that households do not increase their debt levels during periods of unemployment, thereby reinforcing the role of fiscal stabilisers. The role of public policy is particularly evident during a pandemic. Santacreu et al. (2022) analyzed the role of fiscal policy during a pandemic, emphasizing that stimulus measures can create an imbalance between demand and supply. In turn, Vavra and Berger (2014) demonstrated that stimulus measures have an uneven impact on consumption across the business cycle, with the response of spending to stimulus significantly weaker during recessions.

Chen et al. (2021) demonstrated that offline consumption in China declined by more than RMB 1.2 trillion within three months of the pandemic's onset. As Watanabe (2020) noted, unlike natural disasters, the pandemic has a greater impact on demand than on supply, making consumption-stimulating policies particularly relevant. At the macro level, Farhi & Rezza Baqaee (2020) showed that aggregate demand shocks during the pandemic exert deflationary pressure and reduce both real and nominal GDP. Cerrato and Gitti (2023) found that approximately a quarter of the post-pandemic inflation increase was attributable to demand rather than supply factors.

Continuing with the behavioural aspects, Pistaferri and Jappelli (2010) emphasised that consumption responds more strongly to permanent than to temporary income changes, and that perceptions of the nature of fiscal policy significantly affect its effectiveness. The importance of targeted fiscal stimulus in a liquidity-constrained environment is confirmed by Corsetti et al. (2015) and Surico & Andreolli (2019). Their studies show that temporary transfers are more effective when targeted at groups with limited savings and a high propensity to consume.

Another important channel is changes in asset prices. Aruoba et al. (2022) and De Nardi et al. (2011) highlighted the importance of asset price changes (including housing and stocks) for consumption. They show that a fall in asset prices directly reduces household spending, especially under fiscal constraints.

The effects of crises also alter the distribution of consumption across population segments. Meyer and Sullivan (2013) showed that income inequality increased throughout the period from 2000 to 2011, while consumption inequality decreased in the second half of this period. This suggests a significant redistribution of spending across income groups. In terms of behavioral responses to shocks, Hodbod et al. (2021) highlighted that changes in preferences and saving behavior have driven the persistent decline in spending. In support of this, Christelis et al. (2020) and Muellbauer (2020) highlighted the impact of employment instability and limited access to credit as key drivers of the short-term decline in consumption.

An interesting contribution to the literature is made by Kaplan et al. (2014), who reconsidered the role of the "wealthy hand-to-mouth poor". These households, despite having assets, live paycheck to paycheck and exhibit high income sensitivity in consumption. Their response to shocks is similar to that of poor households, making them an important target group for demand-side policies.

The National Bank of Kazakhstan conducted a study to identify the impact of macroeconomic indicators on consumer demand. It was found that a long-term relationship exists between consumer demand and all significant macroeconomic variables, except for the economically active population. Factor regression and VAR models were used to estimate the parameters (Zhuzbayev & Seidakhmetova, 2019).

Empirically, monetary transmission is often studied using VAR-based impulse responses; however, alternative approaches, such as local projections, can provide greater robustness to model misspecification and are increasingly used in cross-country EMDE settings. Recent evidence from emerging markets indicates that monetary tightening reduces output growth and inflation once exchange-rate responses are properly accounted for, and highlights that institutional frameworks may matter more than financial depth for the strength of transmission (Jordà, 2005; Mishra et al., 2012; Aleem, 2010).

Thus, international experience confirms that changes in monetary policy via the base rate affect consumption dynamics, particularly during crisis and post-crisis periods. A standard framework for understanding monetary policy transmission emphasizes that the interest-rate channel is often rein-

forced by financial frictions operating through the credit channel. In particular, informational frictions in credit markets amplify the real effects of policy tightening through changes in the external finance premium and borrowers' net worth, thereby strengthening the balance-sheet and bank-lending channels. These mechanisms are central to the "credit channel" interpretation and the financial accelerator framework widely used in modern macro-finance (Bernanke & Gertler, 1995; Bernanke et al., 1999).

Recent empirical literature increasingly emphasizes the heterogeneous and distributional effects of monetary policy, particularly in emerging and developing economies. Furceri et al. (2018) provided cross-country evidence that contractionary monetary policy shocks tend to increase income inequality in both advanced and emerging economies, primarily through labour income and employment channels. Their findings suggest that tighter monetary conditions disproportionately affect lower-income households. At the microeconomic level, Coibion et al. (2017) demonstrated that monetary tightening reduces earnings and employment opportunities for lower-skilled workers more strongly than for high-income groups, reinforcing income dispersion. These results highlight the indirect welfare consequences of interest rate adjustments through labor market transmission.

Financial and institutional conditions further shape the strength of monetary transmission. Aastveit et al. (2017) showed that the effects of monetary policy on output and consumption are amplified during periods of heightened economic uncertainty, a feature particularly relevant for crisis-prone emerging economies. Complementing this perspective, Harjes et al. (2020) document that monetary policy transmission in EMDEs is influenced more by institutional credibility and financial frictions than by financial depth alone, with weaker frameworks leading to stronger real contractions following policy tightening. Synthesizing recent empirical evidence, Xiang (2023) concludes that monetary policy shocks systematically affect income inequality, with contractionary measures generally increasing inequality in the short to medium term, especially in economies with limited social protection and high labor income dependence. Overall, these studies indicate that monetary policy influences household welfare primarily through indirect macroeconomic channels – including employment, income dynamics, and financial constraints – rather than through direct consumption responses. This evidence underscores the importance of incorporating distributional outcomes into analyses of monetary transmission, particularly in emerging market contexts.

Despite the wide range of international studies on the macroeconomic and social effects of financial crises, the literature still lacks a comprehensive empirical analysis of the transmission mechanisms through which monetary policy, especially changes in the base rate, affects consumer demand, poverty, and income inequality in emerging economies. Evidence for emerging and developing economies suggests that institutional constraints, dollarization, limited financial depth, and low credibility of monetary authorities may weaken monetary transmission. These features can distort conventional channels and shift the relative importance toward the exchange-rate and bank-lending mechanisms. Therefore, empirical identification in EMDE settings should explicitly account for such structural characteristics when interpreting estimated policy effects (Mishkin, 2004; Harjes et al., 2020)

Most prior research focuses either on developed countries or isolates individual channels, such as inflation or unemployment, without integrating their indirect social implications. For Kazakhstan, in particular, there is a notable gap in understanding how monetary policy interacts with structural vulnerabilities – such as commodity dependence and weak social safety nets – to shape both economic and social outcomes during crisis and recovery periods. This study seeks to bridge this gap by providing a detailed empirical assessment of how monetary policy influences consumer behaviour and social inequality in Kazakhstan over an extended period spanning multiple crisis episodes.

METHODOLOGY

To analyze the impact of monetary policy on consumer demand, poverty and inequality in Kazakhstan, data from official statistical sources were used. Data availability constitutes an important constraint of the empirical analysis. Official statistics on poverty and income inequality in Kazakhstan have been available only since 2001 and are reported annually. As a result, the analysis of social indicators is necessarily limited to the period 2001–2023, while macroeconomic variables are examined using quarterly data for the period 2006–2023.

Despite this limitation, the available time span is sufficient to meet the study's objectives and the applied econometric framework. The sample includes multiple economic cycles and major crisis episodes, including the global financial crisis, the oil price shock, and the COVID-19 pandemic, thereby allowing the capture of both short- and medium-term transmission effects of monetary policy. Moreover, the use of parsimonious regression models mitigates potential issues related to sample size and degrees of freedom, ensuring the robustness and interpretability of the estimated relationships.

The main data were obtained from the National Bank of Kazakhstan, the Bureau of National Statistics of Kazakhstan and international financial organizations such as the International Monetary Fund and the World Bank. The variables used to assess the impact of the base rate on inflation, GDP, and consumer spending are shown in Table 1.

Table 1. Variables used in assessing the impact of the base rate on inflation, GDP and consumer spending

Variable	Designation	Description
Base Rate, Log	LINTBASE	Base Rate of the National Bank of Kazakhstan (policy interest rate) – the main monetary policy instrument of the National Bank of Kazakhstan used to regulate credit conditions and influence inflation.
Gross Domestic Product, Log	LGDP	An indicator of economic activity that reflects the volume of goods and services produced.
Consumer Spending, Log	LCONSH	The total volume of household expenditure is an important indicator of well-being.
Consumer Price Index, Log	LCPI	Measures the level of inflation
Investment, Log	LINVEST	The volume of capital investment in the economy
World Oil Price, Log	LPOIL	The price of oil on the world market
Savings, Log	LSAVE	Funds set aside by households for future expenses

Note: compiled by the authors

The analysis covers the period from 2006 to 2023 at quarterly frequency, allowing for the short-term effects of monetary policy changes and seasonal fluctuations. The study examined the impact of consumer spending on poverty and income inequality using annual data from 2001 to 2023, as quarterly data were not available. The variables used in the analysis are presented in Table 2.

Table 2. Variables used in the study of the impact of consumer spending on poverty and income inequality

Variable	Designation	Description
Household final consumption expenditure, logarithm	LCONSH	Total household expenditure is an important indicator of living standards
Real gross domestic product, logarithm	LRGDP	Total output of goods and services in real terms
Real gross capital formation, logarithm	LRSAVE	Amount of accumulated savings adjusted for inflation
Share of population with incomes below the subsistence minimum	BELOWSL	Share of population living below the poverty line
Real income used for consumption on average per capita per month, logarithm	LRINCOMEPCPC	Average real income per capita
Gini index by decile groups	GINI10	Measure of economic inequality in income distribution
Poverty depth	POVDEPTH	Measure of the extent of poverty in a society
Poverty severity	POVSEVERITY	Measure of extreme poverty among the most vulnerable groups of the population

Note: compiled by the authors

Before building econometric models, the data were tested for stationarity using the Dickey-Fuller (ADF) test to identify unit roots. To stabilize variance and eliminate long-term trends, the variables were logarithmized, and for integrated variables, their first differences were used. All continuous variables are transformed to the log scale to stabilise variance and reduce the influence of extreme values. For non-stationary variables, first differences of logarithms (Δlog) are used in the estimations. This transformation allows the coefficients to be interpreted as approximate growth rates, which is particularly suitable for analyzing macroeconomic dynamics and policy transmission mechanisms. In addition, using Δlog variables mitigates the risk of spurious regression and ensures consistency of the estimated relationships over time.

Although vector autoregression (VAR) and vector error-correction (VECM) frameworks are widely used in the literature to analyze monetary policy transmission, their application in this study is constrained by several data-related considerations. First, the analysis combines quarterly macroeconomic variables with annual social indicators (poverty and inequality measures), thereby significantly reducing the effective sample size and rendering joint estimation of multivariate dynamic systems unreliable. Second, unit root and cointegration tests indicate heterogeneous integration properties across variables and do not provide robust evidence in favor of a stable cointegration rank for the full set of variables required for a VECM specification. Third, the relatively short time dimension for social indicators reduces the degrees of freedom and increases the risk of overparameterization in VAR-type models. Given these limitations, the study employs parsimonious multiple linear regression (MLR) models with lagged explanatory variables, which enable transparent identification of direct and indirect transmission channels of monetary policy while ensuring statistical robustness and interpretability of the estimated coefficients.

To build econometric models, data preprocessing was also performed, including the elimination of outliers, the assessment of autocorrelation and heteroscedasticity, and the use of robust standard errors to improve the reliability of the estimates. Data on income and consumer spending were also examined for seasonal effects that could distort the analysis results.

The study employed time-series models with log-transformed variables, including autoregressive models. In the models with quarterly data, the dependent variables were ΔLCPI – the inflation rate, ΔLGDP – the growth rate of gross domestic product, and Δ LCONSH – the growth rate of consumer spending, while in the models with annual data, BELOWSL – the share of the population with incomes below the subsistence minimum, GINI10 – the Gini index by decile groups, POVDEPTH – the depth of poverty, and POVSEVERITY – the severity of poverty. As independent variables, we tested different sets of the variables listed in Tables 1 and 2, as well as their values with lags from one to three.

Overall, the chosen specification balances methodological rigor with data constraints and allows for a clear interpretation of monetary policy effects on macroeconomic and social indicators.

RESULTS

This section presents the empirical findings on the transmission of monetary policy to macroeconomic and social outcomes in Kazakhstan. The analysis proceeds in three stages. First, the dynamic relationship between the base rate and key macroeconomic indicators – namely inflation, economic growth, and consumer spending – is examined using quarterly time-series regressions with lagged effects. Second, the indirect influence of monetary policy on household welfare is assessed by examining the relationships among consumer spending, income dynamics, poverty, and income inequality, using annual data. Finally, the results are interpreted in the context of crisis and post-crisis periods to highlight the temporal structure of monetary transmission. Together, these estimates provide evidence on both the effectiveness of interest-rate policy in stabilizing macroeconomic conditions and its predominantly indirect role in shaping social outcomes.

The dynamics of the base rate in Kazakhstan for 2015-2024 are presented in Figure 1.

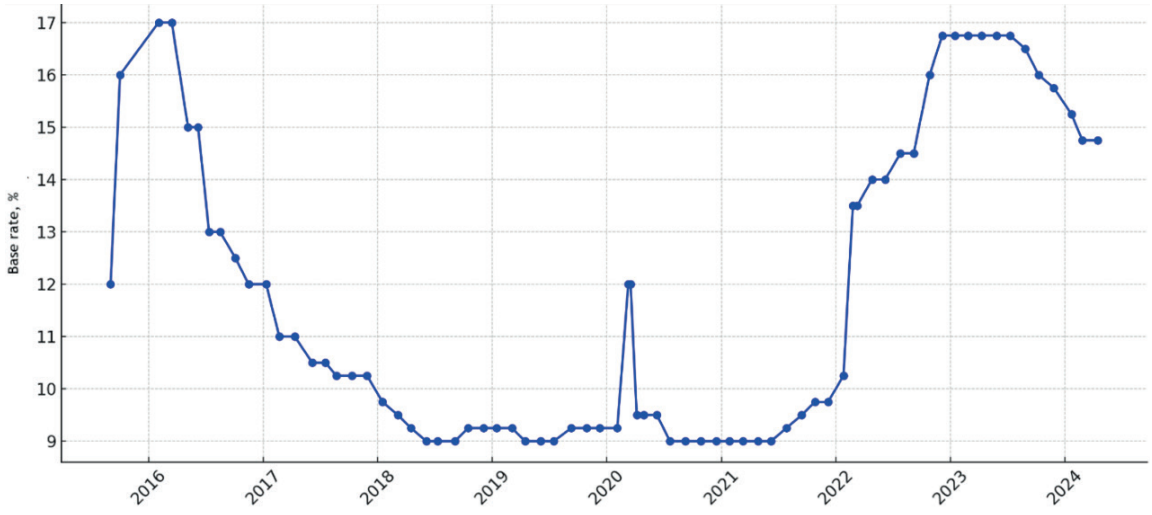


Figure 1. Schedule of decisions on the base rate 2015–2024

This period encompasses two major crises: the decline in global oil prices and the COVID-19 pandemic. Kazakhstan, a country heavily dependent on oil exports, experienced a sharp decline in global oil prices beginning in 2014. This decline threatened budget revenues and overall economic stability. In response to economic shocks and falling oil revenues, the Kazakhstani tenge experienced a significant depreciation. In order to stabilize the national currency and contain inflation expectations, the National Bank increased the base rate. As shown in Figure 1, the base rate increased from 12% in 2015 to 16% in 2016 and then to 17%. The devaluation of the national currency led to higher domestic prices, particularly for imported goods, thereby contributing to inflation. The increase in the rate during this period was intended to control inflation and limit the loss of purchasing power among the population.

Following the transition to a floating exchange rate in 2015, the tenge remained under pressure, necessitating stronger monetary policy to protect the national currency and combat inflation. The ongoing devaluation of the tenge has fueled inflation expectations, necessitating a policy tightening by the central bank to prevent price increases and maintain price stability. In the context of economic instability and declining investment activity, it became important to maintain a balance between stabilization measures and the need to stimulate economic growth. In early 2016, the rate was raised to 17% and maintained at this level to contain inflation and stabilize the currency. By mid-2016, as strong pressure gave way to stabilization, the bank cut the rate to 15%. This was done to ease pressure on the economy, reduce borrowing costs, and stimulate business activity and consumption. The rate cut in the second half of the year increased the availability of lending for businesses and individuals, which is important for the recovery of economic activity and consumer demand.

From 2017 to 2019, the National Bank of Kazakhstan continued its policy of gradually reducing interest rates, which was part of the strategy to restore economic growth and stimulate investment activity in the post-crisis period. Following significant declines in oil prices in previous years, prices gradually recovered beginning in 2017, which had a positive impact on Kazakhstan's economy, increasing government revenues and improving the trade balance. With improvements in foreign trade terms and the measures taken, the tenge has become more stable. This reduced inflationary pressures, allowing the National Bank to lower interest rates without incurring a significant risk of destabilising the foreign exchange market. The country was gradually emerging from economic stagnation, which also encouraged the central bank to ease monetary policy to support further growth. The base rate was gradually reduced to 9% during this period.

Improved access to credit stimulated consumer spending, thereby supporting domestic demand and contributing to economic growth. The increase in the base rate to 12% in March 2020 was a comprehensive response to several challenges facing

the Kazakh economy at the onset of the pandemic. This decision aimed to minimize the adverse effects of the pandemic's economic and financial shocks. However, already in April 2020, the National Bank reduced the base rate to support businesses, especially small and medium-sized ones, and stimulate consumer spending. Additionally, during crises, economic liquidity becomes a crucial factor. Reducing interest rates increases the money supply in circulation, thereby providing businesses and the population with the necessary resources.

From July 2020 to July 2021, the base rate was kept at 9%. For many companies and households, the pandemic has increased the debt burden. Keeping the base rate low has helped reduce the cost of servicing existing debt, reducing the risk of defaults and bankruptcies.

After significantly cutting interest rates in previous years to support the economy during the COVID-19 pandemic, many countries have seen a sharp increase in inflation. Several factors caused this:

(1) As economies began to recover from pandemic restrictions, increased demand met with limited supply, which contributed to rising prices.

(2) The pandemic has severely disrupted global supply chains, leading to shortages of many goods and services and, as a result, higher prices.

(3) Rising prices for oil and other commodities have also fueled inflation.

The increase in the base rate from mid-2021 to mid-2023 was part of efforts to contain inflation and maintain economic stability amid a gradual post-pandemic recovery. Since August 2023, the base rate has been gradually declining, reaching 14.75% in April 2024. Reducing inflationary pressures reduces the need to maintain high interest rates to control it. Also, lower interest rates stimulate investment in the economy and the restoration of consumer demand. It is interesting to assess the impact of base rate fluctuations on poverty and inequality. A change in the base rate affects the economy through various channels, and its effects on inequality and poverty can vary significantly depending on current economic conditions, the labor market structure, and the availability of social programs.

Figure 2 illustrates the dynamics of the average annual base rate and the Gini coefficient in Kazakhstan from 2015 to 2023, enabling a visual assessment of changes in income inequality in relation to the monetary policy stance.

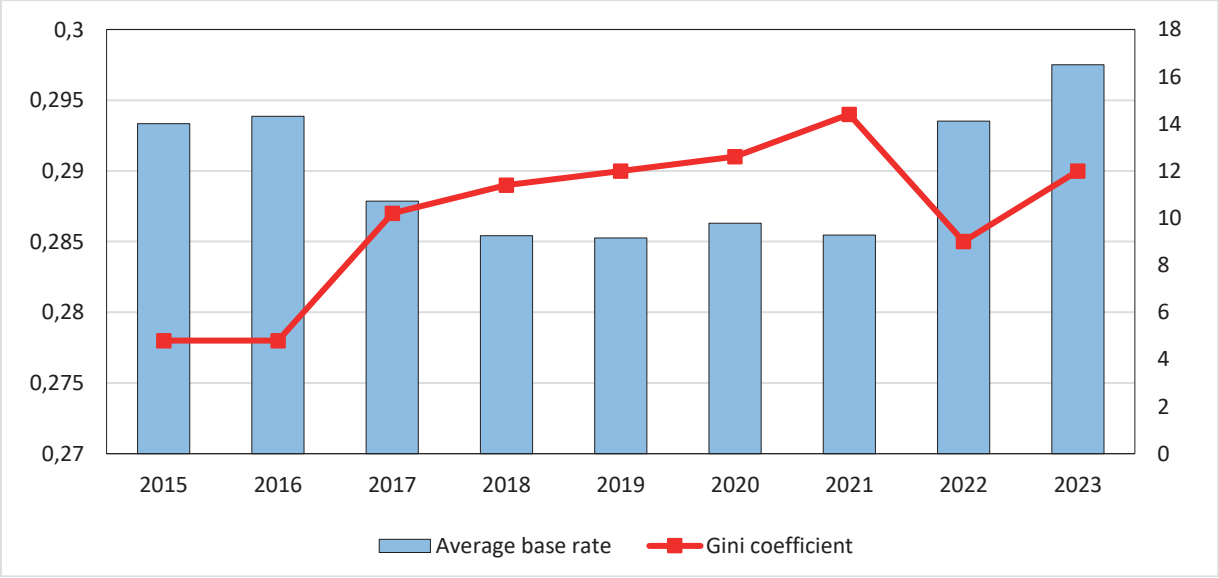


Figure 2. Dynamics of the average base rate and Gini coefficient in Kazakhstan

The Gini coefficient, which measures the level of economic inequality, remains relatively stable over the analyzed period, with a slight increase in 2020–2021. This increase coincided with the period after the COVID-19 pandemic, when the economy experienced significant shocks and the base rate fluctuated between 9.75% and 9%. In 2022 and 2023, when the base rate increased sharply to a maximum of

16.75%, the Gini coefficient initially declined and then returned to its previous level. This may indicate that the sharp increase in rates may have initially reduced inflation expectations and temporarily stabilized incomes at lower levels, but then inequality recovered as higher rates began to put pressure on economically vulnerable segments of the population.

Figure 3 presents the evolution of the average annual base rate and the poverty rate in Kazakhstan from 2015 to 2023, highlighting trends in poverty dynamics alongside fluctuations in the policy interest rate.

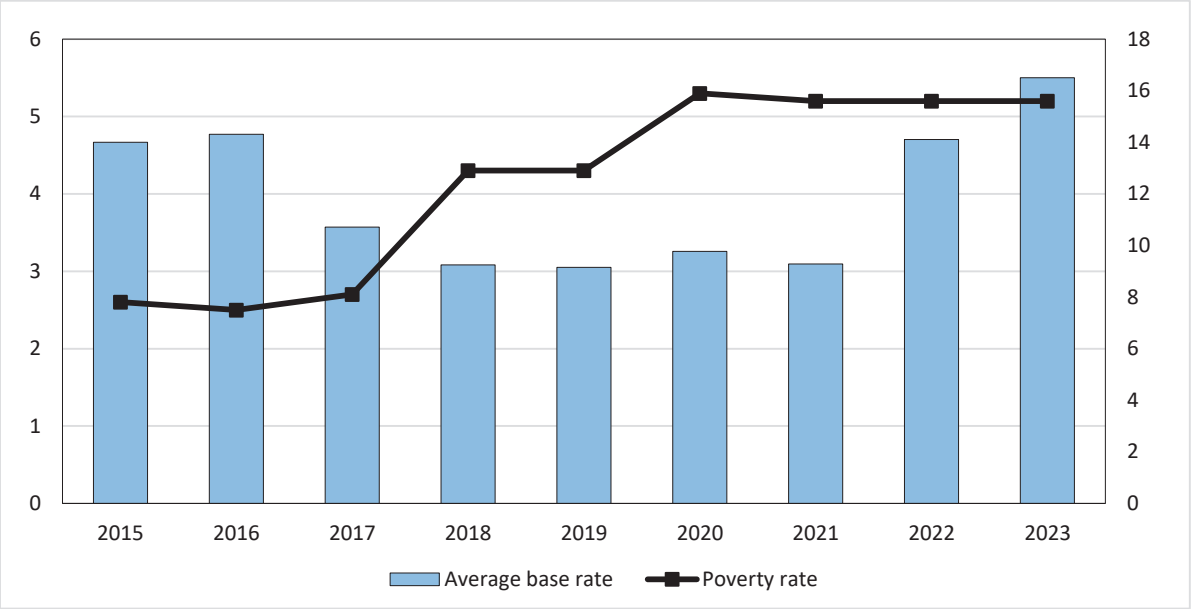


Figure 3. Dynamics of the average base rate and poverty rate in Kazakhstan

The poverty rate has been increasing noticeably since 2018, when the base rate was relatively low (9.25% and 9%). This may be because low rates did not generate sufficient economic growth or were unable to offset other economic problems, such as rising unemployment or declining income. From 2020 to 2023, despite an increase in the base rate, the poverty rate continued to rise, reaching 5.2% in 2023. This increase in the rate was intended to control inflation. Still, it could also increase economic pressure on people experiencing poverty by raising the cost of borrowing and reducing access to financial resources. Increasing the base rate is typically aimed at curbing inflation, which can quickly exacerbate the economic situation of low-income groups and exacerbate inequality. However, high rates can also slow economic growth and increase the cost of living, thereby raising the poverty rate.

At the same time, rate cuts aim to stimulate economic activity by making loans more affordable. Still, unless accompanied by appropriate fiscal stimulus or social programs, they may not yield the expected reductions in poverty or inequality. This highlights the complexity of the relationship between monetary policy and socioeconomic indicators such as inequality and poverty. The effectiveness of monetary policy in achieving social goals depends not only on the choice of instruments but also on the broader policy context and on the economy's structural factors. Therefore, quantitative assessments are necessary to determine the actual impact of monetary policy, as reflected in changes to the base rate, on inequality and poverty.

Figure 4, which shows the behavior of real values of household consumer spending, the base rate, gross domestic product, and the consumer price index during 2006–2023 in logarithmic terms, does not provide grounds for concluding the influence of the base rate on the remaining indicators.

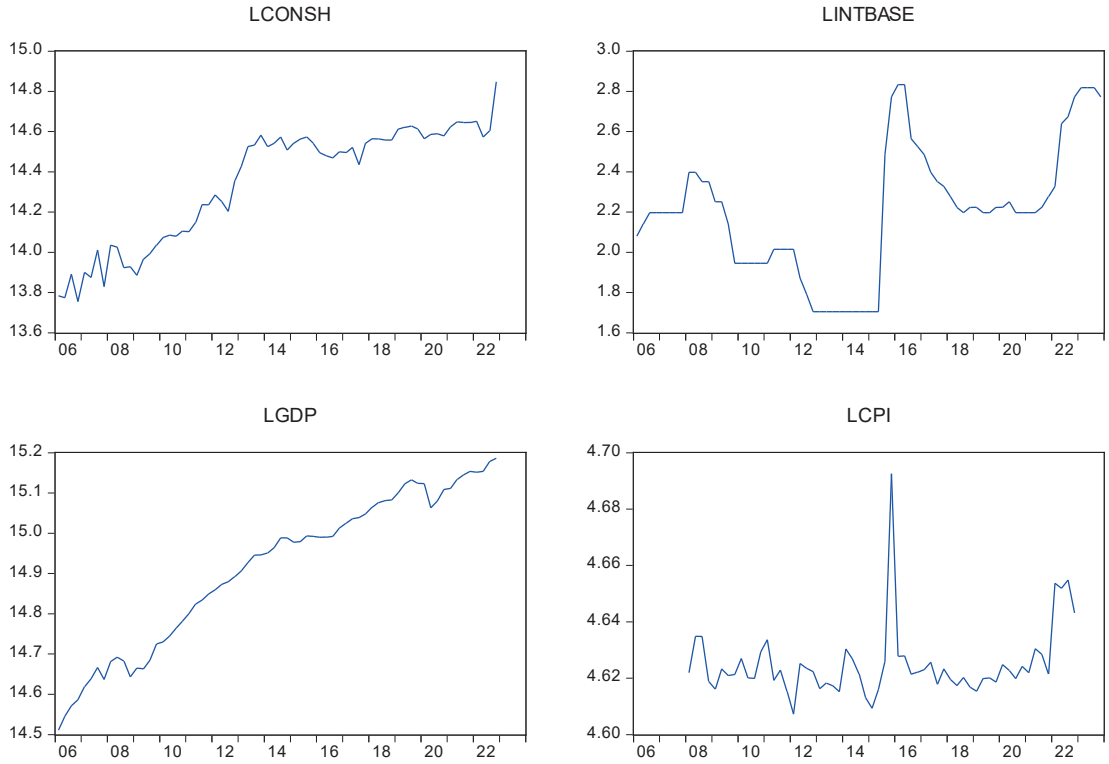


Figure 4. Logarithmic dynamics of key macroeconomic indicators

Therefore, econometric calculations were performed to draw conclusions based on quantitative estimates that accounted for all indicators. Their primary objective was to assess the impact of monetary policy on the macroeconomic indicators, particularly household consumption. The study of dependencies among indicators employed the least-squares method for multiple linear regression, based on quarterly data for Kazakhstan from 2006 to 2023. Since all indicators considered are integrated I(1), their first differences are used in the calculations (Table 3).

Table 3. Dependent variable Δ LCPI – the growth rate of the consumer price index

Independent variable	**Specifications**		
	(1)	**(2)**	**(3)**
ΔLCPI(-1)		-0.3691*** (0.0968)	-0.3122*** (0.0545)
ΔLINTBASE	0.0110** (0.0048)	0.0164*** (0.0060)	0.0166*** (0.0053)
ΔLINTBASE(-1)	0.0554*** (0.0177)	0.0575*** (0.0206)	0.0567*** (0.0204)
ΔLINTBASE(-2)	-0.0699*** (0.0238)	-0.0541** (0.0204)	-0.0593*** (0.0185)
ΔLINTBASE(-3)		-0.0098 (0.0111)	
ΔLINVEST(-1)		0.0098 (0.0116)	
Constant	0.00037 (0.00079)	0.00018 (0.00095)	
Number of observations	59	58	58

R-squared	0.50	0.58	0.57
DW	2.75	2.23	2.35
The last column of the table shows the robust standard errors of the coefficients. *** p < 0.01; ** p < 0.05.			

Note: compiled by the authors

The consequences of potential heteroscedasticity are accounted for. According to the estimates in all specifications of Table 3, the coefficients of the first difference of the base rate in the current quarter, as well as with a lag of 1 and 2 quarters, are statistically significant. Moreover, the coefficients of it in the current and previous quarters are positive, and the coefficient of the increment of the base rate with a lag of two quarters is negative. The impact of a change in the base rate, with a 3-quarter lag, on the inflation rate is insignificant. The result appears counterintuitive and can be explained by the fact that the base rate appears to be higher in the current quarter, when inflation growth is already observed, or in the previous quarter, when inflation growth is expected. However, the downward effect of the base rate on the inflation rate is effective only if its increase occurs two quarters prior to the current quarter.

This contemporaneous and short-term positive association reflects the endogenous response of monetary policy to inflationary pressures rather than a causal effect of interest rate changes on inflation. In other words, the base rate reacts to observed or anticipated inflation dynamics, which gives rise to reverse causality in the current and previous quarters. The causal transmission of monetary policy operates with a delay, as captured by the statistically significant disinflationary effect of the base rate with a two-quarter lag. Accordingly, the lagged coefficients provide a more appropriate basis for assessing the effectiveness of monetary policy in controlling inflation.

Specifications (2) and (3) of Table 3 take into account the influence of lags of the dependent variable – the growth rate of the consumer price index (the inflation rate). Their coefficients with a 1-quarter lag are negative. That is, the faster the inflation rate rose in the previous quarter, the greater the contribution to the slowdown in the current quarter. A higher growth rate of investments in the current quarter also reduced the inflation rate.

Table 4 presents regression estimates of the lagged effects of the base rate on GDP growth in Kazakhstan, controlling for world oil prices and investment dynamics to capture the delayed transmission of monetary policy to real economic activity.

Table 4. Dependent variable ΔLGDP – the growth rate of gross domestic product

Independent variable	**Specifications**		
	(1)	**(2)**	**(3)**
ΔLPOIL	0.0427*** (0.0145)	0.0457*** (0.0130)	0.0412*** (0.0138)
ΔLINTBASE(-2)	-0.0118* (0.0065)		-0.0013 (0.0055)
ΔLINTBASE(-3)		-0.0350*** (0.0069)	-0.0297*** (0.0062)
ΔLINVEST(-1)	-0.0163 (0.0195)	-0.0231 (0.0188)	
Constant	0.0092*** (0.0015)	0.0094*** (0.0014)	0.0092*** (0.0015)
Number of observations	58	58	64
R-squared	0.28	0.36	0.24
DW	2.08	1.99	2.37
The last column of the table shows the robust standard errors of the coefficients. *** p < 0.01; ** p < 0.05.			

Note: compiled by the authors

According to Table 4, economic growth was significantly influenced by the growth rates of oil prices and the base rate, with a 3-quarter lag. A faster rise in global oil prices and an accelerated inflow of investment into Kazakhstan's economy contributed to an increase in the country's economic growth rate. Rising oil prices increase export revenues, which is especially important for Kazakhstan, an oil exporter, as it raises government revenues and stimulates economic activity. Although investment growth should contribute to economic growth by increasing production capacity and efficiency through investments in production, infrastructure, and other sectors of the economy, this effect is not observed after a one-quarter lag. The increase in investment was included in the equation with a one-quarter lag to avoid simultaneity. At the same time, the change in the oil price was included without a lag, as the world oil price is clearly an exogenous factor influencing the rate of economic growth in Kazakhstan.

An increase in the base rate makes it difficult for businesses to obtain loans and reduces business activity in the country's economy. Its significant impact on the rate of economic growth is manifested with a lag. Note that in specifications (2) and (3) of Table 4, the coefficient for the base rate with a lag of 3 quarters is negative and significant at the 1-per cent level. It turns out that the rate of growth in the base rate has a negative effect on the rate of economic growth, with a lag of 3 quarters.

As noted above, Figure 4 does not illustrate the presence of any relationship between the base rate and consumer spending. Cointegration relationships were examined using the Johansen cointegration test, however, the results did not provide robust evidence of a stable long-run equilibrium among the variables.

Table 5 presents four specifications of the equation with the dependent variable of the growth rate of consumer spending.

Table 5. Dependent variable ΔLCONSH – growth rate of consumer spending

Independent variable	**Specifications**			
	(1)	**(2)**	**(3)**	**(4)**
ΔLGDP	1.336*** (0.414)	-	-	-
ΔLGDP(-1)	-	0.812* (0.435)	1.093** (0.476)	-
ΔLSAVE	-0.186*** (0.053)	-	-	
ΔLSAVE(-1)		0.099* (0.057)		0.208*** (0.064)
ΔLINTBASE	0.017 (0.052)		--	
ΔLINTBASE(-1)		-0.037 (0.055)		-0.065** (0.032)
ΔCPI	0.026 (0.483)	-	-0.825* (0.448)	-
ΔCPI(-1)	-	-0.871* (0.504)	-	-
constant	-	-	-	0.014** (0.007)
Number of observations	59	58	58	66
R-squared	0.19	0.14	0.09	0.25
DW	1.88	1.55	1.73	2.05
The last column of the table shows the robust standard errors of the coefficients. *** p < 0.01; ** p < 0.05.				

Note: compiled by the authors

The first of them is unsatisfactory, since it has a simultaneity problem, especially since the coefficient of the base rate is insignificant. To address the simultaneity problem, all independent variables in the second regression are lagged by 1 quarter. But in it, too, the coefficient of the growth rate of consumer spending is not significant. According to the results presented in Tables 3 and 4, the growth rate of consumer spending depends on the inflation rate and the economic growth rate, with some lags. As a result, multicollinearity occurs, as evidenced by insignificant coefficients in the estimated regression. In particular, the coefficient of the growth rate of the base rate is insignificant.

Therefore, the third regression includes only two indicators: the economic growth rate and the inflation rate, lagged by 1 quarter. They convey the impact of changes in the base rate on the growth rate of consumer spending. The coefficient in the first is significant at the 5% level and positive, whereas the second is significant only at the 10% level and negative. Let us consider the downward effect of the base rate on the economic growth rate and the varying effects of the base rate on the inflation rate across different lags. It remains unclear what the total impact of the base rate on the growth rate of consumer spending is.

GDP growth leads to an increase in income and, accordingly, to a rise in household spending. It is typically accompanied by increased economic activity, which contributes to job creation and higher wages. An increase in workers' incomes enhances their ability to consume, thereby stimulating demand for goods and services. The growth of consumer spending, in turn, enhances economic growth through the multiplier effect, as increased demand stimulates production and investment in various sectors of the economy. Additionally, an increase in GDP leads to higher tax revenues, enabling the government to enhance social benefits, subsidies, and infrastructure investments. These measures can further support household income and their consumer spending.

In the fourth regression, all estimated coefficients are significant at the 5 per cent level or higher. Note that the coefficient for the savings growth rate is positive. People tend to save more when they have sufficient funds to cover their current expenses. The coefficient in the base rate growth rate is negative. This means that an increase in the base rate growth rate in the previous quarter reduces the growth rate of consumer spending in the current quarter.

The study examined the impact of consumer spending on poverty levels and income inequality, using annual data because quarterly data was unavailable. The results of testing the data for the presence of a unit root are presented in Table 6.

Table 6. Results of testing the hypothesis for the presence of a unit root for annual data for 2001–2023

No.	Indicator	Designation	Integration
1	Household final consumption expenditure, logarithm	LCONSH	I(1)
	- First difference	ΔLCONSH	I(0)
2	Real gross domestic product, logarithm	LRGDP	I(1)
	- First difference	ΔLRGDP	I(0)
3	Real gross capital formation, logarithm	LRSAVE	I(1)
	- First difference	ΔLRSAVE	I(0)
5	Share of population with incomes below the subsistence minimum	BELOWSL	I(0)
	- First difference	ΔBELOWSL	I(1)
	- Second difference	Δ^2BELOWSL	I(0)
7	Real income used for consumption on average per capita per month, logarithm	LRINCOMEPCPC	I(1)
	- First difference	ΔLRINCOMEPCPC	I(0)
8	Gini index by decile groups	GINI10	I(0)
9	Poverty depth	POVDEPTH	I(0)
10	Poverty severity	POVSEVERITY	I(0)

Note: compiled by the authors

All attempts to identify the relationship between per capita consumer spending and poverty and inequality indicators have yielded almost no significant results. The only significant linear dependence is established for the pair of indicators: Δ^2BELOWSL and $^{\Delta}$LRINCOMEPCP. The robust estimate of the coefficient for the second of them is significant at the 5 percent level, the value of DW = 2.38 indicates the absence of first-order autocorrelation. The negative value of the coefficient -92.05 can be interpreted as follows. A higher growth rate of real income used for consumption on average per capita reduces the increase (or accelerates the decrease) in the share of the population with incomes below the subsistence minimum.

The remaining regressions constructed, including those given in Table 7, do not meet the requirements of statistical significance. In this table, for all regressions except the second, the DW statistics indicate the presence of first-order autocorrelation of the residuals.

Table 7. Dependent variable ΔLCONSH – growth rate of consumer spending

Independent variable	Dependent variables				
	BELOWSL	^{2}BELOWSL	GINI10	POVDEPTH	POVSEVERITY
ΔLRINCOMEPC	147.1 (149.3)	-92.05** (38.41)	0.20 (0.13)	3.93 (37.2)	3.71 (14.9)
ΔLRGDP			0.60*** (0.17)	152.9*** (48.7	57.6*** (19.5)
Constant	10.80** (4.39)		0.28*** (0.004)	-0.88 (1.25)	-0.42 (0.50)
Number of observations	22	21	22	22	22
R-squared	0.048	0.24	0.51	0.37	0.35
DW	0.24	2.38	0.69	0.75	0.70
The last column of the table shows the robust standard errors of the coefficients. *** p < 0.01; ** p < 0.05.					

Note: compiled by the authors

The results indicate that the coefficients associated with the base rate are generally small in magnitude and statistically insignificant across specifications for the poverty rate, poverty depth, poverty severity, and the Gini coefficient. This suggests that there is no strong direct short-term relationship between changes in the base rate and social inequality measures in Kazakhstan. At the same time, these findings should not be interpreted as evidence of the absence of monetary policy effects on poverty and inequality. Rather, they point to the predominantly indirect nature of such effects. As demonstrated in the CPI and GDP regressions, changes in the base rate significantly affect inflation with a lag of two quarters and economic growth with a lag of three quarters. Social indicators respond to these macroeconomic adjustments only with longer and more heterogeneous delays, which reduces the likelihood of detecting statistically significant direct effects in reduced-form regressions. In addition, the limited variation of official poverty and inequality indicators over time, as well as the prominent role of fiscal transfers and social policies in Kazakhstan, further weakens the immediate statistical link between monetary policy instruments and social outcomes.

The empirical results do not reveal a statistically significant direct relationship between changes in the base rate and indicators of poverty and income inequality in Kazakhstan. Across all specifications, the coefficients of the base rate remain small and insignificant for poverty and inequality measures. This indicates that monetary policy does not exert an immediate measurable effect on social outcomes within the current empirical framework. While the base rate significantly affects inflation and economic growth with time lags, the present analysis does not provide robust statistical evidence to quantify indirect effects on poverty and inequality. Therefore, any potential social impacts should be interpreted with caution.

Thus, calculations were performed on time series models to identify how monetary policy affects consumer demand. It was found that the base rate had a significant impact on the behavior of household con-

sumer spending in Kazakhstan through its impact on the rate of economic growth and the rate of inflation with some lags in the studied interval. In general, an increase in the growth rate of the base rate reduced the growth rate of household consumer spending. An increase in the growth rate of consumer spending led to a decrease in the share of the population with incomes below the subsistence level. Its impact on changes in income inequality was not revealed.

CONCLUSION

The results of this study indicate that monetary policy has a significant impact on key macroeconomic indicators, including inflation, gross domestic product, and consumer spending, in Kazakhstan. The base rate, as the main instrument of monetary policy, exhibits significant effects with a time lag. Changes in the base rate affect economic growth with a lag, reflecting the delayed transmission of monetary policy to real economic activity. The impact of the base rate on consumer spending is relatively weak, indicating that household consumption in Kazakhstan is driven primarily by income, employment, and social transfers.

The results indicate that the relationship between monetary policy and poverty and income inequality is predominantly indirect. Changes in the base rate have a limited direct impact on social indicators, highlighting the need for complementary policy measures.

The findings of this study have important practical implications for economic policy in Kazakhstan. First, given the time lags in the transmission of monetary policy to inflation and economic growth, policy decisions should be forward-looking and based on medium-term macroeconomic forecasts rather than on short-term fluctuations.

Second, the limited direct impact of monetary policy on poverty and income inequality suggests that interest rate instruments alone are insufficient to achieve inclusive growth objectives. Effective coordination between monetary and fiscal policies is required, where monetary policy ensures macroeconomic stability, while fiscal and social policies target income distribution, employment support, and poverty reduction.

Third, during crisis and post-crisis periods, a balanced policy mix is needed to avoid excessive tightening that may slow economic recovery and disproportionately affect vulnerable households. Integrating social indicators into macroeconomic monitoring frameworks may improve policy effectiveness and support sustainable and inclusive growth.

Overall, the study highlights the importance of a flexible and coordinated policy framework that takes into account both macroeconomic stabilization and social development objectives. This is particularly relevant for Kazakhstan, given its dependence on global commodity markets and exposure to external shocks.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: ZT; research design: AM, AAK, ZT and AYE; data collection: AM and AEK; analysis and interpretation: AAK and ZT; writing draft preparation: AM, AAK, ZT and AYE; supervision: AM and ZT; correction of article: AM, AAK, ZT and AYE; proofread and final approval of article: AM, AAK, ZT and AYE. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Aastveit, K. A., Natvik, G. J., & Sola, S. (2017). Economic uncertainty and the influence of monetary policy. *Journal of International Money and Finance, 76*, 50–67. https://doi.org/10.1016/j.jimonfin.2017.05.003

Aleem, A. (2010). Transmission mechanism of monetary policy in India. *Journal of Asian Economics, 21*(2), 186–197. https://doi.org/10.1016/j.asieco.2009.10.001

Aruoba, S. B., Elul, R., & Kalemli-Özcan, Ş. (2022). *Housing wealth and consumption: The role of heterogeneous credit constraints* (NBER Working Paper No. 30591). National Bureau of Economic Research. https://doi.org/10.3386/w30591

Bernanke, B. S., & Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives, 9*(4), 27–48. https://doi.org/10.1257/jep.9.4.27

Bernanke, B. S., Gertler, M., & Gilchrist, S. (1999). The financial accelerator in a quantitative business cycle framework. In J. B. Taylor & M. Woodford (Eds.), *Handbook of Macroeconomics* (Vol. 1, pp. 1341–1393). Elsevier. https://doi.org/10.1016/S1574-0048(99)10034-X

Bureau of National Statistics of the Republic of Kazakhstan. (n.d.). *Official statistics database*. Retrieved December 15, 2025, from https://stat.gov.kz

Cerrato, A., & Gitti, G. (2023). Inflation since COVID: Supply versus demand. *VoxEU CEPR Policy Portal*. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/inflation-covid-demand-or-supply

Chen, H., Qian, W., & Qiang, W. (2021). The impact of the COVID-19 pandemic on consumption: Learning from high-frequency transaction data. *AEA Papers and Proceedings, 111*, 307–311. https://doi.org/10.1257/pandp.20211003

Christelis, D., Georgarakos, D., Jappelli, T., & Kenny, G. (2020). *The COVID-19 crisis and consumption: Survey evidence from six EU countries* (ECB Working Paper No. 2507). European Central Bank.

Coibion, O., Gorodnichenko, Y., Kueng, L., & Silvia, J. (2017). Innocent bystanders? Monetary policy and inequality. *Journal of Monetary Economics, 88*, 70–89. https://doi.org/10.1016/j.jmoneco.2017.05.005

Corsetti, G., Simonelli, S., & Acconcia, A. (2015). *Consumption responds to liquidity-enhancing transfers: Micro evidence from Italian earthquakes.* VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/consumption-responds-liquidity-enhancing-transfers-micro-evidence-italian-earthquakes

De Nardi, M., French, E., & Benson, D. (2011). *Consumption and the Great Recession* (NBER Working Paper No. 17688). National Bureau of Economic Research. https://doi.org/10.3386/w17688

Farhi, E., & Baqaee, D. R. (2020). *Supply versus demand: Unemployment and inflation in the COVID-19 recession*. VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/supply-versus-demand-unemployment-and-inflation-covid-19-recession

Furceri, D., Loungani, P., & Zdzienicka, A. (2018). The effects of monetary policy shocks on inequality. *Journal of International Money and Finance, 85*, 168–186. https://doi.org/10.1016/j.jimonfin.2017.11.004

Ganong, P., & Noel, P. (2019). Consumer spending during unemployment: Positive and normative implications. *American Economic Review, 109*(7), 2383–2424. https://doi.org/10.1257/aer.20170537

Gerlach-Kristen, P., & Merola, R. (2019). Consumption and credit constraints: A model and evidence from Ireland. *Empirical Economics, 57*, 475–503. https://doi.org/10.1007/s00181-018-1461-4

Gerlach-Kristen, P., O'Connell, B., & O'Toole, C. (2013). *How do banking crises affect aggregate consumption? Evidence from international crisis episodes* (ESRI Working Paper No. 464). Economic and Social Research Institute. Retrieved December 15, 2025, from https://www.econstor.eu/bitstream/10419/100200/1/771051042.pdf

Harjes, T., Sahay, R., & Xue, Y. (2020). *Monetary policy transmission in emerging markets and developing economies* (IMF Working Paper No. WP/20/35). International Monetary Fund. https://doi.org/10.5089/9781513529738.001

Hodbod, A., Hommes, C., Huber, S. J., & Salle, I. (2021). *The COVID-19 consumption game-changer: Evidence from a large-scale multi-country survey* (ECB Working Paper No. 2599). European Central Bank.

International Monetary Fund. (n.d.). *IMF data*. Retrieved December 15, 2025, from https://www.imf.org/en/Data

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review, 95*(1), 161–182. https://doi.org/10.1257/0002828053828518

Kaplan, G., Violante, G. L., & Weidner, J. (2014). The wealthy hand-to-mouth. *Brookings Papers on Economic Activity*. Retrieved December 15, 2025, from https://www.brookings.edu/wp-content/uploads/2016/07/2014a_Kaplan.pdf

Konstantinou, P., & Corsetti, G. (2009). *The $2 trillion dollar question: How about U.S. demand and output?* VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/2-trillion-dollar-question-how-about-us-demand-and-output

Lee, J., Rabanal, P., & Sandri, D. (2010). *U.S. consumption after the 2008 crisis*. International Monetary Fund. Retrieved December 15, 2025, from https://www.imf.org/external/pubs/ft/spn/2010/spn1001.pdf

Meyer, B. D., & Sullivan, J. X. (2013). Consumption and income inequality and the Great Recession. *American Economic Review: Papers & Proceedings, 103*(3), 178–183. https://doi.org/10.1257/aer.103.3.178

Mishkin, F. S. (2004). *Can inflation targeting work in emerging market countries?* (NBER Working Paper No. 10646). National Bureau of Economic Research. https://doi.org/10.3386/w10646

Mishra, P., Montiel, P. J., & Spilimbergo, A. (2012). Monetary transmission in low-income countries. *IMF Economic Review, 60*(2), 270–302. https://doi.org/10.1057/imfer.2012.7

Muellbauer, J. (2020). *The coronavirus pandemic and U.S. consumption*. VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/coronavirus-pandemic-and-us-consumption

National Bank of Kazakhstan. (n.d.). *Statistical data*. Retrieved December 15, 2025, from https://www.nationalbank.kz

Pistaferri, L., & Jappelli, T. (2010). *The consumption response to income changes*. VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/consumption-response-income-changes

Santacreu, A., Young, H., & de Soyres, F. (2022). *Demand–supply imbalance during the COVID-19 pandemic: The role of fiscal policy.* VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/demand-supply-imbalance-during-covid-19-pandemic-role-fiscal-policy

Surico, P., & Andreolli, M. (2019). *Smaller economic stimulus payments could boost consumer spending more.* VoxEU CEPR Policy Portal. Retrieved December 15,

2025, from https://cepr.org/voxeu/columns/smaller-economic-stimulus-payments-could-boost-consumer-spending-more

Vavra, J., & Berger, D. (2014). *Durable consumption during recessions*. VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/durable-consumption-during-recessions

Watanabe, T. (2020). *The responses of consumption and prices in Japan to the COVID-19 crisis and the Tohoku earthquake*. VoxEU CEPR Policy Portal. Retrieved December 15, 2025, from https://cepr.org/voxeu/columns/responses-consumption-and-prices-japan-covid-19-crisis-and-tohoku-earthquake

World Bank. (n.d.). *World Development Indicators*. Retrieved December 15, 2025, from https://data.worldbank.org

Xiang, L., Wang, W., Ren, J., & Zhao, Y. (2023). The impact of monetary policy shocks on income inequality: A tale of two countries. *Economic Research–Ekonomska Istraživanja, 36*(1), 1-22. https://doi.org/10.1080/1331677X.2022.2106269

Zhuzbayev, A., & Seidakhmetova, B. (2019). *The impact of factors on consumer demand in Kazakhstan: An empirical assessment* (NBRK Working Paper No. 2). National Bank of Kazakhstan.

Information about the authors

Aliya B. Mukhamediyeva – Cand. Sc. (Econ.), Associate Professor, Almaty Management University, Almaty, Kazakhstan, email: aliya.mukhamediyeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-0359-6052

Azimzhan A. Khitakhunov – PhD, Senior Research Fellow, Central Asian Policy Studies, Almaty, Kazakhstan, email: azimkhun@gmail.com, ORCID ID: https://orcid.org/0000-0003-3455-563X

Zhansaya S. Temerbulatova – PhD, Research Professor, Almaty Management University, Almaty, Kazakhstan, email: t.zhansaya.s@mail.ru,ORCID ID: https://orcid.org/0000-0002-3205-0948

***Assem Ye. Kaliyeva** – PhD, Associate Research Professor, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: assemkalieva@gmail.com, ORCID ID: https://orcid.org/0000-0002-1154-4287

Авторлар туралы мәліметтер

Мухамедиева А.Б. – э.ғ.к., қауымдастырылған профессор, Алматы Менеджмент Университет, Алматы, Қазақстан, email: aliya.mukhamediyeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-0359-6052

Хитахунов А.А. – PhD, аға ғылыми қызметкер, Central Asian Policy Studies, Алматы, Қазақстан, email: azimkhun@gmail.com, ORCID ID: https://orcid.org/0000-0003-3455-563X

Темербулатова Ж.С. – PhD, зерттеуші профессор, Алматы Менеджмент Университет, Алматы, Қазақстан, email: t.zhansaya.s@mail.ru, ORCID ID: https://orcid.org/0000-0002-3205-0948

***Калиева А.Е.** – PhD, доцент-зерттеуші, әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: assemkalieva@gmail.com, ORCID ID: https://orcid.org/0000-0002-1154-4287

Сведения об авторах

Мухамедиева А.Б. – к.э.н., ассоциированный профессор, Алматы Менеджмент Университет, Алматы, Казахстан, email: aliya.mukhamediyeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-0359-6052

Хитахунов А.А. – PhD, старший научный сотрудник, Central Asian Policy Studies, Алматы, Казахстан, email: azimkhun@gmail.com, ORCID ID: https://orcid.org/0000-0003-3455-563X

Темербулатова Ж.С. – PhD, профессор исследователь, Алматы Менеджмент Университет, Алматы, Казахстан, e-mail: t.zhansaya.s@ mail.ru, ORCID ID: https://orcid.org/0000-0002-3205-0948

***Калиева А.Е.** – PhD, доцент-исследователь, Казахский национальный университет им. аль-Фараби, Алматы, Казахстан, email: assemkalieva@gmail.com, ORCID ID: https://orcid.org/0000-0002-1154-4287

Research Paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-39-50
МРНТИ 06.81.23
JEL: G21, M15, O32

Check for updates
BY-NC 4.0

Strategic Alignment and Consensus in Digital Innovation: Evidence from Retail Banking

GyuBae Kim[a]*

[a]*Daejeon University, 62 Daehak-ro, Dong-gu, Daejeon 34520, Republic of Korea*

For citation: Kim, G. (2026). Strategic Alignment and Consensus in Digital Innovati on: Evidence from Retail Banking. Economy: strategy and practi ce, 21(1), 39-50. htt ps://doi.org/10.51176/1997-9967-2026-1-39-50

ABSTRACT

This study investigates how integrated strategic communication influences the process of consensus building and organizational readiness during digital innovation in the retail banking industry. Although many institutions adopt digital technologies, innovation performance often remains limited due to weak employee alignment and ineffective communication systems that fail to bridge the gap between strategy and execution. A multiple case study design was employed, comparing a public retail banking organization (Company A) and a private retail banking organization (Company B) that both implemented large-scale digital innovation projects. Data was collected through document analysis, semi-structured interviews, and surveys structured around Lancefield's (2022) five principles of strategic communication: comprehensiveness, personalization, timeliness, transparency, and consistency. Findings indicate that although Company A recognized the importance of digital transformation, significant gaps were observed between the perceived importance and the actual implementation of strategic communication mechanisms. Employees rated the importance of communication dimensions highly (means ranging from 5.70 to 5.98 on a seven-point scale), while the current level of implementation was evaluated considerably lower (means between 4.08 and 4.38), revealing gaps of approximately 1.5-1.9 points. The largest gap was found in terms of timeliness and transparency, which indicates a lack of efficiency and openness of communication processes. Strategic communication functions as a critical mechanism linking technological innovation with cultural and psychological alignment within organizations. The study provides valuable theoretical and practical implications by presenting a communication-based framework for optimizing and successfully improving digital transformation outcomes in financial institutions.

KEYWORDS: Bank, Retail Banking, Banking Practice, Digital Innovation, Digital Strategy, Strategic Communication, Consensus Building, Organizational Change

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest.

FINANCIAL SUPPORT: this research was supported by the Daejeon University Research Grants (2024).

Article history:
Received 13 December 2025
Accepted 15 February 2026
Published 30 March 2026

*** Corresponding author: Kim G.** – PhD, Professor, Business Administration, Daejeon University, 62 Daehak-ro, Dong-gu, Daejeon 34520, Republic of Korea, email: gbkim@dju.ac.kr

Стратегическое выравнивание и организационный консенсус в цифровых инновациях: опыт розничного банкинга

Ким Г.[a]*

[a]*Университет Тэджон, 62 Daehak-ro, район Донгу, Тэджон 34520, Республика Корея*

Для цитирования: Ким Г. (2026). Стратегическое выравнивание и организационный консенсус в цифровых инно-вациях: опыт розничного банкинга. Экономика: стратегия и практика, 21(1), 39-50. https://doi.org/10.51176/1997- 9967-2026-1-39-50

АННОТАЦИЯ

В исследовании анализируется, как интегрированные стратегические коммуникации влияют на формирование организационного консенсуса и готовности персонала в условиях цифровых инноваций в сфере розничного банкинга. Несмотря на активное внедрение цифровых технологий финансовыми институтами, результативность инноваций часто остается ограниченной из-за недостаточной согласованности сотрудников и неэффективных коммуникационных механизмов, не обеспечивающих связку между стратегией и ее реализацией. В статье используется дизайн множественного кейс-исследования с сопоставлением государственной организации розничного банкинга (компания А) и частной организации розничного банкинга (компания В), реализовавших масштабные проекты цифровых преобразований. Сбор данных осуществлялся посредством анализа документов, полуструктурированных интервью и анкетирования, структурированного на основе пяти принципов стратегической коммуникации Лэнсфилда (2022): комплексность, персонализация, своевременность, прозрачность и последовательность. Результаты показали, что хотя компания А осознает значимость цифровой трансформации, выявлены существенные разрывы между декларируемой важностью и фактической реализацией механизмов стратегической коммуникации. Сотрудники высоко оценили значимость коммуникационных измерений (средние значения варьировались от 5,70 до 5,98 по семибалльной шкале), тогда как текущий уровень их реализации был оценен значительно ниже (средние значения от 4,08 до 4,38), что свидетельствует о разрыве примерно в 1,5–1,9 балла. Наибольший разрыв зафиксирован по показателям своевременности и прозрачности, что указывает на недостаточную оперативность и открытость коммуникационных процессов. Стратегическая коммуникация выступает критически важным механизмом, связывающим технологические инновации с культурной и психологической согласованностью внутри организации. Исследование вносит теоретический и практический вклад, предлагая коммуникационно-ориентированную рамочную модель для повышения эффективности и успешности цифровой трансформации в финансовых институтах.

КЛЮЧЕВЫЕ СЛОВА: банк, розничный банкинг, банковская практика, цифровые инновации, цифровая стратегия, стратегическая коммуникация, формирование консенсуса, организационные изменения.

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов.

ФИНАНСИРОВАНИЕ: данное исследование было поддержано Исследовательскими Грантами Университета Тэджон (2024).

История статьи:
Получено 13 декабря 2025
Принято 15 февраля 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Ким Г.** – PhD, профессор, кафедра бизнес-администрирования, Университет Тэджон, 62 Daehak-ro, район Донгу, Тэджон 34520, Республика Корея, email: gbkim@dju.ac.kr

INTRODUCTION

The advancement of digital technologies has brought about a paradigm shift across all domains of modern business management. Technological innovations, represented by Artificial Intelligence (hereinafter – AI), Big Data, Blockchain, Cloud Computing, and the Internet of Things (hereinafter – IoT), have fundamentally reshaped not only firms' value chains but also their organizational culture, structure, leadership, and decision-making processes (Verhoef et al., 2021). Among industries, the financial sector is a representative example in which digital technology serves as the core infrastructure for service delivery. In this sector, the digitisation of customer interfaces and data-driven management practices has become essential sources of competitiveness. However, the establishment of technological infrastructure alone does not guarantee successful innovation. Matt et al. (2015) defined Digital Transformation (DT) not as the mere adoption of technology but as an integrated process of redesigning organizational strategy, processes, resources, and culture. They argued that technology-oriented approaches are insufficient to achieve genuine innovation outcomes.

The reason many organizations fail to achieve expected innovation performance lies less in "technological failure" and more in the lack of organizational consensus (Wessel et al., 2021). Without shared understanding and mutual trust among organizational members regarding the necessity and direction of change, even the most sophisticated strategies encounter resistance during implementation. Kotter (1996), in his eight-step model of change, emphasized that forming a sense of urgency and developing a shared vision are the first two essential stages without which subsequent changes become meaningless. In this context, consensus building is not merely an outcome of communication but a prerequisite for organizational survival and innovation.

In particular, the financial industry places a high premium on public trust and institutional stability. Consequently, employees in this sector tend to exhibit greater psychological resistance to change than those in other industries. The introduction of new technologies or reengineering of business processes is often closely tied to risk management, leading employees to experience anxiety rather than confidence about change (Schein, 2010). Therefore, transparent and strategic communication about the rationale, goals, and concrete processes of change is essential to the successful implementation of digital innovation. However, existing research has largely examined digital transformation from a technological or managerial perspective, often overlooking the communicative processes through which organizations build shared understanding and commitment to change. This study addresses this gap by emphasizing strategic communication as a critical enabler of digital innovation in retail banking.

Against this backdrop, this study investigates how strategic communication affects consensus building and change receptivity during digital transformation in the retail banking industry. Forman and Argenti (2005) identified strategic communication as a critical mechanism for internalizing organizational vision, reputation, and brand identity among employees. Men and Bowen (2017) empirically demonstrated that the quality of internal communication enhances trust, commitment, and engagement, thereby improving strategic execution. Building on these insights, the present study analyzes the structural relationship between components of strategic communication and the driving forces of digital innovation.

The objectives of this study are threefold. First, it aims to identify the key components of strategic communication in the process of digital innovation. Second, it compares and analyzes the communication structures of public and private financial institutions to uncover differences arising from organizational characteristics. Third, it empirically examines the effects of communication quality on innovation performance, using Lancefield's (2022) five principles of strategic communication as the analytical framework.

By extending the discussion of innovation beyond technological aspects to include human and organizational communication structures, this study highlights the importance of psychological alignment and consensus building among organizational members. Ultimately, it provides practical insights for developing successful digital transformation strategies within the financial industry. Thus, this study investigates how integrated strategic communication influences the process of consensus building and organizational readiness during digital innovation in the retail banking industry.

THEORETICAL BACKGROUND

Digital innovation refers to the process of redefining a firm's products, services, processes, and business models through the utilization of information technology (Yoo et al., 2010). Bharadwaj et al. (2013) defined a digital business strategy as "a strategic innovation based on the convergence of information, computing, communication, and connectivity," emphasizing that IT strategy should no longer function as a subordinate element but as the central driver of corporate strategy. This transformation requires organizations to shift from traditional function-oriented structures toward more integrated, platform-based configurations.

Verhoef et al. (2021) conceptualized digital transformation as "a complex process arising from the interplay of technological, organizational, and cultural factors," arguing that technological investment alone cannot ensure successful transformation. Warner and Wäger (2019) interpreted this process as a form of strategic renewal, emphasizing that the essence of change lies not in adopting new technologies but in transforming organizational mindsets and leadership behaviors. Furthermore, the integration of digital transformation into distribution functions allows organizations to improve operational efficiency through lower costs and enhanced resource management (John et al., 2025).

Schein (2010) distinguished three levels of organizational culture artifacts, shared values, and underlying assumptions. Digital innovation, which requires transformation at the level of underlying assumptions, demands communication mechanisms that directly influence employees' belief systems. Therefore, the success of technological innovation depends on concurrent changes in organizational culture and members' cognitive frameworks, and strategic communication serves as the mediating mechanism that facilitates this alignment.

The essence of organizational change lies in changing people. Consensus and psychological readiness are foundational conditions for any successful transformation (Burnes, 2017). Kotter's (1996) model explicitly emphasizes the creation of consensus in the early stages of change. The first step involves establishing a sense of urgency, while the second focuses on building a shared vision that enables members to internalize collective goals.

Similarly, Prosci (2018) ADKAR model conceptualises change at the individual level, asserting that unless awareness and desire are first established, subsequent stages, knowledge, ability, and reinforcement cannot function effectively. Hence, consensus serves as both the starting point and the sustaining factor of change management.

Forman and Argenti (2005), through qualitative research on the role of internal communication in strategy execution, argue that the communication function should be redefined as a central organizational capability. Men and Stacks (2013) also demonstrate that leadership style and the quality of internal communication significantly influence employees' perceptions of organizational reputation and their commitment levels. Welch and Jackson (2007) position communication as the cornerstone of stakeholder relationship management, emphasizing that transparent information flow enhances organizational trust.

In this context, within the environment of digital transformation characterized by high uncertainty and complexity, organizations must establish strategic communication structures that enable members to clearly understand and emotionally accept the direction and rationale for change.

Clampitt et al. (2000) proposed five communication strategies effective under conditions of uncertainty and highlighted that a participative communication strategy exerts the most positive impact on organizational trust and innovation receptivity. They emphasize that leaders should not monopolize information during change processes but should instead design transparent systems that encourage open feedback and shared decision-making. Men and Bowen (2017), in their work Excellence in Internal Communication Management, identify four key elements of effective internal communication - transparency, consistency, participation, and fairness, which correspond directly with Lancefield's (2022) five principles of strategic communication. From Schein's (2010) cultural perspective, strategic communication is not merely the transmission of information but an embedding mechanism of organizational culture. It represents a deep learning process through which organizational values are internalized via repeated dialogue and feedback. Accordingly, strategic communication plays a pivotal role in transforming employees from passive receivers of change into active co-creators of organizational transformation.

Based on the above, it can be stated that modern research on digital transformation in the banking sector demonstrates a high level of theoretical and empirical elaboration of technological aspects of innovation. The focus is on the implementation of fintech solutions, digital platforms, process automation, data analytics, and omnichannel strategies. In this area, digital transformation is primarily interpreted as a technological and operational process aimed at improving efficiency, reducing costs and strengthening the competitive position of financial institutions.

At the same time, the concept of strategic alignment is actively developing in strategic management, which assumes consistency of digital strategy, business model, organizational structure and processes. However, strategic alignment is more often viewed through the prism of formal management mechanisms, performance indicators, and process architecture, while communication mechanisms that ensure employee consistency remain insufficiently disclosed. Research on organizational change highlights the importance of leadership, organizational culture, and staff resistance management in the context of transformation. At the same time, strategic communication is usually considered as a tool for accompanying changes, rather than as an independent system-forming factor that forms organizational consensus and psychological readiness for innovation. As a result, the behavioral and cognitive dimensions of strategic alignment often remain outside the scope of a comprehensive analysis.

Despite the considerable volume of publications, literature remains fragmented: technological, strategic, and behavioral levels of analysis are rarely integrated into a single model. Communication is not included in the structure of digital transformation as a key mechanism for connecting strategy and its practical implementation. There are no empirical sound models that allow quantifying the discrepancy between the perceived importance of strategic communication and the actual level of its implementation. Comparative research in the banking sector is particularly limited, comparing various organizational contexts, including public and private structures. Thus, there remains a theoretical and methodological gap in the scientific field related to the insufficient integration of strategic communication in the digital transformation model and a poorly developed analysis of organizational consensus as a result of strategic alignment. The present study aims to bridge this gap by considering strategic communication as a connecting mechanism between technological innovation, cultural transformation, and employees' psychological readiness for change.

CONCEPTUAL FRAMEWORK AND RESEARCH DESIGN

Conceptual Framework

Lancefield (2022) observed that many organizations fail to execute their strategies successfully because employees neither fully understand nor remember the strategies that have been formulated. The same applies to the execution of digital innovation strategies. Effective strategic communication enhances organizational alignment, resource allocation, and behavioral change, thus increasing the likelihood of strategic success.

He proposed five fundamental principles of effective strategic communication such as comprehensiveness, personalisation, timeliness, transparency, and consistency.

Comprehensiveness refers to conveying the entire strategic narrative rather than communicating only selected parts. This includes articulating the vision, desired future state, expected impacts on customers and society, areas of strategic focus, key change elements during implementation, performance indicators, and the assumptions and rationale underlying the strategy.

Personalization involves linking the organization’s strategy to individual roles, competencies, and performance, thereby creating personal meaning and ownership. If employees are left wondering, “What does this strategy have to do with my work?”, the strategy's execution is unlikely to succeed. Timeliness emphasises delivering messages through appropriate formats and channels at the right time, tailored to each stakeholder group and situational context.

Transparency requires that strategic information not be monopolized by top management but be shared openly with all members. Recent studies have shown that transparency and openness in strategic communication significantly increase employees’ strategic understanding and participation in implementation.

Consistence underscores that strategic commu-

nication must be continuous and repetitive. Regular communication sequences for each stakeholder group reinforce strategic messages and prevent regression to old behaviors once change initiatives have been launched. In the absence of follow-up communication, employees tend to revert quickly to existing practices.

IKEA actively employed visual communication tools to comprehensively convey its digital transformation strategy. The company aimed to ensure that all employees, including internal sceptics, clearly understood how digitalisation was linked to the existing business model and how it created opportunities for revenue and customer expansion. For instance, IKEA produced an animated video titled "Shop with Laura", which vividly illustrated how online–offline integration would affect customer behavior and how digitalization would transform employee roles and workflows. This approach effectively fostered organizational consensus regarding the digital strategy.

Coca-Cola, before initiating its digital innovation program, conducted in-depth interviews with employees at various levels to assess their needs and concerns. Based on these insights, the company customized communication messages and training content by job grade. This case demonstrates how personalization in strategic communication can reduce anxiety and enhance employees' readiness for change. Additionally, Coca-Cola implemented approximately 15 hours of e-learning for pre-transformation training. It provided key information about the upcoming changes approximately one month before the field application, thereby ensuring sufficient time for learning and preparation. Job-specific training programs further exemplified the company's phased communication system centered on timeliness.

DBS Bank subdivided its operations into eight functional areas—from customer service to back-office processes and systematically identified opportunities for digital transformation within each domain. This granularity allowed the design of communication strategies tailored to each department's characteristics while ensuring transparency in the process. The bank also expanded employee roles beyond traditional customer call handling to digital responsibilities, such as live chat and social media management, supported by ongoing training and communication. These ongoing communication efforts fostered employee participation and led to measurable improvements in service quality.

Following Yin's (2018) methodological guidelines, this study employs a multiple case study design to compare how the concept of strategic communication operates across different organizational types—specifically between a public and a private financial institution. The goal is to derive theoretical generalizations regarding the role of strategic communication in digital transformation.

Research Design

The research subjects are two retail banking organizations: Company A (a public financial institution) and Company B (a private financial institution). Both organizations have implemented large-scale digital innovation projects within the past three years. Company A is characterized by a regulation-oriented and stable organizational culture, whereas Company B emphasizes agility and experimentation, making their contrasting contexts ideal for comparative analysis.

Data collection proceeded in three stages. The first stage is document analysis. Internal strategy documents, training materials, disclosure reports, and media interviews were analyzed to understand each organization's digital innovation context. The second stage is semi-structured Interviews. In-depth interviews were conducted with key stakeholders from both institutions. The interview questions were designed based on Lancefield's five principles of strategic communication. The third stage is survey: A structured questionnaire was administered to employees, particularly in Company A, where consensus-building capacity was identified as weaker—to measure perceptions across the five dimensions of strategic communication. Company A is a public institution providing retail banking services centred on deposits and insurance. Like other financial institutions, it has pursued digital innovation by continuously introducing new technologies necessary for the provision of financial services. However, compared with private-sector institutions, Company A exhibits a slower rate of technological adoption and a narrower scope of application.

To ensure methodological validity and increase the reliability of the results, the principle of data triangulation was applied in the study. The use of several sources of information - document analysis, semi-structured interviews, and a questionnaire

survey - made it possible to compare qualitative and quantitative data and minimize the risk of one-sided interpretation. This combined approach has provided a deeper understanding of communication processes in the context of digital transformation. Additionally, a comparative case analysis was used to identify structural differences between a public and a private organization. This made it possible to strengthen the analytical validity of the study and formulate theoretically sound conclusions about the role of strategic communication in building organizational consensus.

EMPIRICAL FINDINGS

The communication process during Company A's digital innovation can be categorized into three stages: (1) the planning stage for system introduction, (2) the system development stage, and (3) the system operation stage.

At the planning stage, it was found that the headquarters often lacked sufficient procedures for collecting input from branch offices. In large-scale system projects, such as the next-generation financial system, however, partial participation by branch departments was occasionally incorporated into the planning process.

During the system development stage, branch employees often found it difficult to grasp the concrete content of the new system or the changes to their work processes until the late phase of development, when detailed manuals were finally distributed. Typically, branch offices prepare for upcoming changes by reviewing the manuals provided toward the end of system implementation. In contrast, questions and feedback regarding the new system are communicated to headquarters or the IT department on an ad hoc basis. During system operation, when operational issues arose while using the new system, employees typically contacted headquarters or the IT department by phone to resolve them. In certain cases, issues and improvement needs identified at branch offices were systematically documented and reported to headquarters, and such structured communication was found to enhance overall communication effectiveness within the organization.

Based on Lancefield's five principles of effective strategic communication, a survey questionnaire was developed to assess employees' perceptions. To complement the qualitative observations, a quantitative assessment was conducted to evaluate employees' perceptions of communication practices. The survey items consisted of five dimensions comprehensiveness, personalization, timeliness, transparency, and consistency, each dimension containing two or three items, as shown in Table 1.

Table 1. Survey items on the strategic communication

Dimension	Survey item
Comprehensiveness	The organization provides sufficient explanation of the reasons for introducing the new system.
	The organization offers training or demonstrations to show how existing work processes will change with the introduction of the new system.
	Opinions from frontline departments are collected during the planning stage of the new system.
Personalization	User-friendly manuals or reference materials are provided to help employees easily understand the new system.
	Training programs are offered to help employees effectively apply the new system in their work.
Timeliness	Manuals and relevant information about the new system are provided at an appropriate time.
	Training on the new system is conducted at a suitable time before implementation.
	When problems occur while using the new system, employees can immediately receive assistance from headquarters or the IT department.
Transparency	Open communication channels are maintained so that employees can easily share ideas and ask questions.
	Progress updates and developments following the introduction of the new system are shared with employees.

Consistency	Procedures are in place to collect feedback and improvement suggestions related to the newly introduced system.
	The organization makes continuous efforts to reflect employees' feedback and improvement suggestions after the system has been introduced.

Note: compiled by the author

Branch employees of Company A were asked to rate the perceived importance of each communication dimension for future digital innovation projects and to evaluate the current level of communication based on past experiences, using a seven-point Likert scale. Data was collected via an online survey, yielding 91 usable responses for the final analysis. The analysis results are presented in Table 2.

Table 2. Survey results on the strategic communication

Dimension	Survey Item	Importance (Mean)		Level (Mean)	
Comprehensiveness	Sufficient explanation of the reasons for introducing the new system	5.63	5.70	4.10	4.14
	Training or demonstrations showing how work processes will change	5.65		4.23	
	Collection of frontline opinions during the planning stage	5.82		4.10	
Personalization	Provision of user-friendly manuals and reference materials	5.78	5.80	4.32	4.33
	Training programs to help employees effectively use the new system	5.81		4.34	
Timeliness	Manuals provided at an appropriate time	6.05	5.98	4.18	4.19
	Timely training programs before implementation	5.82		4.13	
	Immediate assistance available when problems arise	6.05		4.26	
Transparency	Operation of open communication channels	5.80	5.87	4.10	4.08
	Sharing of progress updates following system implementation	5.95		4.05	
Consistency	Procedures for collecting feedback and improvement suggestions	5.88	5.90	4.36	4.38
	Continuous efforts to reflect employees' improvement suggestions	5.92		4.41	

Note: compiled by the author

The findings indicate that branch employees of Company A perceive all five dimensions of strategic communication as highly important in the digital innovation process-Comprehensiveness (M=5.70), Personalization (M=5.80), Timeliness (M=5.98), Transparency (M=5.87), and Consistency (M=5.90). However, the current implementation levels across all five dimensions were rated as only moderate: Comprehensiveness (M=4.14), Personalization (M=4.33), Timeliness (M=4.19), Transparency (M=4.08), and Consistency (M=4.38). Compared with their perceived importance, these lower scores indicate a clear gap between the desired and actual states of strategic communication within Company A.

To better illustrate the magnitude of the discrepancy, Table 3 presents the calculated gap between perceived importance and actual implementation.

Table 3. Gap between perceived importance and implementation of strategic communication (Company A)

Dimension	Importance (Mean)	Implementation (Mean)	Gap
Comprehensiveness	5.70	4.14	1.56
Personalization	5.80	4.33	1.47
Timeliness	5.98	4.19	1.79
Transparency	5.87	4.08	1.79
Consistency	5.90	4.38	1.52

Note: compiled by the author

Company B established a highly integrated collaborative structure involving three major domains Digital Strategy, Information Technology (IT), and Business Operations - to drive digital innovation. The core axis of communication in digital transformation projects was the close interaction between the IT department and business units, supplemented by additional coordination among IT planning and development teams and between headquarters and branch offices.

For large-scale projects, Task Force Teams (TFTs) were organised to ensure the joint participation of IT departments, headquarters units, and branch offices from the early planning stage. This structural collaboration served as a critical foundation for aligning strategic intent and execution logic across the organization, thereby facilitating an integrated approach to digital innovation.

Company B emphasized comprehensiveness in its strategic communication throughout the digital innovation process. In large-scale system development projects, TFTs were formed to ensure that all relevant departments shared a common understanding of the strategic background, objectives, and expected outcomes of system implementation. This approach strengthened employees' strategic comprehension from the initial stage and helped minimize resistance during later implementation phases. Communication about process changes was carried out in a phased manner. First, IT and business members involved in the planning stage disseminated their clear understanding of the upcoming process changes internally. Second, upon completion of the planning stage, the overall direction of change was officially communicated to all employees through formal documentation. Third, during the development and testing stages, the organization utilized demonstrations, manuals, and training programs to convey more detailed and practical information about workflow changes. This progressive and comprehensive communication structure enabled employees to gradually assimilate the intended changes in an informed and structured manner.

In addition to standardized formal communication, Company B actively implemented personalized communication tailored to departmental characteristics. Formal communication included manuals and official documents, online video training, and scenario-based simulations, utilizing multiple channels such as the intranet bulletin board, document circulation system, and video conferencing tools. Some departments supplemented these efforts with customized educational videos, internal broadcasting, or YouTube-based content, allowing information to be delivered in a more familiar and engaging format. Such personalization enhanced employees' comprehension and emotional connection to the digital transformation agenda, contributing to smoother adoption across diverse functional areas.

From a timeliness perspective, Company B structured its strategic communication into sequential phases. During the planning and design stages, communication focused on articulating the strategic direction and purpose of system introduction. In the development and testing stages, attention shifted to explaining the operational details and practical impacts on employees' workflows. After implementation, various events and programs were organized to encourage the effective use of the new system. Moreover, informal communication between IT, headquarters, and branch departments was highly active, complementing formal channels. These real-time interactions accelerated problem-solving processes and fostered mutual trust among employees, reinforcing organizational agility during the transition.

Company B demonstrated a strong commitment to transparency by producing and sharing video content that documented both the system development process and post-implementation updates through the company's internal broadcasting channel. Additionally, initiatives such as system adoption events,

feedback collection programs, and employee reward schemes were implemented to encourage active participation and bidirectional feedback. Early-stage system issues and their corresponding solutions were promptly communicated to reduce uncertainty and maintain organizational confidence throughout the transition process.

The consistency of Company B's communication was maintained through a variety of mechanisms. Real-time communication channels, including phone consultations, quick memos, and internal Q&A boards, were established to facilitate continuous dialogue. An ongoing feedback collection system was operated to support continuous improvement of newly implemented systems. Furthermore, through on-site branch audits conducted every three to six months, system enhancement requirements were gathered and jointly reviewed by IT and business departments to determine feasible updates. This sustained communication framework substantially contributed to the stable institutionalization and long-term improvement of the digital systems, ensuring that digital innovation was embedded as a continuous organizational capability rather than a one-time initiative.

CONCLUSIONS

This study conducted a multiple case analysis of two retail banking organizations to explore how strategic communication can foster organizational consensus in digital innovation, particularly in organizations where transformation performance remains suboptimal. The analysis revealed a consistent pattern: while Company A exhibited a strong awareness of the future importance of strategic communication (average score above 5.8 on a seven-point Likert scale), its current communication practices were rated substantially lower (around 4.2 on average). This discrepancy indicates that although employees understood and valued the need for digital transformation, insufficient information flow and limited front-line participation hindered the formation of shared understanding and alignment within the organization.

First, with respect to comprehensiveness, employees at Company A perceived that operational feedback from field units was insufficiently reflected during the planning stage. This gap between policy design and practical needs has intensified the misalignment between strategy and execution. Therefore, it is necessary to institutionalize the participation of field employees within standardized project planning processes. Embedding a systematic mechanism for field-level feedback from the planning phase would ensure stronger coherence between strategic direction and operational change during digital transformation.

Second, personalization emerged as a key determinant of consensus-building. Both surveys and interviews confirmed that employees sought a clearer understanding of how their individual roles and tasks would change. Hence, beyond generic organization-wide training, it is essential to establish differentiated and simulation-based training systems tailored to specific job functions and skill levels. Particularly in financial service roles characterized by frequent system updates, personalized learning materials and hands-on training can enhance employees' engagement, comprehension, and acceptance of change.

Third, timeliness was found to be a critical variable influencing the speed of digital transformation adoption. While the provision of manuals at an appropriate time (mean importance score of 6.05) was rated as the most significant item, its current implementation received a relatively low score (4.18). This suggests that last-minute, one-way communication before change implementation fails to enable employees' timely understanding. To address this, organizations should establish rapid-support communication systems—such as AI chatbots, information centers, and real-time training video platforms—to ensure timely and accessible knowledge transfer throughout the change process.

Fourth, in terms of transparency, insufficient sharing of project progress and information asymmetry between headquarters and field offices were identified as major barriers to consensus-building in Company A. To overcome this, organizations should move away from top-down communication and introduce open feedback channels (e.g., digital forums or real-time Q&A boards), encouraging employees to participate as co-creators in the innovation process rather than passive recipients.

Fifth, consistency was evaluated as a crucial foundation for sustaining digital transformation in the long term. A significant gap was observed between employees' perceived importance (5.9) and the current level of practice (4.4), suggesting a lack

of structured post-implementation feedback and improvement mechanisms. Therefore, organizations should institutionalize performance monitoring and iterative feedback loops even after project completion, establishing a cyclical communication structure that continuously reinforces learning, adaptation, and improvement.

In summary, the success of digital innovation extends beyond technological infrastructure—it fundamentally depends on psychological and organizational consensus among members. This study empirically demonstrates the necessity of a strategic communication model built upon five key dimensions: comprehensiveness, personalization, timeliness, transparency, and consistency. By articulating how these communicative elements mediate the alignment between technological and cultural transformation, the study provides both theoretical and practical implications for enhancing digital innovation outcomes in the financial sector. Future research should expand on these findings by designing a quantitative communication framework that measures consensus-building effectiveness across hierarchical levels and departments, thus contributing to a deeper understanding of communication-driven digital transformation in complex organizational systems.

This study contributes to both theory and practice by positioning strategic communication as a core mechanism of successful digital transformation. It extends existing digital innovation research by highlighting communication not merely as a supporting process but as a structural enabler of organizational alignment and cultural adaptation. For practitioners, the findings emphasize the importance of establishing transparent and continuous communication systems that integrate employee feedback throughout the transformation process. The proposed five-dimensional communication model can serve as a practical framework for financial institutions to assess, design, and improve their internal communication strategies, thereby enhancing consensus, trust, and engagement across all organizational levels.

Despite its contributions, this study has several limitations. First, as a qualitative multiple case study focusing on two financial institutions, the findings may not be generalizable to all industries or cultural contexts. Future research should employ quantitative or mixed-method approaches to statistically examine the relationships among communication quality, consensus formation, and innovation performance. Second, because digital innovation is an evolving process, longitudinal studies are recommended to track how communication practices change over time and impact the sustainability of transformation.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: GK; research design: GK; data collection: YK; analysis and interpretation: GK; writing draft preparation: GK; supervision: GK; correction of article: GK; proofread and final approval of article: GK. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Argyris, C., & Schön, D. A. (1996). *Organizational learning II: Theory, method, and practice*. Reading, MA: Addison-Wesley.

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly, 37*(2), 471–482. https://doi.org/10.25300/MISQ/2013/37:2.3

Burnes, B. (2017). *Managing change* (7th ed.). Harlow, UK: Pearson Education.

Clampitt, P., DeKoch, R., & Cashman, T. (2000). A strategy for communicating about uncertainty. *Academy of Management Executive, 14*(4), 41–57. https://doi.org/10.5465/ame.2000.3979815

Foreman, J., & Argenti, P.A. (2005). How Corporate Communication Influences Strategy Implementation, Reputation and the Corporate Brand: An Exploratory Qualitative Study. *Corporate Reputation Review, 8*, 245-264. https://doi.org/10.1057/PALGRAVE.CRR.1540253

Gillen, T. (2006). *The manager's guide to effective change management*. London, UK: CIPD Publishing.

John, N., David, J. A., Ameh, E. B., Samson, I. P., & Osere, N. J. (2025). Leveraging Digital Transformation for Responsible Food Production and Distribution in an Emerging Economy's Manufacturing Sector. *Journal of Distribution Science, 23*(2), 1-11. https://doi.org/10.15722/jds.23.02.202502.1

Kotter, J. P. (1996). *Leading change*. Boston, MA: Harvard Business School Press.

Lancefield, D. (2022). How to communicate your company's strategy effectively. *Harvard Business Review*. Retrieved January 25 2026 from https://hbr.org/2022/11/how-to-communicate-your-companys-strategy-effectively

Matt, C., Hess, T., & Benlian, A. (2015). Digital transformation strategies. *Business & Information Systems Engineering, 57*(5), 339–343. https://doi.org/10.1007/s12599-015-0401-5

Men, L. R., & Bowen, S. A. (2017). *Excellence in internal communication management*. New York: Business Expert Press.

Men, L. R., & Stacks, D. W. (2013). The impact of leadership style and employee empowerment on perceived organizational reputation. *Journal of Communication Management, 17*(2), 171–192. https://doi.org/10.1108/13632541311318765

Prosci. (2018). *ADKAR: A model for change in business, government and our community*. Fort Collins, CO: Prosci Learning Center.

Schein, E. H. (2010). *Organizational culture and leadership* (4th ed.). San Francisco: Jossey-Bass.

Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J.Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, *122,* 889–901. https://doi.org/10.1016/j.jbusres.2019.09.022

Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning, 52*(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001

Welch, M., & Jackson, P. R. (2007). Rethinking internal communication: A stakeholder approach. Corporate Communications: *An International Journal, 12*(2), 177–198. https://doi.org/10.1108/13563280710744847

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind Jensen, T. (2021). Unpacking the difference between digital transformation and IT-enabled organizational transformation. *Journal of the Association for Information Systems, 22*(1), 102–129. https://doi.org/10.17705/1jais.00655

Yin, R. K. (2018). *Case study research and applications: Design and methods*. Thousand Oaks, CA: Sage Publications.

Information about the author

***GyuBae Kim** – PhD, Professor, Business Administration, Daejeon University, Daejeon, Republic of Korea, email: gbkim@dju.ac.kr

Автор туралы мәліметтер

***Ким Г.** – PhD, профессор, бизнес-әкімшілендіру кафедрасы, Тэджон университеті, Тэджон, Корея Республикасы, email: gbkim@dju.ac.kr

Сведения об авторе

***Ким Г.**– PhD, профессор, кафедра бизнес-администрирования, Университет Тэджон, Тэджон, Республика Корея, email: gbkim@dju.ac.kr

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-51-64
МРНТИ 06.52.13
JEL: M10, M31, O17

Check for updates
BY-NC 4.0

Strategic Crisis Response in Tourism: The Role of Location and Marketing Activities

Aisha A. Akhmetbayeva[a]*, Lazat S. Spankulova[b]

[a]KIMEP University, 2 Abai ave., Almaty, Kazakhstan; [b]Al-Farabi Kazakh National University, 71 Al-Farabi ave., Almaty, Kazakhstan

For citation: Akhmetbayeva, A.A. & Spankulova, L.S. (2026). Strategic Crisis Response in Tourism: The Role of Location and Marketing Activities. Economy: strategy and practice, 21(1), 51-64. https://doi.org/10.51176/1997-9967-2026- 1-51-64

ABSTRACT

With the increasing frequency and depth of crisis shocks, the analysis of factors that determine the recovery of tourism industry enterprises across various institutional contexts is becoming particularly relevant. The purpose of the study is to assess the impact of geographical location and marketing activities on anti-crisis adaptation and revenue dynamics of tourism organizations, and to analyze the relationship between operational changes and marketing strategies during the crisis. The research methodology is based on structural equation modeling (hereinafter – SEM), which enables simultaneous assessment of direct, indirect, and moderating effects among key variables. The empirical base of the study includes data from a survey of 342 tourism organizations from 40 countries, including 187 companies registered in Kazakhstan (54.7%) and 155 companies from other countries (45.3%). The data were collected in 2025 using a questionnaire and cover marketing activities, operational changes, crisis challenges, geographical location, and a subjective assessment of the crisis's impact on revenue. The results of the study showed that geographical location is the only statistically significant predictor of revenue changes ($\beta = -0.157$; $p = 0.004$): companies operating in Kazakhstan, on average, demonstrated higher revenue indicators compared with organizations from other countries. Marketing activities proved to be the strongest factor influencing the implementation of operational changes ($\beta = 0.385$; $p < 0.001$). The results indicate the need to develop context-specific anti-crisis strategies and confirm the role of marketing activities as a key driver of organizational adaptability, rather than as a direct source of financial recovery.

KEYWORDS: Economy, Tourism Economy, Marketing, Marketing Activity, Strategic Management, Crisis Management, Moderation Analysis, Structural Modeling

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT. The study did not receive any financial support (conducted via authors' own resources)

Article history:
Received 23 November 2025
Accepted 09 February 2026
Published 30 March 2026

*** Corresponding author: Akhmetbayeva A.A.** – PhD student, Researcher, KIMEP University, 2 Abay ave., Almaty, Kazakhstan, 87475769710, email: a.akhmetbayeva@kimep.kz

Стратегическое реагирование на кризис в туризме: влияние географического контекста и маркетинговой активности

Ахметбаева А.А.[a]*, Спанкулова Л.С.[b]

[a] *Университет КИМЭП, пр. Абая 2, Алматы, Казахстан;* [b] *Казахский Национальный Университет им. Аль-Фараби, пр. аль-Фараби 71, Алматы, Казахстан*

Для цитирования: Ахметбаева А.А., Спанкулова Л.С. (2026). Стратегическое реагирование на кризис в туризме: влияние географического контекста и маркетинговой активности. Экономика: стратегия и практика, 21(1), 51-64. https://doi.org/10.51176/1997-9967-2026-1-51-64

АННОТАЦИЯ

В условиях роста частоты и глубины кризисных потрясений особую актуальность приобретает анализ факторов, определяющих восстановление предприятий туристской отрасли в различных институциональных контекстах. Целью исследования является оценка влияния географического положения и маркетинговых активностей на антикризисную адаптацию и динамику выручки туристских организаций, а также анализ взаимосвязи между операционными изменениями и маркетинговыми стратегиями в период кризиса. Методология исследования основана на применении структурного моделирования (далее – SEM), позволяющего одновременно оценить прямые, косвенные и модерационные эффекты между ключевыми переменными. Эмпирическая база исследования включает данные опроса 342 туристских организаций из 40 стран, в том числе 187 компаний, зарегистрированных в Казахстане (54,7%), и 155 компаний из других стран (45,3%). Данные были собраны в 2025 году с использованием анкетирования и охватывают маркетинговые активности, операционные изменения, кризисные вызовы, географическое положение и субъективную оценку влияния кризиса на выручку. Результаты исследования показали, что географическое положение является единственным статистически значимым предиктором изменения выручки ($\beta = -0{,}157$; $p = 0{,}004$): компании, функционирующие в Казахстане, в среднем демонстрировали более высокие показатели выручки по сравнению с организациями из других стран. Маркетинговые активности оказались наиболее сильным фактором, влияющим на реализацию операционных изменений ($\beta = 0{,}385$; $p < 0{,}001$). Полученные результаты указывают на необходимость разработки контекстно-специфичных антикризисных стратегий и подтверждают роль маркетинговых активностей, как ключевого фактора организационной адаптивности, а не прямого источника финансового восстановления.

КЛЮЧЕВЫЕ СЛОВА: экономика, экономика туризма, маркетинг, маркетинговая деятельность, стратегический менеджмент, антикризисное управление, модерационный анализ, структурное моделирование

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ. Исследование не получало финансовой поддержки (проведено за счет собственных средств авторов)

История статьи:
Получено 23 ноября 2025
Принято 09 февраля 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Ахметбаева А.А.** – PhD докторант, исследователь, НАО Университет КИМЭП, пр. Абая 2, Алматы, Казахстан, 87475769710, email: a.akhmetbayeva@kimep.kz

INTRODUCTION

The global business landscape has been marked by increasing uncertainty and crisis events that challenge firms' resilience and adaptability (Wenzel et al., 2020). From financial crises to pandemics, organizations face unprecedented disruptions requiring rapid strategic responses (Herbane, 2010). In the tourism sector specifically, crises have become more frequent and severe, affecting firms of all sizes and across diverse geographic contexts. While existing research emphasizes the importance of operational changes and marketing strategies during crises (Srinivasan et al., 2005), limited attention has been paid to how these factors interact and whether their effectiveness varies across geographic contexts. Moreover, most crisis management research treats geographic location as a mere control variable rather than examining it as a substantive predictor of crisis outcomes.

The economic stakes of understanding crisis recovery in tourism are substantial. Tourism contributes approximately 10% of global GDP and supports approximately one in ten jobs worldwide (World Travel & Tourism Council, 2024). The COVID-19 pandemic resulted in a combined loss of US$2.1 trillion in tourism export revenues between 2020 and 2021, with international tourist arrivals declining by 72% in 2020 and 71% in 2021 compared to 2019 (World Tourism Organization, 2023). For transition economies such as Kazakhstan, where tourism has been identified as a strategic diversification priority to reduce dependence on oil, these losses were particularly consequential—Kazakhstan's tourism sector. Despite the magnitude of these economic impacts, empirical research on the drivers of recovery in tourism firms, particularly in emerging and transition economies, remains limited. Most existing studies focus on developed Western markets, leaving a significant gap in understanding how firms in different institutional contexts respond to and recover from crises.

Kazakhstan presents a particularly valuable research context for several reasons. As Central Asia's largest economy and a key node in China's Belt and Road Initiative, Kazakhstan occupies a strategic position in regional tourism flows. In addition, as a transition economy, Kazakhstan exhibits institutional characteristics, including evolving regulatory frameworks, developing market infrastructure, and varying levels of government support, that differ substantially from those of both developed Western markets and other emerging economies. These institutional differences may fundamentally shape how firms respond to crises and whether standard crisis management prescriptions apply. Kazakhstan's tourism sector comprises a mix of domestic operators and international chains, providing variation in organizational capabilities and strategic orientations. Understanding whether crisis recovery patterns differ between Kazakhstan and other countries can inform both theory development regarding institutional contingencies and practical guidance for managers operating across diverse contexts.

Despite extensive research on crisis management, critical gaps remain that limit both theoretical understanding and practical guidance. The role of geographic location in shaping crisis recovery outcomes remains underexplored. While institutional theory suggests that the effectiveness of organizational strategies depends on contextual factors (Scott, 1995), location is rarely examined as a substantive predictor. This gap is consequential: if location systematically affects recovery outcomes, then crisis management prescriptions developed in one context may be ineffective or even counterproductive in another, potentially leading to misallocated resources and prolonged recovery periods. The interactive effects between operational changes and marketing activities during crises are poorly understood. Firms facing crises must decide how to allocate scarce resources between operational restructuring and marketing initiatives, yet most studies examine these strategies in isolation rather than investigating their potential complementarities or substitution effects. Without understanding how these strategies interact, managers lack evidence-based guidance for resource allocation decisions that could mean the difference between firm survival and failure.

This study makes three contributions to the crisis management literature. By examining location as a focal predictor rather than a control variable, the study provides empirical evidence on whether geographic context, specifically operating in a transition economy like Kazakhstan, systematically affects crisis recovery outcomes. This contributes to institutional theory by testing whether context-specific advantages shape firm performance during environmental discontinuities. Next, by testing the interaction between marketing activities and opera-

tional changes, the study contributes to the strategic complementarities literature by examining whether these crisis responses function as complements (mutually reinforcing) or as independent levers. Further, by examining marketing activities as predictors of operational change implementation, the study contributes to the organizational adaptation literature by identifying antecedents of firm responsiveness during crises.

Using data from 342 tourism organizations across 40 countries, this study employs structural equation modeling to test hypotheses about the relationships between challenges, operational changes, marketing activities, location, and revenue outcomes. The analysis reveals that location is a significant predictor of revenue impact, with Kazakhstan-based firms demonstrating systematically different outcomes compared to firms in other countries. Additionally, marketing activities emerge as strong predictors of organizational adaptation. These findings challenge conventional wisdom about crisis response strategies and highlight the importance of geographic context in shaping crisis management effectiveness.

This study addresses two research questions with direct implications for both theory and practice:

RQ1: Does geographic location (Kazakhstan versus other countries) significantly predict revenue recovery outcomes during crisis periods, controlling for firm strategies and crisis severity?

RQ2: Do marketing activities moderate the relationship between operational changes and revenue impact, that is, are operational changes more effective when accompanied by strong marketing activities?

These questions are important because their answers determine whether crisis management guidance should be context-specific or universal (RQ1) and whether firms should pursue integrated or independent approaches to operational and marketing responses (RQ2).

LITERATURE REVIEW

The theoretical foundation of this research draws on three interconnected streams of literature: crisis management and organizational adaptation; marketing capabilities and their role in crisis contexts; and institutional theory regarding geographic context. This review synthesizes existing knowledge on these themes to develop testable hypotheses regarding the relationships among challenges, operational changes, marketing activities, location, and revenue outcomes.

Despite the substantial economic importance of crisis management in tourism, significant gaps remain in empirical research that limit evidence-based decision-making (Baron & Kenny, 1986; Armenakis & Bedeian, 1999). While studies document that firms implement operational changes during crises, particularly in tourism SMEs during the COVID-19 period , evidence on whether these changes actually improve financial outcomes is mixed and often contradictory (Kukanja et al., 2022). Some research reports positive effects of operational adaptation on firm performance, while other studies find null or even negative effects, leaving practitioners without clear guidance on the economic returns to operational restructuring (Wenzel et al., 2020; Reeves et al., 2020). Research on marketing during economic downturns has focused predominantly on large firms in developed markets, with limited evidence on whether findings generalize to small and medium-sized enterprises in emerging economies, despite SMEs comprising the majority of tourism firms globally and facing the most severe resource constraints during crises. Most critically, the economic literature has not systematically examined whether crisis management strategies that prove effective in one geographic context transfer to others. If location-specific factors moderate strategy effectiveness, then the substantial investments firms make in crisis response may yield fundamentally different returns depending on where they operate – a possibility with significant implications for resource allocation but minimal empirical investigation to date.

Research on organizational crisis response provides the first theoretical pillar for this study. During crisis periods, firms typically implement operational changes to adapt to new market conditions (Kovoor-Misra et al., 2001). These changes may include updating crisis management models, revising marketing strategies, and exploring new markets (Herbane, 2010; Lai et al., 2016). Prior research suggests that organizational agility – the ability to reconfigure operations rapidly – is critical for crisis survival (Teece et al., 2016). Dynamic capabilities theory posits that firms' ability to sense, seize, and reconfigure resources determines competitive advantage in turbulent environments (Teece, 2007).

However, the effectiveness of operational chang-

es during crises remains contested. While some studies report positive effects of operational adaptation (Wenzel et al., 2020), others suggest that reactive changes may be poorly planned or executed, resulting in minimal or even negative outcomes (Reeves et al., 2020). Research on organizational change indicates that 70% of change initiatives fail (Burnes, 2004), often due to implementation challenges, resource constraints, or poor strategic fit (Kotter, 1995). The study proposes that the mere implementation of operational changes is insufficient; rather, these changes must be supported by complementary strategic initiatives.

Marketing activities during crises serve multiple functions: maintaining customer relationships, communicating value propositions, and identifying new market opportunities. Marketing literature emphasizes both defensive strategies (retaining existing customers, maintaining brand equity) and offensive strategies (acquiring new customers, expanding into new segments) during downturns (Steenkamp & Fang, 2011). Beyond direct revenue generation, marketing activities may also serve an enabling function by facilitating the effectiveness of other strategic initiatives (Vorhies & Morgan, 2005).

Study draws on marketing capabilities literature to propose that marketing activities moderate the relationship between operational changes and revenue impact. Specifically, marketing capabilities including market sensing, customer relationship management, and brand management (Vorhies et al., 2009) may help firms communicate changes to stakeholders, identify which operational changes will resonate with customers, and create market conditions favorable to new operational approaches. This suggests an interactive, rather than additive, relationship between marketing and operational strategies.

The gap in understanding how marketing and operational strategies interact has direct economic consequences. Firms facing crises must allocate scarce resources between operational restructuring (e.g., exploring new markets, updating business models) and marketing initiatives (e.g., customer retention, digital promotion). If these strategies are complementary, meaning operational changes are more effective when combined with marketing, then firms that cut marketing budgets to fund operations may inadvertently undermine their recovery. Conversely, if strategies operate independently, firms can allocate resources based on expected individual returns. Current research provides insufficient evidence to guide these allocation decisions. Testing the interaction between marketing activities and operational changes addresses this gap directly:

H1: Marketing activities moderate the relationship between operational changes and revenue impact, such that operational changes are more effective when marketing activities are stronger.

Drawing on institutional theory (Scott, 1995) and international business literature (Buckley & Ghauri, 2004; Khanna & Palepu, 2010), the study argues that geographic location may fundamentally shape the effectiveness of crisis response. Geographic location encompasses multiple dimensions, including market maturity, competitive intensity, regulatory environment, and broader economic conditions (Meyer & Peng, 2016). Despite its multidimensional nature, location is often treated as merely a control variable in strategy research.

Kazakhstan, a transition economy with unique institutional and market characteristics, provides an interesting contrast to more developed markets. Research on emerging markets suggests that institutional contexts significantly affect firm strategy and performance (Wright et al., 2005). Differences in competitive intensity, government support, market expectations, and crisis severity may all contribute to divergent outcomes between Kazakhstan and other countries (Urdabaev & Utkelbay, 2011). The failure to examine location as a substantive predictor has practical economic implications. Crisis management prescriptions such as recommendations to invest in marketing, diversify offerings, or restructure operations are often presented as universal best practices. However, evidence from logistics and distribution sectors indicates that the performance effects of managerial practices, particularly those related to knowledge management and innovation are highly contingent on institutional and market contexts (Karácsony et al., 2025). For firms operating across multiple markets, understanding location effects is essential for tailoring crisis responses rather than applying uniform strategies. Moreover, for policymakers in transition economies such as Kazakhstan, evidence on whether local firms exhibit systematically different recovery trajectories can inform the design of support programs. Despite these stakes, location remains underexplored as a focal variable. Testing whether Kazakhstan-based firms exhibit outcomes different from those of firms elsewhere addresses this gap.

H2: Location significantly influences revenue impact, with systematic differences between Kazakhstan-based firms and those in other countries.

Beyond their moderating role, marketing activities may directly influence organizational adaptation. Marketing-oriented firms tend to be more externally focused, customer-centric, and information-rich – characteristics that facilitate adaptive responses to environmental changes (Day, 2011). The market orientation literature establishes that firms with strong, market-sensing capabilities are better positioned to anticipate and respond to market changes (Narver & Slater, 1990).

Marketing capabilities provide organizations with crucial information about customer needs, competitive dynamics, and market opportunities. This information richness enables firms to identify which operational changes are necessary and how to implement them effectively (Sinkula et al., 1997). Additionally, marketing-oriented firms often possess stronger communication capabilities and stakeholder management skills, facilitating change implementation (Varadarajan, 2010). Firms with strong marketing capabilities are better positioned to recognize the need for operational changes and to implement them effectively, particularly in competitive market environments where adaptive conduct shapes performance outcomes (Nurhilalia, Aditya, 2019).

Understanding what drives organizational adaptation during crises has direct implications for crisis preparedness. If marketing orientation predicts whether firms implement operational changes, then investments in marketing capabilities prior to crises may enhance organizational agility when disruptions occur. This has economic implications for both individual firms (suggesting where to invest pre-crisis) and policymakers (suggesting which firm characteristics predict adaptive capacity). However, while the market orientation literature establishes links between marketing capabilities and general firm performance, the specific relationship between marketing activities and crisis-period operational adaptation has not been empirically tested. Establishing this relationship addresses a gap in understanding the antecedents of crisis responsiveness:

H3: Marketing activities positively predict the implementation of operational changes.

In summary, this literature review identifies three key gaps that the current study addresses. While crisis management research acknowledges contextual factors, geographic location remains underexplored as a substantive predictor rather than a control variable. Hypothesis 2 directly addresses this gap by examining whether Kazakhstan-based firms demonstrate systematically different crisis outcomes. Next, the interactive effects between marketing and operational strategies during crises have received insufficient attention; most studies treat these as independent, additive factors. Hypothesis 1 addresses this gap by testing whether marketing activities enable operational changes to be more effective. Finally, while marketing orientation is associated with adaptive capabilities, its role in predicting crisis-period operational changes has not been empirically established. Hypothesis 3 addresses this gap by examining whether marketing activities predict the implementation of operational changes. Together, these hypotheses contribute to a more nuanced understanding of crisis management that accounts for strategic interactions and geographic context.

METHODOLOGY

Data were collected from tourism organizations through three channels: face-to-face questionnaires administered to Kazakhstani and international exhibitors at the "Tourism and Travel 2025" international exhibition in Almaty, Kazakhstan (April 23–25, 2025); electronic surveys distributed via email to tourism agencies and hotels identified through online industry directories; and direct visits to tourism agencies in Almaty. Survey-based research remains an appropriate approach for examining organizational responses across multiple contexts (Brewer et al., 2016). Survey invitations were distributed to approximately 3150 firms, yielding 342 usable responses (response rate: 10.9%), comparable to other survey-based crisis management research in the tourism sector (Kukanja et al., 2022). The final sample comprised 342 firms distributed as follows: Kazakhstan (n=187, 54.7%) and Other Countries (n=155, 45.3%), spanning 39 additional countries, including CIS countries and various European and Asian nations. All measurement items were drawn from Kukanja et al. (2022) and modified to reflect the COVID-19 context. To ensure accessibility across diverse respondents, the survey was made available in English, Kazakh, and Russian.

Marketing Activities were measured using a

10-item composite scale assessing various marketing initiatives, including targeting new customers, developing new offerings, enlarging campaigns, offering discounts, enhancing customer loyalty programs, adopting digital tools, utilizing social media, increasing marketing budgets, monitoring competitors, and improving quality. Respondents rated each activity on a 5-point scale (1 = not at all, 5 = to a great extent). The composite was computed as the mean across all items, consistent with reflective measurement models.

Challenges were measured by counting four crisis-related difficulties: cash-flow problems, employee absenteeism, partner/supplier issues, and demand fluctuations. Count measures are appropriate for capturing the cumulative burden or breadth of responses when each additional item represents a distinct, additive contribution (Bollen & Lennox, 1991). Operational Changes were measured using three adaptive responses: increasing crisis-response models, updating marketing strategies, and exploring new markets. Count measures capture the breadth of organizational responses.

(1) Revenue Impact: Respondents rated their firms' revenue impact during the crisis period on a 4-point scale (1 = severe negative impact, 4 = positive impact). The use of a single-item subjective measure for revenue impact represents a methodological limitation that warrants explicit acknowledgment. While single-item measures can demonstrate acceptable validity for concrete, unambiguous constructs (Bergkvist & Rossiter, 2007), the ordinal nature of this measure and its reliance on subjective assessment rather than objective financial data constrain the precision of revenue-related findings. Practical constraints necessitated this measurement approach: collecting objective financial data from 342 firms across 40 countries was not feasible, and many small tourism enterprises lack formal financial reporting systems. However, readers should interpret findings on revenue impact with appropriate caution, recognizing that more precise measurement using objective financial indicators (e.g., actual revenue changes, profit margins) would strengthen confidence in revenue-related conclusions. This limitation is discussed further in the Limitations section.

(2) Location: Location was coded as 1 = Kazakhstan, 2 = Other countries. Location was operationalized as a binary variable, given the study's focus on Kazakhstan-specific crisis dynamics. While this operationalization has limitations in capturing heterogeneity within the "Other countries" category, which encompasses diverse institutional, economic, and competitive contexts, it aligns with the research objective of examining whether Kazakh firms exhibit distinct crisis-response patterns. The binary coding was also pragmatically driven by sample size considerations for more granular geographic analyses.

The study employed structural equation modeling (hereinafter – SEM) using lavaan in R (Rosseel, 2012) to test the hypotheses. SEM offers several advantages over traditional regression approaches for this research. First, SEM enables simultaneous estimation of multiple dependent relationships, which is crucial given that operational changes serve as both outcomes (predicted by challenges and marketing activities) and predictors (of revenue impact). Second, SEM provides a comprehensive assessment of model fit through multiple indices, offering diagnostic information on overall model adequacy. Third, SEM facilitates testing of complex moderation effects while accounting for the full pattern of relationships in the theoretical model.

Model was specified, including:

(1) Main effects of challenges, operational changes, and marketing activities on revenue impact;

(2) Interaction terms (challenges × MA, operational changes × MA) to test moderation;

(3) Location as a predictor of both revenue impact and operational changes;

(4) A path from challenges to operational changes to test for adaptation processes.

Marketing activities were mean-centered before creating interaction terms to facilitate interpretation and reduce multicollinearity. The model included 11 parameters and was estimated using maximum likelihood, which provides efficient and unbiased estimates under normality assumptions.

Model fit was evaluated using multiple indices following recommendations by Hu and Bentler (1999) and Kline (2015): Comparative Fit Index (CFI > 0.95), Tucker-Lewis Index (TLI > 0.95), Root Mean Square Error of Approximation (RMSEA < 0.08), and Standardized Root Mean Square Residual (SRMR < 0.08). Both unstandardized and standardized coefficients were reported, as recommended by Hayes (2013).

RESULTS

The structural equation model demonstrated acceptable fit to the data: CFI = 0.966, SRMR = 0.012, RMSEA = 0.086 (90% CI: 0.024–0.159), χ^2 (2) =

7.081, p = 0.029. The CFI and SRMR values exceeded conventional thresholds for good fit, while RMSEA was slightly above the ideal threshold but within an acceptable range. The model explained 33.7% of the variance in operational changes (R^2 = 0.337), indicating substantial predictive power for this outcome. However, the model explained only 3.7% of the variance in revenue impact (R^2 = 0.037). This low R^2 warrants explicit attention.

Methodological guidelines suggest that in social science research, R^2 values below 0.10 (10%) are generally acceptable only when key predictors are statistically significant. For the revenue impact outcome, the current model fails to meet either criterion: R^2 is well below 0.10, and most predictors of revenue impact do not meet conventional significance thresholds (p < 0.05). Accordingly, findings regarding the revenue impact should be interpreted as exploratory rather than conclusive, and the theoretical framework should be understood as identifying potential factors rather than as a predictive model. Table 1 presents the results of hypothesis testing.

Table 1. Structural equation model results

Path	Estimate	SE	z-value	p-value	Std. β
Revenue Impact					
Challenges → Revenue	0.009	0.050	0.177	0.859	0.011
OpChanges → Revenue	-0.014	0.055	-0.260	0.795	-0.017
MA → Revenue	-0.223	0.123	-1.816	0.069†	-0.170
Challenges × MA → Revenue	-0.030	0.080	-0.373	0.709	-0.035
OpChanges × MA → Revenue	0.141	0.085	1.653	0.098†	0.183
Location → Revenue	-0.272	0.094	-2.890	0.004*	-0.157
Operational Changes					
Challenges → OpChanges	0.336	0.044	7.558	<0.001*	0.348
MA → OpChanges	0.594	0.071	8.408	<0.001*	0.385
Location → OpChanges	0.010	0.092	0.109	0.913	0.005
*p < 0.10, *p < 0.05					

Note: compiled by the authors

The summarized results of the verification of the hypotheses put forward in the study are presented below. For each hypothesis, theoretical expectations are compared with the empirical estimates obtained, which makes it possible to assess the degree of their confirmation. Special attention is paid to the direction and statistical significance of the identified effects. This format of presentation of the results ensures the visibility and logical coherence of the analysis. A summary of the hypothesis testing results is presented in Table 2.

Table 2. Summary of hypothesis testing

Hypothesis	Prediction	Result	Verdict
H1	Marketing activities moderate the relationship between operational changes and revenue impact	β = 0.183, p = 0.098	Not supported (p > 0.05)
H2	Location significantly influences revenue impact	β = -0.157, p = 0.004	Supported
H3	Marketing activities positively predict operational changes	β = 0.385, p < 0.001	Supported

Note: compiled by the authors

Hypothesis 2 predicted that location would significantly influence revenue impact. This hypothesis was supported (β = -0.157, p = 0.004). Location was the only statistically significant predictor of revenue impact in the model. Because location was coded as 1 = Kazakhstan and 2 = Other countries, the negative coefficient indicates that Kazakhstan-based firms reported a greater revenue impact than firms in other countries. Specifically, Kazakhstan firms scored 0.272 points higher on the 4-point revenue impact scale, representing approximately 0.16 standard deviations. Location did not significantly predict operational changes (β = 0.005, p = 0.913), indicating that firms in both Kazakhstan and other countries implemented similar levels of operational adaptation.

Hypothesis 1 posited that marketing activities would moderate the relationship between operational changes and the impact on revenue. This hypothesis was not supported at conventional significance levels. The interaction term (Operational Changes × MA) did not reach statistical significance (β = 0.183, p = 0.098). Because the p-value of 0.098 exceeds the conventional threshold of 0.05, the null hypothesis cannot be rejected. The evidence for moderation is insufficient to draw firm conclusions. While the direction of the coefficient is consistent with the hypothesized relationship, readers should not interpret this as support for the hypothesis. For a more detailed interpretation of the direction of interaction, simple slopes were analyzed at different levels of marketing activity (average value and ±1 standard deviation). The results of this analysis are presented in Table 3.

Table 3. Conditional effects of operational changes on revenue at different marketing activity levels

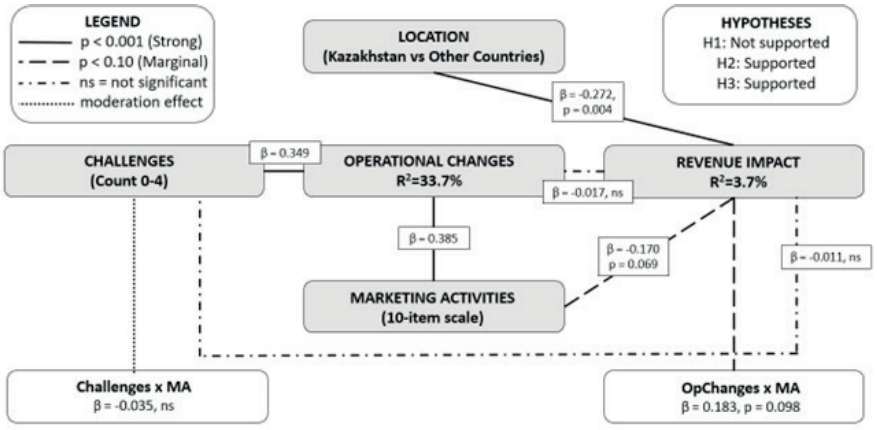
MA Level	Effect	SE	p-value
Low MA (-1 SD)	-0.155	0.101	0.127
Mean MA (0 SD)	-0.014	0.055	0.795
High MA (+1 SD)	0.126	0.101	0.214

Note: compiled by the authors

None of the simple slopes reached statistical significance. The pattern suggests that the relationship between operational changes and revenue may shift from negative at low levels of marketing activity to positive at high levels of marketing activity; however, this pattern requires replication with larger samples before substantive interpretation. The interaction between challenges and marketing activities was not significant (β = −0.035, p = 0.709). Consistent with these findings, the indirect effect of challenges on revenue through operational changes was not significant (β = −0.006, p = 0.795), as operational changes did not significantly predict revenue impact.

Hypothesis 3 proposed that marketing activities would positively predict operational changes, and this hypothesis was strongly supported. Marketing activities emerged as the strongest predictor of operational changes (β = 0.385, p <0.001): for every one-unit increase in marketing activities, firms implemented 0.594 additional operational changes. Challenges also significantly predicted operational changes (β = 0.348, p <0.001), indicating that firms experiencing greater crisis-related difficulties were more likely to undertake adaptive responses. In summary, the results provide strong support for H2 (location effect) and H3 (marketing activities predict operational changes), no support for H1 (moderation) at conventional significance levels, limited explanatory power for revenue impact (R^2 = 0.037), and substantial explanatory power for operational changes (R^2 = 0.337).

Figure 1 presents the path diagram with standardized coefficients.



Notes: N = 342 firms, CFI = 0.966, RMSEA = 0.086, SRMR = 0.012

Figure 1. Crisis recovery conceptual map

The diagram clearly reflects the structure of the verified model and the main identified relationships between the variables. A key role is assigned to marketing activities as a factor contributing to the implementation of operational changes in the context of the crisis. At the same time, the direct impact of operational changes on financial results has not been statistically supported, which highlights the limited explanatory power of the model in relation to revenue indicators. A significant result is the significant impact of geographical location on revenue dynamics, which confirms the importance of the institutional context. Taken together, the visualized relationships demonstrate that the crisis adaptation of firms is more determined by factors of context and adaptive ability than by individual strategic actions.

DISCUSSION

This study examined how location and marketing activities influence firms' crisis recovery in the tourism sector. The results provide strong support for two hypotheses and no support for a third, while also revealing important limitations in explaining revenue outcomes.

The most robust finding concerns the role of geographic location. Kazakhstan-based firms demonstrated a significantly greater revenue impact than firms in other countries ($\beta = -0.157$, $p = 0.004$), even after controlling for strategic responses and the challenges faced. This finding challenges the common practice of treating location as a mere control variable and suggests that geographic context fundamentally shapes crisis recovery trajectories. This aligns with institutional theory's emphasis on context shaping organizational actions and outcomes (Scott, 1995) and contributes to the internationalization literature by demonstrating that location may be a first-order consideration in understanding crisis response effectiveness (Meyer & Peng, 2016).

Several mechanisms may explain the Kazakhstan advantage. As a transition economy, Kazakhstan may offer opportunities unavailable in mature markets: lower competitive intensity, underserved customer segments, and greater potential for market-share gains (Khanna & Palepu, 2010). Government support programs and institutional factors specific to Kazakhstan may have mitigated the severity of the crisis. Different baseline expectations in transition versus developed economies may shape how the impact of revenue is perceived and reported. However, it is crucial to acknowledge that the binary operationalization of location (Kazakhstan vs. Other countries) represents a significant limitation. The "Other countries" category collapses highly diverse institutional environments, including developed Western European markets, CIS countries, and Asian economies, into a single comparison group. This heterogeneity makes it difficult to pinpoint precisely which contextual factors drive the observed effect. The Kazakhstan advantage may reflect characteristics of a transition economy, specific government policies, cultural factors, competitive dynamics, or some combination thereof.

The second well-supported finding concerns marketing activities as drivers of organizational adaptation. Firms with stronger marketing activities were substantially more likely to implement operational changes ($\beta = 0.385$, $p < 0.001$), with the model accounting for 33.7% of the variance in operational changes. This finding contributes to the market orientation literature by demonstrating that externally-focused, customer-centric capabilities facilitate adaptive responses to environmental disruptions (Day, 2011; Narver & Slater, 1990). It also extends research on organizational agility (Teece et al., 2016) by identifying marketing orientation as an antecedent of crisis-period adaptation.

Marketing-oriented firms may be more adaptive for several reasons: customer focus provides early warning signals about needed changes; external orientation facilitates environmental scanning and opportunity identification; communication capabilities enable change implementation by building stakeholder support (Kotter, 1995); and market-linking competencies help identify which adaptation paths are viable (Vorhies & Morgan, 2005). The strong relationship between challenges and operational changes ($\beta = 0.348$, $p < 0.001$) confirms that firms respond to crisis pressures by adapting their operations, consistent with threat-rigidity theory (Staw et al., 1981), although responses vary in effectiveness.

The hypothesized moderation effect of marketing activities on the relationship between operational changes and revenue impact was not supported at conventional significance levels ($p = 0.098$). While the pattern of simple slopes was directionally consistent with the hypothesis (operational changes showing negative effects at low marketing levels and positive effects at high marketing levels), the in-

teraction term did not reach statistical significance, and none of the individual simple slopes were significant.

This null finding warrants careful interpretation. It could indicate that: marketing activities do not, in fact, moderate the effectiveness of operational change; the effect exists but the study lacked sufficient statistical power to detect it; measurement imprecision in the count-based operational change measure obscured a true interactive relationship; or the relationship operates through mechanisms not captured in the current model. Given that the moderation hypothesis was theoretically grounded in complementarity theory (Milgrom & Roberts, 1995) and strategic fit research (Venkatraman, 1989), the null finding should prompt further investigation rather than immediate theoretical rejection. However, until replicated with larger samples and more precise measurements, claims about marketing-operations complementarity during crises should be considered speculative rather than empirically established.

The low proportion of explained variance in revenue outcomes ($R^2 = 0.037$) requires explicit discussion. This finding indicates that the theoretical framework captures only a small portion of the factors driving crisis recovery. Model fit indices for social science research suggest that R^2 values below 0.10 are acceptable only when key predictors are statistically significant (Ozili, 2023). The current model meets neither criterion for revenue impact: R^2 falls well below 0.10, and most predictors did not reach significance. This does not necessarily indicate theoretical failure, rather, it reflects the inherent complexity and unpredictability of crisis outcomes, where firm performance results from numerous interacting factors including firm size, industry dynamics, pre-crisis financial health, leadership capabilities, government interventions, and idiosyncratic crisis characteristics (Wenzel et al., 2020). Simple, parsimonious models may be insufficient for predicting crisis outcomes, suggesting that future research should employ more comprehensive frameworks or configurational approaches (for example, fuzzy-set qualitative comparative analysis) that examine how multiple factors combine.

Given the pattern of supported and unsupported findings, practical implications should be stated with appropriate caution. Two implications rest on well-supported findings. Geographic context matters for crisis outcomes. The significant location effect suggests that managers should explicitly consider their operating context when evaluating crisis response effectiveness and setting recovery expectations. Crisis management prescriptions developed in one context may not transfer to another: what works in developed Western markets may not work in transition economies like Kazakhstan, and vice versa. Rather than applying universal "best practices", firms should assess whether their market context provides conditions favorable to specific strategies (Khanna & Palepu, 2010).

Next, marketing orientation facilitates organizational adaptation. The strong relationship between marketing activities and operational changes suggests that firms seeking to enhance crisis responsiveness should invest in market-sensing capabilities, customer-insight systems, and an external orientation, rather than merely operational flexibility (Day, 2011; Teece, 2007). Marketing capabilities appear to enable firms to recognize and implement needed changes more effectively.

One implication rests on exploratory evidence and should be treated cautiously. The descriptive pattern suggesting that operational changes may be more effective when combined with strong marketing activities is intriguing but not statistically confirmed. Managers may wish to consider integrating operational and marketing responses rather than treating them as independent initiatives, but this recommendation awaits empirical confirmation.

Importantly, the low explained variance for revenue impact ($R^2 = 0.037$) indicates that the variables examined here: operational changes, marketing activities, and location, cannot reliably predict crisis recovery outcomes. Other factors not included in this study likely play substantial roles. Practitioners should not rely solely on these variables when developing crisis response strategies.

Future research could explore several extensions: mechanism studies examining which specific aspects of geographic context explain the Kazakhstan advantage; temporal dynamics examining how relationships evolve over the crisis recovery period; boundary conditions identifying when operational changes succeed without strong marketing; and marketing activity specifics examining which particular activities matter most.

CONCLUSION

This study examined the roles of geographic location and marketing activities in crisis recovery among tourism firms. The analysis provides strong support for two findings and important null results for a third. First, location emerged as the strongest and only statistically significant predictor of revenue impact. Kazakhstan-based firms reported significantly higher revenue than firms in other countries, challenging the common practice of treating location as a control variable. This finding highlights the importance of geographic context as a substantive factor shaping crisis recovery.

Second, marketing activities strongly predicted organizational adaptation. Firms with stronger marketing orientation were substantially more likely to implement operational changes, suggesting that marketing capabilities enable organizational agility during crises.

Third, the hypothesized moderation effect that marketing activities would make operational changes more effective was not supported at conventional significance levels. While the pattern of results was directionally consistent with complementarity theory, the evidence is insufficient to conclude that marketing and operational strategies interact synergistically.

Importantly, this study does not provide a predictive model for revenue outcomes. The low explained variance indicates that crisis recovery depends on numerous factors beyond those examined here. The contribution lies not in prediction, but in identifying location as a significant factor warranting further investigation and marketing orientation as a driver of adaptive capacity.

For practitioners, the findings suggest that crisis response should account for geographic context and that investments in marketing capabilities may enhance organizational adaptability. For researchers, the results highlight the importance of contingency perspectives, the challenges of modeling complex crisis outcomes, and the need for context-sensitive theory development in crisis management.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: AA; research design: AA; data collection: AA and LS; analysis and interpretation: AA and LS; writing draft preparation: AA and LS; supervision: LS; correction of article: AA; proofread and final approval of article: AA and LS. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Armenakis, A. A., & Bedeian, A. G. (1999). Organizational change: A review of theory and research in the 1990s. *Journal of Management*, *25(*3), 293-315. https://doi.org/10.1177/014920639902500303

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51(*6), 1173-1182. https://doi.org/10.1037/0022-3514.51.6.1173

Bergkvist, L., & Rossiter, J. R. (2007). The predictive validity of multiple-item versus single-item measures of the same constructs. *Journal of Marketing Research, 44*(2), 175-184. https://doi.org/10.1509/jmkr.44.2.175

Brewer, M. B., Crano, W. D., & Lac, A. (2016). Principles and methods of social research (3rd ed.). Routledge. https://doi.org/10.4324/9781315430164

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research, 21*(2), 230-258. https://doi.org/10.1177/0049124192021002005

Buckley, P. J., & Ghauri, P. N. (2004). Globalisation, economic geography and the strategy of multinational enterprises. *Journal of International Business Studies, 35*(2), 81-98. https://doi.org/10.1057/palgrave.jibs.8400076

Burnes, B. (2004). *Managing change: A strategic approach to organisational dynamics* (4th ed.). Pearson Education.

Day, G. S. (2011). Closing the marketing capabilities gap. *Journal of Marketing*, *75*(4), 183-195. https://doi.org/10.1509/jmkg.75.4.183

Doern, R., Williams, N., & Vorley, T. (2019). Special issue on entrepreneurship and crises: Business as usual? An introduction and review of the literature. *Entrepreneurship & Regional Development, 31*(5-6), 400-412. https://doi.org/10.1080/08985626.2018.1541590

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Press.

Herbane, B. (2010). Small business research: Time for a crisis-based view. *International Small Business Journal, 28*(1), 43-64. https://doi.org/10.1177/0266242609350804

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55. https://doi.org/10.1080/10705519909540118

Karácsony, P., Kireyeva, A., Valkó, V. & Nurbatsin, A. (2025). The Impact of Knowledge Management Prac-

tices on Innovation in Logistics and Distribution Enterprises in Hungary, *Journal of Distribution Science*, *23*(5), 13-25. https://doi.org/10.15722/jds.23.05.202505.13

Khanna, T., & Palepu, K. G. (2010). *Winning in emerging markets: A road map for strategy and execution*. Harvard Business Press.

Kline, R. B. (2015). *Principles and practice of structural equation modeling* (4th ed.). Guilford Press.

Kotter, J. P. (1995). Leading change: Why transformation efforts fail. *Harvard Business Review, 73*(2), 59-67.

Kovoor-Misra, S., Clair, J. A., & Bettenhausen, K. L. (2001). Clarifying the attributes of organizational crises. *Technological Forecasting and Social Change, 67*(1), 77-91. https://doi.org/10.1016/S0040-1625(99)00081-5

Kukanja, M., Planinc, T. i Sikošek, M. (2022). Crisis Management Practices in Tourism SMEs During COVID-19 - An Integrated Model Based on SMEs and Managers' Characteristics. *Tourism: An International Interdisciplinary Journal, 70* (1), 113-126. https://doi.org/10.37741/t.70.1.8

Lai, Y., Saridakis, G., Blackburn, R., & Johnstone, S. (2016). Are the HR responses of small firms different from large firms in times of recession? *Journal of Business Venturing, 31*(1), 113-131. https://doi.org/10.1016/j.jbusvent.2015.04.005

Meyer, K. E., & Peng, M. W. (2016). Theoretical foundations of emerging economy business research. *Journal of International Business Studies, 47*(1), 3-22. https://doi.org/10.1057/jibs.2015.34

Milgrom, P., & Roberts, J. (1995). Complementarities and fit: Strategy, structure, and organizational change in manufacturing. *Journal of Accounting and Economics, 19*(2-3), 179-208. https://doi.org/10.1016/0165-4101(94)00382-F

Narver, J. C., & Slater, S. F. (1990). The effect of a market orientation on business profitability. *Journal of Marketing, 54*(4), 20-35. https://doi.org/10.1177/002224299005400403

Nurhilalia, Aditya, H.P., Jusni, Kadir, A., & Mahlia, M. (2019). Determinant of Market Orientation on SME Performance: RBV and SCP Perspective. *Journal of Distribution Science*, *17*(9), 35-45. https://doi.org/10.15722/jds.17.9.201909.35

Ozili, P. K. (2023). The Acceptable R-Square in Empirical Modelling for Social Science Research. In C. Saliya (Ed.), *Social Research Methodology and Publishing Results: A Guide to Non-Native English Speakers* (pp. 134-143). IGI Global Scientific Publishing. https://doi.org/10.4018/978-1-6684-6859-3.ch009

Reeves, M., Whitaker, K., Stillman, R., & Fink, T. (2020). *How Chinese companies have responded to coronavirus*. Harvard Business Review

Rosseel, Y. (2012). Iavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*(2), 1-36. https://doi.org/10.18637/jss.v048.i02

Scott, W. R. (1995). *Institutions and organizations*. Sage Publications.

Sinkula, J. M., Baker, W. E., & Noordewier, T. (1997). A framework for market-based organizational learning: Linking values, knowledge, and behavior. *Journal of the Academy of Marketing Science, 25*(4), 305-318. https://doi.org/10.1177/0092070397254003

Srinivasan, R., Lilien, G. L., & Rangaswamy, A. (2005). Turning adversity into advantage: Does proactive marketing during a recession pay off? *International Journal of Research in Marketing, 22*(2), 109-125. https://doi.org/10.1016/j.ijresmar.2004.05.002

Staw, B. M., Sandelands, L. E., & Dutton, J. E. (1981). Threat rigidity effects in organizational behavior: A multilevel analysis. *Administrative Science Quarterly, 26*(4), 501-524. https://doi.org/10.2307/2392337

Steenkamp, J. B. E., & Fang, E. (2011). The impact of economic contractions on the effectiveness of R&D and advertising: Evidence from U.S. companies spanning three decades. *Marketing Science, 30*(4), 628-645. https://doi.org/10.1287/mksc.1110.0641

Teece, D. J. (2007). Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal, 28*(13), 1319-1350. https://doi.org/10.1002/smj.640

Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review, 58*(4), 13-35. https://doi.org/10.1525/cmr.2016.58.4.13

Urdabaev, M.T., & Utkelbay, R. (2021). SWOT analysis of smart city projects in capital cities of Russia and Kazakhstan. *R-Economy, 7*(4), 235-243. https://doi.org/10.15826/recon.2021.7.4.021

Varadarajan, R. (2010). Strategic marketing and marketing strategy: Domain, definition, fundamental issues and foundational premises. *Journal of the Academy of Marketing Science, 38*(2), 119-140. https://doi.org/10.1007/s11747-009-0176-7

Venkatraman, N. (1989). The concept of fit in strategy research: Toward verbal and statistical correspondence. *Academy of Management Review, 14*(3), 423-444. https://doi.org/10.5465/amr.1989.4279078

Vorhies, D. W., & Morgan, N. A. (2005). Benchmarking marketing capabilities for sustainable competitive advantage. *Journal of Marketing, 69*(1), 80-94. https://doi.org/10.1509/jmkg.69.1.80.55505

Vorhies, D. W., Morgan, R. E., & Autry, C. W. (2009). Product-market strategy and the marketing capabilities of the firm: Impact on market effectiveness and cash flow performance. *Strategic Management Journal, 30*(12), 1310-1334. https://doi.org/10.1002/smj.798

Wenzel, M., Stanske, S., & Lieberman, M. B. (2020). Strategic responses to crisis. Strategic Management Journal, 42(2), O16-O27. https://doi.org/10.1002/smj.3161

World Tourism Organization. (2023). UNWTO World Tourism Barometer, 21(1). UNWTO. https://doi.org/10.18111/wtobarometereng.2023.21.1.1

World Travel & Tourism Council. (2024). Travel & tourism economic impact research. WTTC. Retrieved January 10, 2026, from https://wttc.org/research/economic-impact

Wright, M., Filatotchev, I., Hoskisson, R. E., & Peng, M. W. (2005). Strategy research in emerging economies: Challenging the conventional wisdom. *Journal of Management Studies, 42*(1), 1-33. https://doi.org/10.1111/j.1467-6486.2005.00487.x

Information about the authors

***Aisha A. Akhmetbayeva** – PhD student, Researcher, KIMEP University, Almaty, Kazakhstan, email: a.akhmetbayeva@kimep.kz, ORCID ID: https://orcid.org/0000-0003-0222-9899

Lazat S. Spankulova – Doc. Sc. (Econ.), Professor, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: lyazzat.spankulova@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-1865-4681

Авторлар туралы мәліметтер

***Ахметбаева А.А.** – PhD докторант, ғылыми қызметкер, КИМЭП Университеті, Алматы, Қазақстан, email: a.akhmetbayeva@kimep.kz, ORCID ID: https://orcid.org/0000-0003-0222-9899

Спанкулова Л.С. – э.ғ.д., профессор, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: lyazzat.spankulova@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-1865-4681

Сведения об авторах

***Ахметбаева А.А.** – PhD докторант, исследователь, Университет КИМЭП, Алматы, Казахстан, email: a.akhmetbayeva@kimep.kz, ORCID ID: https://orcid.org/0000-0003-0222-9899

Спанкулова Л.С. – д.э.н., профессор, Казахский Национальный Университет им. аль-Фараби, Алматы, Казахстан, email: lyazzat.spankulova@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-1865-4681

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-65-78
МРНТИ 06.73.55
JEL: G21, G32, O22

Check for updates
BY-NC 4.0

A Project-Based Approach to Managing Non-Performing Mortgage Loans: Evidence from Europe and Asia

Javokhir S. Mukhamedov[a]*, Tatyana S. Sokira[a], Zebo Kuldasheva[b]

[a] Al-Farabi Kazakh National University, 71 al-Farabi Ave., Almaty, Kazakhstan; [b]Tashkent State University of Economics, Islom Karimov 49, Tashkent, Uzbekistan.

For citation: Mukhamedov, J. S., Sokira, T. S. & Kuldasheva, Z. (2026). A Project-Based Approach to Managing Non-Performing Mortgage Loans: Evidence from Europe and Asia. Economy: strategy and practice, 21 (1), 65-78. https://doi.org/10.51176/1997-9967-2026-1-65-78

ABSTRACT

In the context of increasing macroeconomic instability and increasing credit risks, the analysis of the factors of formation of problem mortgage loans in the banking system is becoming particularly relevant. This study aims to develop and propose a conceptual project-based framework, the NPL Project Approach that conceptualizes the management of non-performing mortgage loans as an integrated project cycle. The methodological basis of the research consists of methods of descriptive statistics, correlation analysis and multiple regression modeling. The empirical basis of the study consists of data collected from the Bureau of National Statistics and the National Bank of the Republic of Kazakhstan for the period 2020-2024, including indicators of household income, gross domestic product, inflation, interest rates, deposits and overdue debt. The analysis results show that the average level of problem loans in the European Union decreased from 2.6% in 2020 to 1.9% in 2024, reflecting an increase in the effectiveness of credit risk management systems. In Central Asian countries, the level of problem loans in Kazakhstan decreased from 6.9% in 2020 to 3.1% in 2024, indicating a partial improvement in the quality of the loan portfolio, but sensitivity to the growth of mortgage lending remains. The prospects for further research include empirical verification of the model based on case studies of emerging market banks, quantification of its impact on loan portfolio performance, as well as adaptation of the approach to other non-mortgage lending segments.

KEYWORDS: Non-Performing Loan, Credit, Credit Risk, Bank, Banking Strategy, Financial Stability, Financial Regulation, Economic Sustainability

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest.

FINANCIAL SUPPORT: the study was not sponsored (own resources).

Article history:
Received 13 December 2025
Accepted 07 March 2026
Published 30 March 2026

*** Corresponding author: Mukhamedov J.S.** – PhD candidate, Al-Farabi Kazakh National University, 71 al-Farabi Ave., Almaty, Kazakhstan, 87014493240, email: javokhir.mukhamedov@gmail.com

Проектный подход к управлению проблемными ипотечными кредитами: сравнительный анализ Европы и Азии

Мухамедов Ж.Ш.[a]*, Сокира Т.С.[a], Кулдашева З.[b]

[a]Казахский национальный университет им. аль-Фараби, про. Аль-Фараби 71, Алматы, Казахстан; [b]Ташкентский государственный экономический университет, ул. Ислама Каримова 49, Ташкент, Узбекистан

Для цитирования: Мухамедов Ж.Ш., Сокира Т.С., Кулдашева З. (2026). Проектный подход к управлению проблемными ипотечными кредитами: сравнительный анализ Европы и Азии. Экономика: стратегия и практика, 21 (1), 65-78. https://doi.org/10.51176/1997-9967-2026-1-65-78

АННОТАЦИЯ

В условиях усиления макроэкономической нестабильности и роста кредитных рисков особую актуальность приобретает анализ факторов формирования проблемных ипотечных кредитов в банковской системе. Данное исследование направлено на разработку и предложение концептуальной проектной модели управления проблемной задолженностью (NPL), которая рассматривает управление проблемными ипотечными кредитами как интегрированный проектный цикл. Методологическую основу исследования составляют методы описательной статистики, корреляционного анализа и множественного регрессионного моделирования. Эмпирическую базу исследования составляют данные, собранные из Бюро национальной статистики и Национального банка Республики Казахстан за период 2020–2024 гг., включая показатели доходов населения, валового внутреннего продукта, уровня инфляции, процентных ставок, объема депозитов и просроченной задолженности. Результаты анализа показывают, что средний уровень проблемных кредитов в Европейском союзе снизился с 2,6% в 2020 г. до 1,9% в 2024 г., что отражает повышение эффективности систем управления кредитным риском. В странах Центральной Азии уровень проблемных кредитов в Казахстане сократился с 6,9% в 2020 г. до 3,1% в 2024 г., что свидетельствует о частичном улучшении качества кредитного портфеля, однако сохраняется чувствительность к росту ипотечного кредитования. Перспективы дальнейших исследований включают эмпирическую проверку модели на основе кейс-исследований банков развивающихся рынков, количественную оценку ее влияния на показатели кредитного портфеля, а также адаптацию подхода к другим сегментам кредитования, не связанным с ипотекой.

КЛЮЧЕВЫЕ СЛОВА: проблемный кредит, кредит, кредитный риск, банк, банковская стратегия, финансовая стабильность, финансовое регулирование, экономическая устойчивость

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов.

ФИНАНСИРОВАНИЕ: исследование не имело спонсорской поддержки (собственные ресурсы).

История статьи:
Получено 13 декабря 2025
Принято 07 марта 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Мухамедов Ж.Ш.** – PhD докторант, Казахский национальный университет им. аль-Фараби, пр. Аль-Фараби,71, Алматы, Казахстан, 87014493240, email: javokhir.mukhamedov@gmail.com

INTRODUCTION

Non-performing mortgage loans remain a major source of financial instability in banking systems, especially in emerging market economies, where rapid mortgage lending expansion is accompanied by heightened sensitivity to macroeconomic shocks. The level and persistence of non-performing loans (hereinafter – NPLs) in mortgage portfolios are determined by a complex interaction among borrower behaviour, housing-price dynamics, credit standards, monitoring quality, regulatory policy, and the organisational maturity of financial institutions. Since mortgage credit risk develops unevenly over time and across regions, the diagnosis, forecasting and management of NPLs remain serious challenges for both banks and regulators.

Recent international monitoring confirms significant regional differences in NPL dynamics. In the European Union, the average NPL ratio declined from approximately 2.6% in 2020 to around 1.9% in 2024, reflecting improvements in supervisory systems and risk-management practices. In contrast, several emerging markets in Europe and Asia continue to face higher and more volatile levels of non-performing assets due to rapid credit growth, institutional constraints and increased exposure to macroeconomic shocks, while the average NPL ratio for Asia as a whole remains around 1.6% but masks large cross-country differences (EBRD, 2025; ADB, 2025).

Existing approaches to managing NPLs tend to focus on individual components of the credit-risk management system. Numerous studies examine borrower-level credit-risk modelling, default forecasting, or macroprudential regulation, while others analyse monitoring procedures or restructuring mechanisms (Crouhy et al., 2000; Suryanto et al. 2022; Bermpei et al., 2023; Cenzon & Szabó, 2024). However, these approaches are often developed separately and rarely integrated into a single organizational framework. As a result, analytical models are implemented without clear links to operational processes, monitoring signals are not systematically connected to intervention decisions, and regulatory constraints do not always ensure coordinated action by banks, supervisory authorities and government agencies.

At the same time, recent research and practice in banking management show that complex organizational transformations such as digitalisation, risk-management reforms and process restructuring are increasingly implemented within project-based structures. Project management provides structured phases, clearly defined responsibilities and feedback mechanisms that help align analytical tools, operational procedures and strategic decisions within a single governance structure. Applying this logic to the management of non-performing mortgage loans suggests that NPL resolution should be organised as an integrated project cycle rather than as a set of fragmented analytical and operational activities.

Despite a growing body of research on credit risk, NPL determinants and supervisory policy, existing studies rarely treat the management of non-performing mortgage loans as a unified project-oriented process that links early-warning systems, ongoing monitoring, intervention measures and portfolio resilience within a single organizational framework. This gap limits the ability of banks and regulators to coordinate decisions at different stages of the credit cycle, especially in emerging economies characterised by rapid growth in mortgage lending and higher macro-financial volatility.

Therefore, this study aims to develop and propose a conceptual project-based framework, the NPL Project Approach that conceptualizes the management of non-performing mortgage loans as an integrated project cycle. The relevance of the framework is substantiated through an analysis of recent NPL dynamics and institutional practices in European and Asian banking systems, providing a basis for more coordinated and effective NPL management strategies.

LITERATURE REVIEW

Early discussions of credit risk in the first half of the twentieth century were primarily descriptive and supervisory, relying on expert judgment and simple balance sheet indicators rather than formal statistical models. A major methodological shift occurred in the 1960s with the emergence of quantitative approaches, most notably Altman's Z-score model (1968), which introduced discriminant analysis for bankruptcy prediction and became a benchmark for firm-level credit-risk assessment. In the 1970s, structural models further advanced the field, with Merton's (1974) framework conceptualizing default as a contingent-claims problem driven by the sto-

chastic dynamics of firm asset values and leverage. During the 1980s and 1990s, the focus expanded to portfolio-level risk, leading to the development of credit portfolio models that account for default correlations and loss distributions (Crouhy et al., 2000). Regulatory and methodological reviews, including those of the Basel Committee on Banking Supervision (BCBS, 1999) and later retrospective analyses of credit-risk models, highlighted both the analytical strengths and practical limitations of these approaches, emphasizing issues such as parameter instability, data requirements, and model risk in real-world banking applications (Altman et al., 2017).

Since the early 2000s, the literature has increasingly focused on portfolio-level risk management, regulatory capital and the macro-financial environment in which NPLs accumulate. Advances in internal ratings-based approaches and credit portfolio modelling have stimulated research on stress testing and economic capital, highlighting how macroeconomic cycles, sectoral shocks and portfolio composition jointly shape expected and unexpected losses on bank balance sheets (Crouhy et al., 2000). At the same time, cross-country empirical studies have analyzed how GDP growth, unemployment, interest rates, credit expansion and bank-specific characteristics explain the accumulation of NPLs in different banking systems. International institutions have compiled extensive databases on the dynamics of NPLs during banking crises and on the effectiveness of alternative resolution strategies, World Bank reviews of NPL management in banks, and regional assessments of the causes, impacts and resolution strategies of NPLs in Asia and Europe (Van Zwieten, 2019; ADB & ECB, 2021). Complementary regional monitoring reports further document recent NPL developments: high-frequency evidence on the evolution of NPLs in Asian banking systems is provided by the Asian Development Bank and IPAF Asia, while European monitoring reports track post-crisis balance-sheet repair in Europe and Central and Eastern Europe (ADB, 2025; EBRD, 2025). Taken together, these contributions have shaped a macro-prudential and institutional perspective on NPLs, which complements traditional micro-level credit-risk models and provides a basis for more recent research on mortgage NPLs.

Against this backdrop, the contemporary academic literature on NPLs can be divided into several interconnected research streams, which provide a structured framework for analysing prior work and positioning the proposed model. Recent studies emphasize that the formation and management of non-performing mortgage loans is a multifactorial process involving behavioral, macroeconomic, regulatory and institutional elements. Analyzes of structural instability in default models show that borrowers and financial intermediaries adapt to lenders' policies, leading to systematic biases in default-probability forecasts and an increase in the volume of NPLs (Smith & Yezer, 2025). The importance of behavioural factors is confirmed by research showing that households' inflation experience and expectations affect mortgage-product choice and the probability of future delinquency (Cenzon & Szabó, 2024). The spatial connectedness of housing markets increases the sensitivity of mortgage portfolios, as Balcılar et al. (2024) showed that during periods of macroeconomic instability, price shocks spread more quickly across regions. At the same time, climate risks are becoming an independent driver of deterioration in mortgage asset quality. Holtermans et al. (2024) demonstrated that extreme weather events significantly increase the probability of payment arrears. At the institutional level, Bianco et al. (2025) showed that regulatory changes redistribute the share of risky loans between large and small banks, thereby affecting future NPL levels.

First, therefore, a large number of studies examine the macroeconomic and behavioral determinants of mortgage delinquency and default, highlighting the combined impact of income dynamics, housing prices, expectations and regulatory changes on the formation of non-performing mortgage loans and linking earlier macro-prudential work on NPL cycles with recent behavioral and spatial perspectives. In the field of credit risk modeling, there is a clear shift from static scoring models to more advanced algorithms that account for borrower behavior and external shocks. Bosker et al. (2025) examined machine-learning-based variable selection in clustered credit risk models, while Suryanto et al. (2022) and Sanz-Guerrero and Arroyo (2025) analyzed transfer learning and large language model approaches for credit risk and delinquency prediction in environments with limited or evolving default data. Chen et al. (2025) and Han et al. (2025) showed how nonlinear optimisation, gradient-descent tree algorithms and symmetry-aware deep-learning architectures can be combined to enhance credit-risk assessment

and credit-strategy design. Noriega et al. (2025) provided evidence from Peru that crisis-period delinquency prediction can be improved by tailoring machine-learning models to critical external factors, reinforcing the importance of model adaptability in volatile macro-financial environments. Together with research on Bayesian models within international financial reporting standards and on cluster and deep-learning models for robust estimation of default probabilities and expected losses, these studies demonstrate how modern analytical tools expand the classical credit-risk toolkit.

Second, a rapidly expanding stream of research focused on methods for modeling and forecasting credit risk, shifting from traditional scoring systems to advanced statistical and machine learning approaches that integrated behavioral, textual, and macro-financial information and extended beyond the classic models of the late twentieth century. Research on credit monitoring emphasized the transition from static control procedures to process-oriented and digital methods. Process mining and business process analysis algorithms that integrated industry standards and internal bank knowledge were able to identify rare but critical deviations (Li et al., 2025). Bermpei et al. (2023) showed that managers' personality traits influenced monitoring styles in syndicated loans, with more individualistic managers tending to apply softer control, thereby altering the portfolio's risk profile. Instefjord and Nakata (2022) argued that micro-prudential regulation reduced banks' incentives to engage in dynamic monitoring, increasing their reliance on static approaches. Crosato et al. (2024) demonstrated that alternative digital data, such as website structure, content, and online activity, could be used to construct continuous monitoring indicators that signalled borrower deterioration earlier than traditional reporting. Beyond anomaly detection in business processes, Silva et al. (2019) and Simonović and Todorović (2019) showed that Monte Carlo simulation and project management techniques could be applied to banking operations and product development, highlighting the relevance of quantitative tools for operational risk and innovation management, while Christou et al. (2010) demonstrated that agile process frameworks could be successfully adapted to banking IT projects, anticipating later developments in digital transformation in the sector.

Third, a growing body of literature therefore analyses monitoring mechanisms and early-warning systems, emphasising the transition from static checks to continuous, process- and data-driven oversight of borrowers and portfolios, and addressing weaknesses of earlier frameworks in which monitoring was primarily viewed as a static back-office function. The literature on restructuring and optimizing problem-loan processes analyzes how the combination of data, timing and intervention methods affects the effectiveness of debt collection. Chai et al. (2023) proposed an integrated analytical approach to identify hidden default patterns in loans to small and medium-sized enterprises. Witzany and Kozina (2022) described that regression models for estimating time to recovery outperform logistic models when choosing the timing of the transition to soft collection measures. Gutkowski (2021) demonstrated that successful sovereign-debt restructuring creates macroeconomic conditions conducive to domestic credit growth. Forster and Sun (2022) confirmed that macro-prudential policies, including loan-to-value regulation, can smooth credit-price cycles and reduce the likelihood of future NPLs.

Fourth, a substantial body of work examines restructuring mechanisms and regulatory instruments aimed at reducing the accumulation of non-performing assets by linking micro-level collection strategies with macro-prudential instruments and sovereign-debt resolution, echoing the policy-oriented NPL literature developed by international institutions. The regulatory environment, more broadly, is a key factor in determining the volume of NPLs. Rahman et al. (2023) showed that fiscal consolidation in countries with high public debt increases the share of NPLs: soft consolidation leads to a moderate deterioration in portfolio quality, whereas hard consolidation causes a pronounced increase in NPLs. From a supervisory and accounting perspective, Jakubik and Teleu (2025) examined how IFRS-9-based expected-credit-loss frameworks affect credit-risk assessment in uncertain environments, while Scope Ratings (2025) and the EBRD's NPL Monitor (2025) provided practitioner-oriented evidence on how regulatory guidance, provisioning practices and secondary-market development influence banks' NPL trajectories. Authors also emphasise that cross-country data comparability is hampered by differences in NPL definitions, treatment of restructured loans, and compliance with international reporting standards, underscoring the need to

analyse regulatory and fiscal conditions when formulating NPL-management strategies.

Research on project management and organizational change in the banking sector shows that a significant proportion of transformation initiatives is implemented through structured project mechanisms. Iljins and Skvarciany (2015) showed that effective change management is crucial for building and maintaining customer trust in commercial banks, while Sarfraz et al. (2018) analyzed how environmental-risk-management strategies and corporate social responsibility shape project-financing decisions, highlighting the need to integrate sustainability and stakeholder engagement into banking project cycles. Rodrigues et al. (2023) highlighted the central role of technology-management capabilities in driving successful digital transformation in banks, demonstrating that the quality of coordination, communication and agile governance within project teams is a key determinant of transformation outcomes. These studies, together with earlier work on Monte Carlo simulation in banking operations, agile process frameworks in banking IT and project-management techniques in banking product development, reinforce the view that complex banking initiatives from risk-management reform to digitalisation, benefit from structured project cycles with clearly defined stages, roles and coordination mechanisms (Silva et al., 2019; Simonović & Todorović, 2019).

Finally, recent research on project management and organizational change in the banking sector emphasizes that complex transformations, including risk-management and digitalisation initiatives, are typically implemented through structured project cycles with clearly defined stages, roles and coordination mechanisms, suggesting that similar project structures may be useful for organising NPL management. International practice has contributed significantly to the understanding of NPL management. An analysis of World Bank country cases (Bauze, 2021) showed that the successful reduction of NPLs in countries such as Serbia, Albania, Slovenia, and Tunisia was achieved through comprehensive, structured, and inter-agency strategies that were broadly consistent with cross-country policy reviews of NPL management (World Bank, 2019; ADB & ECB, 2021). These countries established working groups on NPL reduction, set measurable targets, developed project plans and allocated roles among banks, regulators and government agencies. This experience confirms that NPL management requires a project-based approach with phased implementation, coordination among participants, clear control mechanisms, stakeholder engagement and adaptable solutions.

Overall, the literature shows that macroeconomic variables, borrower behavior, supervisory intensity and the organizational maturity of banks influence the risk of non-performing mortgage loans. Multi-level and integrated NPL management should combine analytical models, process monitoring, restructuring mechanisms, the regulatory context and a project-based approach to managing banking processes. At the same time, existing research streams primarily develop these components in isolation and rarely conceptualise the management of non-performing mortgage loans as a single, integrated project cycle. As a result, banks and regulators receive fragmented recommendations on default forecasting, monitoring, restructuring or regulatory design, but lack a unified concept that combines early risk identification, continuous monitoring, intervention measures and long-term portfolio sustainability within a coherent organizational structure. This methodological gap motivates the present study and underpins the development of the NPL Project Approach model, which treats the management of non-performing mortgage loans as an integrated project cycle.

METHODOLOGY

This study is qualitative and conceptual, relying on secondary data analysis and theoretical synthesis rather than on primary empirical data collection. It adopts a structured conceptual research design that integrates a targeted literature review, a comparative analysis of secondary macroeconomic data, and an integrative synthesis procedure to develop a practice-oriented framework for managing non-performing mortgage loans. A conceptual research design was chosen because the study aims to synthesise fragmented knowledge across multiple disciplines credit risk, banking regulation, and project management into an integrated framework, rather than to test specific hypotheses on primary data. The research followed four sequential stages.

At the first stage, a structured search and selection of academic sources was conducted. The search

covered international peer-reviewed journals indexed in Scopus and Web of Science, as well as reports and databases of international financial institutions (IMF, World Bank, ADB, EBRD, ECB, Scope Ratings). The primary time frame was 2010–2025, although seminal earlier works that established the theoretical foundations of credit risk analysis (e.g., Altman, 1968; Merton, 1974; Basel Committee, 1999; Crouhy et al., 2000) were also included where relevant.

The search was conducted in English using keyword combinations such as 'non-performing loans', 'mortgage default', 'credit risk' modeling", 'NPL resolution', 'early warning systems', 'loan portfolio monitoring', 'restructuring of distressed debt', and 'project management in banking'. Publications were retained if they (i) directly addressed non-performing loans in banking or mortgage markets, credit risk, monitoring or restructuring; (ii) analyzed institutional, regulatory or organizational mechanisms of NPL management; and (iii) contained conclusions with clear implications for managerial practice. Studies that mentioned non-performing loans only in passing were excluded. A large body of literature was initially reviewed, of which 41 publications met the inclusion criteria and were retained for thematic analysis. It should be noted that the search was limited to English-language sources and did not follow a formal systematic review protocol (e.g. PRISMA); accordingly, the procedure is best described as a structured narrative review with explicit inclusion criteria.

At the second stage, the selected publications were grouped into five thematic streams corresponding to the main components of NPL management: (1) macroeconomic and behavioral determinants of mortgage default; (2) credit-risk modeling and forecasting methods; (3) monitoring mechanisms and early-warning systems; (4) restructuring instruments and macroprudential tools; and (5) project management and change management in financial institutions. Within each stream, the strengths and limitations of existing approaches were identified, and possibilities for their integration into a unified system were assessed.

In the third stage, a comparative analysis of secondary data on NPL dynamics was conducted. Two summary tables in heatmap format were compiled using publicly available data from Scope Ratings GmbH (2025) for EU countries and IPAF Asia (2025) for Asian sub-regions, covering the period 2020–2024. In addition, forward-looking NPL projections published by the Asian Development Bank (2025) were used to supplement the retrospective analysis. The comparative analysis illustrated regional differences in credit-risk trajectories and contextualised the relevance of the proposed framework for emerging mortgage markets.

At the fourth stage, a conceptual synthesis procedure was applied to develop the NPL Project Approach model. Based on the thematic analysis of the literature and the patterns identified in the comparative data, the key phases of non-performing loan management (early risk identification, monitoring and intervention, portfolio and sustainability management) were mapped to the typical stages of a project cycle (initiation, planning, implementation, monitoring and closure), drawing on established project-management standards (PMBoK, ISO 21502). For each phase, the roles of banks, regulators and government agencies, the main information flows and the decision points were specified, resulting in a formalised project-based framework for NPL management.

This four-stage methodological approach formed the basis for the results presented in the following section.

RESULTS

This section presents the results of a comparative analysis of the dynamics of problem loans (NPL) in the banking systems of Europe and Asia for the period 2020-2024. The analysis is based on aggregated statistical data characterizing the level and change in the share of problem assets in banks' loan portfolios, which makes it possible to assess the quality of credit risk in various institutional and macroeconomic conditions. The presented data form an empirical basis for subsequent comparisons with emerging markets and for interpreting the identified trends in the context of institutional and structural features. Summary indicators for the European Union countries are presented in Table 1.

Table 1. NPL ratio in the EU for 2020–2024

Country	2020	2021	2022	2023	2024
European Union	2,6%	2,0%	1,8%	1,8%	1,9%
Austria	2,1%	1,9%	1,8%	2,2%	2,4%
Belgium	2,0%	1,5%	1,5%	1,2%	1,3%
Denmark	1,9%	1,7%	1,4%	1,3%	1,3%
Finland	1,5%	1,3%	0,9%	1,1%	1,2%
France	2,2%	1,9%	1,9%	1,9%	2,0%
Germany	1,3%	1,1%	1,1%	1,3%	1,6%
Italy	4,1%	3,1%	2,5%	2,4%	2,3%
Spain	2,9%	3,1%	2,8%	2,8%	2,7%
Sweden	0,5%	0,3%	0,2%	0,3%	0,4%
Netherlands	2,0%	1,5%	1,4%	1,4%	1,5%

Note: compiled by the authors based on Scope Ratings GmbH (2025)

As shown in Table 1, the average EU NPL ratio declined from 2.6% in 2020 to 1.9% by 2024. This trend reflects the maturity of the European credit risk management system, which includes a developed secondary market for non-performing assets, institutionalized restructuring procedures, stringent supervisory standards, and regular stress testing of mortgage portfolios. Italy and Spain, which initially exhibited comparatively elevated NPL levels (4.1% and 2.9%, respectively), demonstrated sustained reductions, while several Northern European countries (Sweden, Denmark, and Finland) maintained consistently low ratios throughout the period. At the same time, Austria and Germany showed a modest upward trend in 2023–2024, suggesting that even mature banking systems are not immune to localized credit quality pressures. Overall, the European experience can serve as a benchmark for emerging mortgage markets, highlighting the importance of comprehensive regulation and transparent reporting for effective NPL management.

To compare regional credit risk features and assess the heterogeneity of problem-loan dynamics in developing financial systems, an analysis of Asian countries over the same period was conducted. Unlike European banking systems, the Asian region is characterised by greater variability in institutional conditions, credit growth rates, and levels of regulatory development, leading to significant differences in NPL dynamics. As shown in Table 2, the evolution of the share of NPLs across four Asian subregions (East, South, Southeast, and Central Asia) from 2020 to 2024 is presented.

Table 2. NPL ratio in Asia for 2020–2024

Country	2020	2021	2022	2023	2024
Asia				1,7%	1,6%
East Asia				1,5%	1,4%
Japan	1,2%	1,3%	1,2%	1,3%	1,2%
Mongolia	11,7%	10,0%	9,1%	7,5%	5,1%
People's Republic of China	1,8%	1,7%	1,6%	1,6%	1,5%
Republic of Korea	0,5%	0,4%	0,3%	0,4%	0,4%
South Asia				4,0%	3,5%
Bangladesh	7,7%	7,9%	8,2%	9,0%	20,2%
India	7,9%	6,5%	4,8%	3,4%	2,5%
Nepal	1,7%	1,2%	2,4%	3,8%	4,6%
Pakistan	9,2%	7,9%	7,3%	7,6%	6,3%
Sri Lanka	4,9%	4,5%	12,0%	13,1%	12,9%
Southeast Asia				2,6%	2,6%
Cambodia	2,1%	2,0%	3,1%	5,4%	7,0%
Indonesia	3,1%	3,0%	2,4%	2,2%	2,1%

Malaysia	1,6%	1,7%	1,7%	1,7%	1,4%
Philippines	3,6%	4,0%	3,2%	3,2%	3,3%
Singapore	2,6%	2,1%	1,8%	1,7%	1,3%
Thailand	3,1%	3,0%	2,7%	2,7%	2,7%
Viet Nam	1,7%	1,5%	2,0%	4,6%	5,4%
Central Asia				2,8%	2,7%
Armenia	4,5%	1,9%	2,8%	2,4%	1,2%
Azerbaijan	6,1%	4,6%	2,6%	1,9%	1,9%
Kazakhstan	6,9%	3,3%	3,4%	2,9%	3,1%
Uzbekistan	2,1%	5,1%	3,5%	3,5%	3,9%

Note: compiled by the authors based on IPAF Asia (2025)

The data in Table 2 reveal pronounced regional heterogeneity. East Asian banking systems (Japan, China, and the Republic of Korea) maintained low and stable NPL ratios (1.2–1.8%), reflecting well-developed risk-management infrastructure and institutional stability. In contrast, South Asia exhibited the highest and most volatile levels: Bangladesh experienced a sharp increase to 20.2% by 2024, while India achieved a notable reduction from 7.9% to 2.5% over the same period. In Central Asia, Kazakhstan occupies an intermediate position — its NPL ratio declined from 6.9% to 3.1%, yet sensitivity to accelerated mortgage-portfolio growth and household debt burden persists, requiring stronger supervision. Uzbekistan's NPL ratio remains officially moderate (3.9% in 2024), but rapid lending expansion and the limited history of the mortgage market create potential vulnerabilities that warrant deeper monitoring and integrated risk-management mechanisms.

To supplement the retrospective analysis, Table 3 presents the Asian Development Bank's (2025) forecast of NPL dynamics for selected countries over the next four quarters, together with the key macroeconomic determinants identified for each case.

Table 3. ADB NPL projections and key risk determinants in Asia (Next 4Q)

Country	Forecast NPL (%, min–max)	Summary	Key determinant
Indonesia	2.6%–3.1%	Sharp increase	Government Consumption
Kazakhstan	3.4%–4.2%	Less volatile	Government Debt
Malaysia	≈1.6%	Remain high	Government Consumption
Mongolia	7.3%–8.3%	More volatile	NPL Ratio (past)
People’s Republic of China	≈1.6%	Maintain	NPL Volume (past)
Republic of Korea	0.3%–0.4%	Slight decline	Household Mortgage
Thailand	≈2.9%	Slight increase	Industrial Product Index
Vietnam	3.0%–3.3%	Fluctuating	Market Capitalization

Note: compiled by the authors based on ADB (2025)

These projections provide a forward-looking dimension that contextualizes the relevance of adaptive approaches to NPL management. As Table 3 indicates, the forecasts show mixed dynamics. China, South Korea, and Malaysia are expected to maintain low NPL levels, while Mongolia and Indonesia are projected to see increases. Kazakhstan shows a trend toward gradual stabilization (3.35–4.23%), consistent with the strengthening of supervisory measures. A comparison of the historical data (Tables 1–2) with these forward-looking estimates provides a comprehensive picture of the evolution of credit risk in both regions and underscores the need for adaptive, project-oriented frameworks for NPL management, particularly in emerging markets where credit-risk trajectories remain volatile.

Based on the thematic analysis of the literature and the patterns identified in the comparative data above, this study proposes “the NPL Project Approach model”, which conceptualizes the management of non-performing mortgage loans as a structured project cycle and is illustrated in Figure 1.

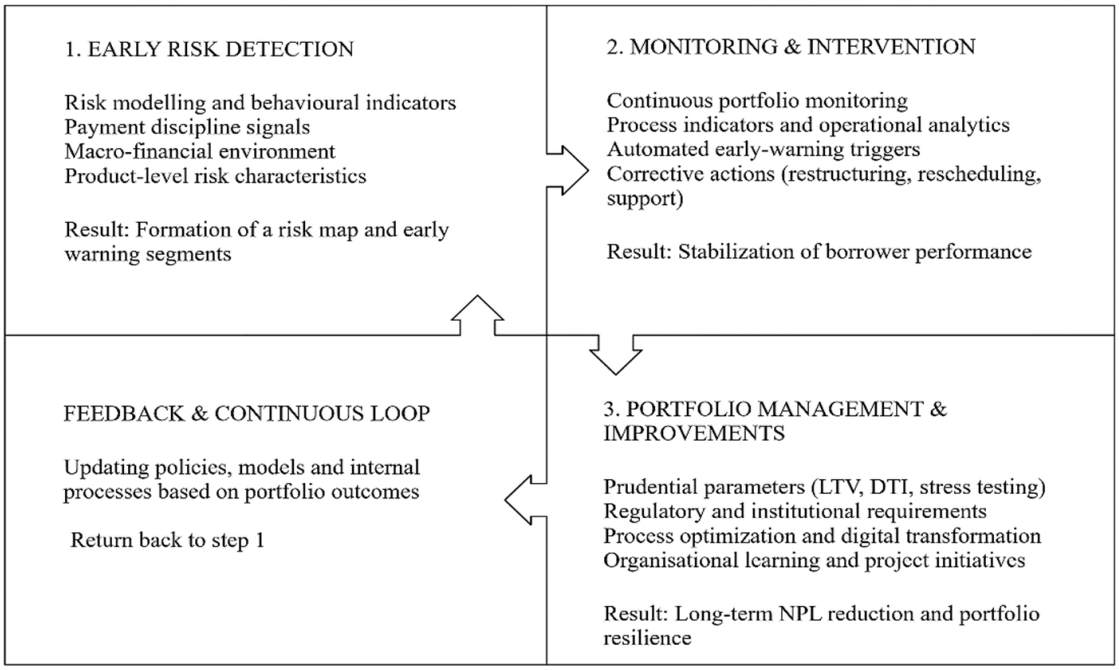


Figure 1. Conceptual project cycle of the NPL Project Approach model

As shown in Figure 1, the model comprises three sequential stages that form a continuous cycle with feedback loops between analytical diagnostics, operational interventions, and strategic portfolio decisions. The first stage (early risk detection) focuses on the preliminary identification of borrowers and credit segments at increased risk of financial deterioration. At this stage, the bank uses risk-modelling outputs, borrower-behavior data, macroeconomic signals, and credit-product parameters to map potential risk areas, thereby enabling early corrective action. The second stage combines continuous monitoring with managerial intervention measures. Regular tracking of payment discipline, internal operational data, and changes in borrower behavior enables timely detection of deviations. Where necessary, intervention measures are initiated, such as restructuring, term adjustments, or personalized borrower support, to stabilize the client's financial situation and prevent the loan from being classified as non-performing. The third stage (portfolio management and sustainability) shifts the focus to the long-term resilience of the mortgage portfolio. Banks incorporate macroprudential requirements, stress test results, regulatory changes, and organizational factors into credit policy revisions, process improvements, and staff training, ultimately reducing NPL levels and strengthening risk management.

DISCUSSION

The development of the NPL Project Approach confirms that managing non-performing mortgage loans requires a comprehensive, project-oriented approach rather than isolated tools. Empirical studies show that even advanced default-prediction and credit-risk models do not prevent NPL accumulation when not embedded in organizational decision-making processes (Smith & Yezer, 2025; Bosker et al., 2025). The proposed framework extends this literature by explicitly linking analytical models to monitoring, restructuring, and portfolio-level decisions within a single project cycle.

The three-stage structure of the model reflects evidence that mortgage distress is driven by a combination of behavioral, macroeconomic, and regulatory factors (Cenzon & Szabó, 2024; Balcılar et al., 2024; Holtermans et al., 2024). Early-warning tools and portfolio segmentation address the determinants of delinquency, while the monitoring and intervention stage translates risk signals into concrete actions, and the portfolio-management stage aligns underwriting and restructuring policies with long-term sustainability goals.

The emphasis on process-based monitoring and clearly defined responsibilities is consistent with research calling for a shift from static checks to con-

tinuous, data-driven surveillance (Li et al., 2025; Bermpei et al., 2023; Instefjord & Nakata, 2022). By assigning monitoring roles, decision rules, and escalation paths, the NPL Project Approach offers a practical way to ensure that early signals of borrower distress lead to timely interventions rather than remaining confined to risk reports.

The model also resonates with international practice. The World Bank's NPL Resolution: Country Cases (Bauze, 2021) and the European Parliament study by Bertay and Huizinga (2021) show that successful NPL reduction is achieved through coordinated strategies with clear timelines and institutional roles, not through individual instruments alone. The proposed approach provides a conceptual structure for such programs, formalizing the roles of banks, supervisors, and government agencies within an integrated project framework that can be adapted to emerging mortgage markets such as Kazakhstan and Uzbekistan, where rapid credit growth and macro-financial volatility heighten the need for coordinated NPL management.

Overall, the NPL Project Approach does not replace existing analytical or regulatory tools; it offers a unifying, project-based framework that connects early-warning systems, operational decisions, and portfolio-level adjustments, thereby transforming fragmented insights into NPL determinants, monitoring, and restructuring into a coherent organizational model.

CONCLUSION

This study developed the NPL Project Approach model, a conceptual framework that reconceptualizes the management of non-performing mortgage loans as an integrated three-stage project cycle, moving beyond the fragmented treatment of credit risk diagnostics, monitoring, and restructuring that characterizes the existing literature. Three principal findings emerge from the analysis.

First, the comparative examination of NPL dynamics across EU and Asian banking systems (2020–2024) demonstrates that sustained NPL reduction in the EU over this period is associated not with any single instrument but with the coordinated functioning of supervisory standards, secondary NPL markets, and institutionalized restructuring procedures. Second, the pronounced heterogeneity observed in Asia, where NPL ratios range from below 2% to above 7% across sub-regions, confirms that institutional maturity, regulatory capacity, and the pace of credit expansion are critical mediating factors that determine whether analytical tools translate into effective portfolio outcomes. Third, forward-looking ADB projections indicate that emerging markets in Central and Southeast Asia face continued credit-quality pressures, underscoring that reactive, instrument-by-instrument approaches are insufficient and that structured, anticipatory frameworks are required.

The theoretical contribution of this study lies in bridging two largely disconnected bodies of knowledge, credit-risk management and project-management theory, by demonstrating that the phased logic of the project cycle (initiation, planning, implementation, monitoring, closure) provides a productive organising structure for NPL management. The methodological contribution consists in the formalization of this logic into a three-stage model with specified roles, information flows, and decision points for banks, regulators, and government agencies, grounded in PMBoK and ISO 21502 standards. The practical contribution is a ready-to-adapt organizational blueprint: for banks, the model offers a mechanism to connect early-warning signals to concrete intervention decisions rather than leaving them isolated in risk reports; for regulators, it provides a framework for designing coordinated, multi-stakeholder NPL reduction programs of the type that proved effective in Serbia, Albania, Slovenia, and Tunisia.

Several limitations should be acknowledged. The model remains at the conceptual stage and has not been tested against operational data from individual banking institutions. The literature review, while structured and criterion-based, was confined to English-language sources and did not employ a formal systematic protocol (e.g. PRISMA), potentially omitting relevant work in other languages. The comparative NPL analysis is descriptive and does not isolate causal effects of specific policies or institutional arrangements on credit-quality outcomes.

These limitations define a concrete agenda for future research. First, case-study or action-research designs could be applied to pilot the NPL Project Approach within selected banks in Kazakhstan or Uzbekistan, generating evidence on implementation barriers and measurable portfolio effects. Second, quantitative studies using panel-data models could

test whether banking systems with project-structured NPL management exhibit lower default rates, higher recovery rates, or shorter resolution times than those relying on ad hoc practices. Third, extending the framework to non-mortgage credit segments, consumer lending, and SME portfolios would test its generalizability and reveal segment-specific adaptations required for effective implementation.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: JM; research design: JM, TS and ZK; data collection: JM; analysis and interpretation: TS and ZK; writing draft preparation: JM; supervision: TS and ZK; correction of article: JM, TS and ZK; proofread and final approval of article: JM, TS and ZK. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, *23*(4), 589–609. https://doi.org/10.2307/2978933

Altman, E. I., Iwanicz-Drozdowska, M., Laitinen, E. K., & Suvas, A. (2017). Financial distress prediction in an international context: A review and empirical analysis of Altman's Z-score model. *Journal of International Financial Management & Accounting*, *28*(2), 131–171. https://doi.org/10.1111/jifm.12053

Ari, A., Chen, S., & Ratnovski, L. (2019). *The dynamics of non-performing loans during banking crises: A new database* (IMF Working Paper 19/272). International Monetary Fund. https://doi.org/10.5089/9781513521152.001

ADB. (2025). *Nonperforming loans watch in Asia 2025*. https://doi.org/10.22617/TCS250316-2

Asian Development Bank, & European Central Bank. (2021). *Nonperforming loans in Asia and Europe—Causes, impacts, and resolution strategies*. Asian Development Bank. http://dx.doi.org/10.22617/TCS210412-2

Balcılar, M., Usman, O., Yülek, M., Ağan, B., & Erdal, B. (2024). *House price connectedness and consumer sentiment in an era of destabilizing macroeconomic conditions: Empirical evidence from Türkiye*. *Borsa Istanbul Review, 24*(1), 14–34. https://doi.org/10.1016/j.bir.2023.08.006

BCBS. (1999). *Credit risk modeling: Current practices and applications.* Bank for International Settlements. Retrieved January 30, 2026 https://www.bis.org/publ/bcbs49.pdf

Bauze, K. (2021). *NPL resolution: Country cases. Regulatory framework for NPL resolution and private sector participation* [Conference presentation]. IFC Workshop on NPL Resolution, FinSAC, World Bank Group, Vietnam. Retrieved January 30, 2026 https://www.ifc.org/content/dam/ifc/doc/mgrt/2-npl-resolution-country-cases-karlis-bauze-eng.pdf

Bermpei, T., Degl'Innocenti, M., Kalyvas, A. N., & Zhou, S. (2023). *Lender individualism and monitoring: Evidence from syndicated loans*. *Journal of Financial Stability, 66*, 101123. https://doi.org/10.1016/j.jfs.2023.101123

Bertay, A. C., & Huizinga, H. (2021). *Non-performing loans – New risks and policies? NPL resolution after COVID-19: Main differences to previous crises* [In-depth analysis]. Economic Governance Support Unit, European Parliament. Retrieved January 30, 2026 https://www.europarl.europa.eu/RegData/etudes/IDAN/2021/659648/IPOL_IDA(2021)659648_EN.pdf

Bianco, T., Cornwall, G., & Sauley, B. (2025). *Financial reform and mortgage lending by systemically important financial institutions*. *Economics Letters, 256*, 112633. https://doi.org/10.1016/j.econlet.2025.112633

Bosker, J., Gürtler, M., & Zöllner, M. (2025). *Machine learning–based variable selection for clustered credit risk modeling*. Journal of Business Economics, 95, 617–652. https://doi.org/10.1007/s11573-024-01213-8

Cenzon, J., & Szabó, B. E. (2024). *Mortgage choice and inflation experiences in the Eurozone*. *Journal of Monetary Economics, 147*, 103611. https://doi.org/10.1016/j.jmoneco.2024.103611

Chai, N., Shi, B., & Dong, Y. (2023). *Default feature selection in credit risk modeling: Evidence from Chinese small enterprises*. *SAGE Open, 13*(2). https://doi.org/10.1177/21582440231165224

Chen, G., Chutiman, N., Suraphee, S., Busababodhin, P., & Volodin, A. (2025). *Gradient Descent Decision Tree Algorithm and Nonlinear Programming for Credit Risk Assessment and Credit Strategy*. *Emerging Science Journal, 9*(4), 04–05. https://doi.org/10.28991/ESJ-2025-09-04-05

Christou, I., Ponis, S., & Palaiologou, E. (2010). Using the Agile Unified Process in banking. *IEEE Software, 27*(3), 72–79. https://doi.org/10.1109/MS.2009.156

Crosato, L., Domenech, J., & Liberati, C. (2024). *Websites' data: A new asset for enhancing credit risk modeling*. *Annals of Operations Research, 342*, 1671–1686. https://doi.org/10.1007/s10479-023-05306-5

Crouhy, M., Galai, D., & Mark, R. (2000). A comparative analysis of current credit risk models. *Journal of Banking & Finance*, *24*(1–2), 59–117. https://doi.org/10.1016/S0378-4266(99)00053-9

EBRD. (2025). NPL monitor: H1 2025. Vienna Initiative. Retrieved January 30, 2026 https://npl.vienna-initiative.com/assets/Uploads/2025/NPL-Monitor-H1-2025-fv.pdf

Forster, R., & Sun, X. (2022). *Taming the housing crisis: An LTV macroprudential policy*. *Economic*

Modeling, 108, 105761. https://doi.org/10.1016/j.econmod.2022.105761

Gutkowski, V. A. (2021). *Sovereign debt restructuring and credit recovery*. *Economía LACEA Journal, 23*(1), 230–258. https://doi.org/10.31389/eco.409

Han, X., Yang, Y., Chen, J., Wang, M., & Zhou, M. (2025). *Symmetry-Aware Credit Risk Modeling: A Deep Learning Framework Exploiting Financial Data Balance and Invariance*. *Symmetry, 17*(3), 341. https://doi.org/10.3390/sym17030341

Holtermans, R., Kahn, M. E., & Kok, N. (2024). *Climate risk and commercial mortgage delinquency*. *Journal of Regional Science*, *64*(4), 994–1037. https://doi.org/10.1111/jors.12681

Iljins, J., & Skvarciany, V. (2015). *The role of change management in trust formation in commercial banks*. *Business: Theory and Practice, 16*(4), 373–378. https://doi.org/10.3846/btp.2015.557

Instefjord, N., & Nakata, H. (2022). *Micro-prudential regulation and loan monitoring. Journal of Financial Services Research, 63,* 339–362. https://doi.org/10.1007/s10693-021-00376-7

IPAF Asia. (2025). *NPLs in Asia: 2024 Data Analysis*. International Public AMC Forum. Retrieved from https://ipafasia.org/news-and-data/npl-data&rid=4

Jakubik, P., & Teleu, S. (2025). *Improving Credit Risk Assessment in Uncertain Times: Insights from IFRS 9*. *Risks, 13*(2), 38. https://doi.org/10.3390/risks13020038

Li, Y., Ni, Z., & Xiao, B. (2025). *Domain Knowledge-Enhanced Process Mining for Anomaly Detection in Commercial Bank Business Processes*. *Systems, 13*(7), 545. https://doi.org/10.3390/systems13070545

Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *Journal of Finance*, 29(2), 449–470. https://doi.org/10.2307/2978814

Noriega, J., Rivera, L., Castañeda, J., & Herrera, J. (2025). *From Crisis to Algorithm: Credit Delinquency Prediction in Peru Under Critical External Factors Using Machine Learning*. *Data, 10*(5), 63. https://doi.org/10.3390/data10050063

Rahman, H. U., Arian, A., & Sands, J. (2023). *Does fiscal consolidation affect non-performing loans? Global evidence from heavily indebted countries (HICs)*. *Journal of Risk and Financial Management, 16*(9), 417. https://doi.org/10.3390/jrfm16090417

Rodrigues, L. F., Oliveira, A., & Rodrigues, H. (2023). *Technology management has a significant impact on digital transformation in the banking sector*. *International Review of Economics & Finance, 88*, 1375–1388. https://doi.org/10.1016/j.iref.2023.07.040

Sanz-Guerrero, M., & Arroyo, J. (2025). *Credit Risk Meets Large Language Models: Building a Risk Indicator from Loan Descriptions in P2P Lending*. *Inteligencia Artificial, 28*(75), 220–247. https://doi.org/10.4114/intartif.vol28iss75pp220-247

Sarfraz, M., Qun, W., Hui, L., & Abdullah, M. I. (2018). *Environmental risk management strategies and the moderating role of corporate social responsibility in project financing decisions*. *Sustainability, 10*(8), 2771. https://doi.org/10.3390/su10082771

Scope Ratings GmbH. (2025). *European Bank NPL Monitor*. Retrieved January 30, 2026 https://www.scoperatings.com/ScopeRatingsApi/api/download-study?id=a4f8e84c-d1d8-4446-90ad-9cb1b0e1dc92

Silva, S. A., de Abreu, P. H. C., de Amorim, F. R., & Santos, D. F. L. (2019). *Application of Monte Carlo simulation for analysis of costs and economic risks in a banking agency*. *IEEE Latin America Transactions, 17*(3), 418–425. https://doi.org/10.1109/TLA.2019.8863311

Simonović, I., & Todorović, M. (2019). *Banking product and services development projects: The way to implement innovations*. *European Project Management Journal, 9*(1), 3–9. https://doi.org/10.18485/epmj.2019.9.1.1

Smith, B. C., & Yezer, A. M. (2025). *A Lucas Critique of Mortgage Lending: Theory, Evidence, and Implications*. *The Journal of Real Estate Finance and Economics, 70*, 637–676. https://doi.org/10.1007/s11146-023-09951-2

Suryanto, H., Mahidadia, A., Bain, M., Guan, C., & Guan, A. (2022). *Credit Risk Modeling Using Transfer Learning and Domain Adaptation*. *Frontiers in Artificial Intelligence, 5,* 868232. https://doi.org/10.3389/frai.2022.868232

Van Zwieten, K. (2019). *Managing Non-Performing Loans in Banks: A Review of the Evidence of the Impact of Insolvency and Creditor Rights Regimes (English).* Washington, D.C.: World Bank Group. Retrieved January 30, 2026 http://documents.worldbank.org/curated/en/389811561742153005

Witzany, J., & Kozina, A. (2022). *Recovery process optimization using survival regression*. *Operational Research, 22*, 5269–5296. https://doi.org/10.1007/s12351-022-00703-3

Information about the authors

***Javokhir S. Mukhamedov** – PhD candidate, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: javokhir.mukhamedov@gmail.com, ORCID ID: https://orcid.org/0009-0003-8955-7840

Tatyana S. Sokira – Cand. Sc. (Econ.), Associate Professor, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: t_sokira@mail.ru, ORCID ID: https://orcid.org/0000-0002-4825-1189

Zebo Kuldasheva – Doc. Sc. (Econ.), Associate Professor, Tashkent State University of Economics, Tashkent, Uzbekistan, email: z.kuldasheva@tsue.uz, ORCID ID: https://orcid.org/0000-0002-6367-2192

Авторлар туралы мәліметтер

***Мухамедов Ж.Ш.** – PhD докторанты, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: javokhir.mukhamedov@gmail.com, ORCID ID: https://orcid.org/0009-0003-8955-7840

Сокира Т.С. – э.ғ.к., доцент, Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан, email: t_sokira@mail.ru, ORCID ID: https://orcid.org/0000-0002-4825-1189

Кулдашева З. – э.ғ.д., доцент, Ташкент мемлекеттік экономика университеті, Ташкент, Өзбекстан, email: z.kuldasheva@tsue.uz, ORCID ID: https://orcid.org/0000-0002-6367-2192

Сведения об авторах

***Мухамедов Ж.Ш.** – PhD докторант, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан, email: javokhir.mukhamedov@gmail.com, ORCID ID: https://orcid.org/0009-0003-8955-7840

Сокира Т.С. – к.э.н., доцент, Казахский национальный университет имени аль-Фараби, Алматы, Казахстан, email: t_sokira@mail.ru, ORCID ID: https://orcid.org/0000-0002-4825-1189

Кулдашева З. – д.э.н., доцент, Ташкентский государственный экономический университет, Ташкент, Узбекистан, email: z.kuldasheva@tsue.uz, ORCID ID: https://orcid.org/0000-0002-6367-2192

Research Paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-79-92
МРНТИ 06.52.17
JEL: D15, M31, O30

Check for updates
BY-NC 4.0

The Formation of Consumer Value under AI-Based Recommendation Content in the Digital Economy

Ju-Ah Lim[a]*, Young-Jin So[b]

[a]*Eulji University, 553 Sanseong-daero, Sujeong-gu, Seongnam-si, Gyeonggi-do, Republic of Korea*

For citation: Lim, J. & So, Y. (2026). The Formation of Consumer Value under AI-Based Recommendation Content in the Digital Economy. Economy: strategy and practice, 21(1), 79-92. https://doi.org/10.51176/1997-9967-2026-1-79-92

ABSTRACT

This study investigates how integrated strategic communication influences the process of consensus building and organizational readiness during digital innovation in the retail banking industry. This study examined how the technological attributes of AI-based short-form content recency, reliability, and shareability effect cognitive attributes, specifically convenience and usefulness, and how these cognitive responses subsequently influence satisfaction and repurchase intention. Analyzed differences based on consumers' levels of functional and economic value. A survey was conducted with 400 consumers who had viewed AI-based short-form content and purchased the recommended product, and the research model was validated using exploratory factor analysis, confirmatory factor analysis, structural equation modeling, and multi-group analysis. The results showed that relevance and the possibility of distribution significantly increase perceived convenience ($\beta = 0.366$ and $\beta = 0.600$; $p < 0.001$), while reliability has a positive effect on usefulness ($\beta = 0.266$; $p < 0.001$). Usefulness has a pronounced positive effect on satisfaction ($\beta = 3.378$; $p < 0.001$), which, in turn, significantly increases the intention of repeat purchase ($\beta = 0.921$; $p < 0.001$). The practical significance of the study lies in substantiating the priority of increasing the perceived usefulness and trust in AI content in order to increase loyalty and repeat demand. The prospects for further research are related to expanding the sample to different age and gender groups, comparative analysis of various types of AI algorithms, as well as studying the long-term effects of personalization in the context of digital transformation of consumer markets.

KEYWORDS: Digitalization, Digital Economy, Digital Platform, Marketing, Personalization, Artificial Intelligence, Repeated Consumption

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest.

FINANCIAL SUPPORT: the study was not sponsored (own resources).

Article history:
Received 10 January 2026
Accepted 26 February 2026
Published 30 March 2026

*** Corresponding author: Lim J.** – PhD, Eulji University, 553 Sanseong-daero, Sujeong-gu, Seongnam-si, Gyeonggi-do, Republic of Korea, email: ibeauty1712@naver.com

Формирование потребительской ценности в условиях внедрения AI-рекомендательных технологий в цифровой экономике

Лим Дж.[a]*, Со Ю.[b]

[a]*Университет Тэджон, 62 Daehak-ro, район Донгу, Тэджон 34520, Республика Корея*

Для цитирования: Лим Дж., Со Ю.(2026). Формирование потребительской ценности в условиях внедрения AI-рекомендательных технологий в цифровой экономике. Экономика: стратегия и практика, 21(1), 79-92. https://doi.org/10.51176/1997-9967-2026-1-79-92

АННОТАЦИЯ

Стремительное развитие технологий искусственного интеллекта трансформирует цифровой маркетинг и механизмы формирования потребительского поведения, особенно в индустрии красоты, где персонализированные рекомендации становятся ключевым инструментом конкурентного преимущества. Целью исследования является анализ структурных взаимосвязей между техническими характеристиками AI-основанного рекомендательного контента, когнитивными оценками пользователей, эмоциональной реакцией и поведенческим результатом, а также выявление различий этих связей в зависимости от уровня воспринимаемой функциональной и экономической ценности. Проанализированы различия в зависимости от уровня функциональной и экономической ценности для потребителей. В исследовании приняли участие 400 потребителей, которые просмотрели краткий контент на основе искусственного интеллекта и приобрели рекомендованный продукт, и модель исследования была подтверждена с помощью исследовательского факторного анализа, подтверждающего факторного анализа, моделирования структурными уравнениями и анализа нескольких групп. Результаты показали, что актуальность и возможность распространения значимо повышают воспринимаемое удобство ($\beta = 0.366$ и $\beta = 0.600$; $p < 0.001$), тогда как надёжность оказывает положительное влияние на полезность ($\beta = 0.266$; $p < 0.001$). Полезность оказывает выраженное положительное влияние на удовлетворённость ($\beta = 3.378$; $p < 0{,}001$), которая, в свою очередь, существенно повышает намерение повторной покупки ($\beta = 0.921$; $p < 0{,}001$). Практическая значимость исследования заключается в обосновании приоритетности повышения воспринимаемой полезности и доверия к AI-контенту для усиления лояльности и повторного спроса. Перспективы дальнейших исследований связаны с расширением выборки на различные возрастные и гендерные группы, сравнительным анализом различных типов AI-алгоритмов, а также изучением долгосрочных эффектов персонализации в условиях цифровой трансформации потребительских рынков.

КЛЮЧЕВЫЕ СЛОВА: цифровизация, цифровая экономика, цифровая платформа, маркетинг, персонализация, искусственный интеллект, повторное потребление

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов.

ФИНАНСИРОВАНИЕ: Исследование не имело спонсорской поддержки (собственные ресурсы).

История статьи:
Получено 10 января 2026
Принято 26 февраля 2026
Опубликовано 30 марта 2026

*** Корреспондирующий автор: Лим Ж.** – PhD, Университет Юлджи, 553 Сансон-дэро, Суджон-гу, Соннамси, Кенгидо, Республика Корея, email: ibeauty1712@naver.com

INTRODUCTION

The rapid advancement of digital technologies has transformed consumers' lifestyles and purchasing behaviors, heightening the importance of emotional satisfaction, personalization, and immediate responsiveness (Seong, 2025). In this trend, artificial intelligence (hereinafter – AI) has gained attention as a core technology capable of delivering personalized experiences. By analyzing individuals' preferences and contextual information based on extensive data, AI provides optimized information in real time, fulfilling consumer expectations and enhancing trust in the brand (Epart, 2025). Particularly, the beauty industry is one of the sectors that has most rapidly adopted hyper-personalization technologies, utilizing AI-based recommendation content to deliver customized product information and user experiences to consumers (Lee, 2023). In the context of the digital economy, AI personalization is becoming a strategic tool for creating competitive advantages. Algorithmic recommendation systems not only improve the accuracy of communication with consumers but also create new mechanisms for distributing attention and value within digital ecosystems. Thus, AI content serves not just as a marketing tool but also as an element of strategic management of consumer experience in a platform-type economy.

Meanwhile, as the shift toward video-centred social media accelerates, short-form content that delivers key messages within a brief time span has become a central mode of consumer communication. Platforms such as TikTok, Instagram Reels, and YouTube Shorts automatically expose beauty-related videos tailored to user preferences through AI recommendation systems. These systems directly influence product awareness and the formation of purchase intentions. In particular, short-form beauty content serves as an effective digital marketing tool that enhances product perception and brand attitudes and drives actual purchases by eliciting strong visual stimulation and emotional engagement (Jung & Kwon, 2025). The integration of AI technologies with short-form content is reshaping consumer experiences in the beauty industry on a new level. However, empirical research examining how the value perceived through AI-based beauty product recommendation content translates into actual satisfaction and repurchase intention remains insufficient. Given that beauty products are consumption goods strongly influenced by individual preferences and emotional satisfaction, it is necessary to closely investigate how consumers' perceptions of functional value (product utility and performance) and economic value (cost-effectiveness) affect their purchasing behavior (Chandra, 2025).

Despite the growing amount of research in the field of AI recommendation systems, existing work tends to consider technological characteristics, cognitive assessments, and behavioral intentions in isolation. There is no integrated model explaining the sequential transformation of technological characteristics of AI content into cognitive assessments, emotional reactions, and subsequent purchasing behavior. Accordingly, this study aims to analyze how the technical characteristics of AI-based beauty product recommendation content recency, reliability, and shareability affect consumers' cognitive attributes (convenience and usefulness), emotional responses (satisfaction), and behavioral outcomes (repurchase intention). Furthermore, by comparing differences in consumer perception structures according to levels of functional value and economic value, this study seeks to provide a comprehensive understanding of how AI-driven personalized marketing influences the formation of value perceptions and behavioral intentions among consumers. Ultimately, by clarifying how AI-based recommendation content connects consumers' thoughts and behaviors, the study aims to offer insights that can inform AI-personalized content strategies and consumer experience design in the beauty industry. From a practical point of view, the research results can be used to develop AI personalization strategies aimed at increasing the economic efficiency of digital marketing, optimizing the customer path and creating sustainable competitive advantages.

LITERATURE REVIEW

AI refers to technologies that mimic human cognition and judgment to solve problems or make autonomous decisions. Across fields such as healthcare, finance, education, and entertainment, AI has enabled personalized services through the integration of big data, machine learning, and deep learning (CSES, 2023). Personalized recommendation systems have evolved based on collaborative filtering and content-based filtering, and more recently, hybrid models combining both approaches have

become mainstream due to their sophistication and contextual relevance (Lee, 2024). The AI-based beauty product recommendation content examined in this study is likewise grounded in a hybrid recommendation framework.

Beyond recommendation algorithms, AI techniques such as sentiment analysis have been applied to beauty product reviews to classify positive and negative consumer opinions using machine learning algorithms (e.g., K-Nearest Neighbor) and text-mining approaches (Wardani et al., 2022). However, these studies mainly focus on improving classification accuracy and do not examine how AI-driven content characteristics influence consumer satisfaction and repurchase intention from an economic and strategic perspective. Recent industry reports also emphasize that AI-driven personalization enhances user experience by integrating behavioral data and contextual signals to optimize real-time content delivery (Epark, 2025). Such developments highlight the growing strategic importance of AI in digital marketing ecosystems.

Short-form content typically consists of videos approximately 15 to 60 seconds in length and has rapidly proliferated as it aligns with mobile-friendly consumption patterns. Platforms such as YouTube (Shorts), Instagram (Reels), and TikTok continuously expose users to beauty-related videos tailored to their preferences through algorithmic recommendations. Accumulating findings indicate that attributes such as informativeness, entertainment, interactivity, and credibility positively influence satisfaction and purchase intention. In particular, the vertical immersive format delivers strong visual stimuli within a short time span, compressing the decision-making process from initial interest to behavioral conversion (Kim, 2025a).

Recency refers to the extent to which information is provided when users need it. In the rapidly changing beauty context, delivering up-to-date information reduces search time and enhances the speed and accuracy of purchase decisions (Kim, 2025b). Reliability refers to the degree to which the information in the content is perceived as factual and free from distortion. When trust is established, acceptance and resonance with the information increase, thereby strengthening consumers' willingness to follow the recommendation and proceed with a purchase (Kim, 2025c).

Shareability refers to the extent to which content can be easily transmitted and disseminated among users. Short, impactful formats encourage engagement and drive virality, thereby accelerating brand awareness and product learning (Park, 2024). Convenience refers to the experience of perceiving the search and usage processes as simple and low-effort. Personalized recommendations reduce the time and effort costs for users, thereby increasing continued usage, satisfaction, and readiness to purchase (Sim & Yoon, 2020). Usefulness refers to the extent to which the provided information is evaluated as genuinely helpful for achieving one's goals. Facilitating product understanding and simplifying comparisons of alternatives enhances confidence in purchase decision-making (Lee, 2021).

Perceived value is understood as consumers' overall assessment of the balance between the benefits and costs experienced when using a product or service. It is not merely satisfaction relative to price but is formed by considering the utility gained from product use along with the time, psychological, and monetary costs incurred during the process. In this study, perceived value is categorized into functional value and economic value. Functional value refers to value based on product performance and utility, whereas economic value refers to value based on price fairness and non-monetary costs, such as time and effort. Functional value is primarily shaped by trust in product quality and performance, while economic value is reinforced by perceptions of efficiency and rational decision-making. Both dimensions contribute to purchase intention by reducing information search costs and increasing decision confidence, although their relative influence may vary depending on consumers' value orientation (Lee, 2021). Prior studies further indicate that functional and economic value may exert differential effects on satisfaction and repurchase intention, particularly in personalized digital environments (Chandra, 2025). In addition, research on brand experience suggests that positive evaluative perceptions can strengthen brand loyalty and brand equity, highlighting the broader strategic importance of value-based consumer judgments (Athira et al., 2024).

Purchase intention refers to the behavioral willingness to buy a specific product, and it becomes stronger as the burden of information search decreases in personalized short-form recommendation environments. External cues, such as price, quality, and packaging, interact with individual psycholog-

ical factors, while content attributes, such as reliability, usefulness, and convenience, reduce decision-making uncertainty and accelerate purchase decisions (Li, 2025; Khanh et al., 2026). Previous studies conducted in crisis contexts have also confirmed that satisfaction significantly mediates the effects of social influence, price value, and convenience on repurchase intention among Generation Z consumers (Thuc, 2023). These findings suggest that even under uncertain economic conditions, satisfaction remains a critical determinant of behavioral continuity, highlighting its strategic importance in digital consumption environments.

RESEARCH METHODS

The survey for this study was conducted over approximately three weeks, from August 10 to August 30, 2025, through the online platform Tally.so. Among the 443 collected responses, 43 insincere or invalid responses were excluded, and a total of 400 responses were used for the final analysis. The survey targeted female consumers in their 10s to 50s who had watched AI-based short-form content (Instagram Reels, TikTok, YouTube Shorts, etc.) and had purchased beauty products within the past six months.

The questionnaire used in this study comprised 50 items covering demographic characteristics, content attributes (recency, reliability, shareability, convenience, and usefulness), perceived value (functional and economic), satisfaction, and purchase intention. All items were adapted from prior research and reconstructed to suit the study's purpose, and a 7-point Likert scale was employed (1 = strongly disagree, 7 = strongly agree).

Content attributes were composed of five factors centred on the technical characteristics of AI-based short-form recommendation content. Recency refers to how quickly and appropriately information is provided at the needed moment, and reliability indicates the extent to which the information is perceived as factual and free from distortion. Shareability represents the degree to which content is easily disseminated among users, convenience refers to the ease experienced during the search and usage processes, and usefulness signifies the extent to which the content is helpful in actual decision-making (Kim & Kim, 2024).

Perceived value refers to consumers' assessment of the balance between the utility and costs they perceive, and it was categorized into functional value and economic value. Functional value was measured to evaluate whether the product's performance and quality meet expectations, while economic value was constructed to assess the rationality of the benefits relative to the costs paid (Jeon & Heo, 2022). Satisfaction refers to the overall psychological fulfilment experienced after purchasing the product, and purchase intention signifies the behavioural willingness to repurchase the same product or recommend it to others (Tian, 2022).

The data collected was analyzed using SPSS 30.0 and AMOS 21. First, a frequency analysis was conducted to examine the general characteristics of the sample, followed by an exploratory factor analysis (EFA) and reliability analysis to verify the measurement items' structure and internal consistency. Subsequently, confirmatory factor analysis (CFA) was performed to assess convergent and discriminant validity. The construct reliability (CR) exceeded 0.7, and the average variance extracted (AVE) exceeded 0.5, confirming overall validity. Structural equation modelling (SEM) was then applied to evaluate model fit, and key fit indices, including CMIN/DF, GFI, AGFI, CFI, and RMSEA, met the recommended criteria. Finally, multi-group analysis (MGA) was conducted to verify the moderating effects of functional value and economic value (high vs. low). Respondents were divided into two groups based on mean scores, and structural differences according to value levels were examined by comparing path coefficients.

The structural model of this study specifies that the technical characteristics of AI-based short-form recommendation content (recency, reliability, and shareability) influence consumers' cognitive characteristics (convenience and usefulness), which, in turn, lead to satisfaction and repurchase intention. Additionally, a moderation model was tested to examine whether these causal relationships differ depending on the levels of functional value and economic value (see Figure 1).

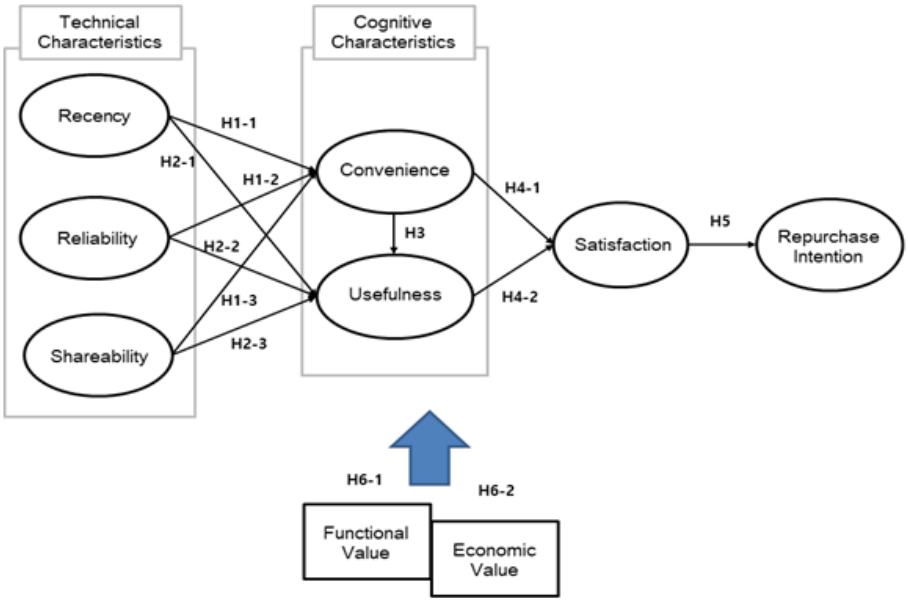


Figure 1. Research model

This study aims to examine the structural relationships in which the technical characteristics of AI-based beauty product recommendation content influence users' cognitive factors, emotional responses, and behavioral outcomes, based on prior research. In addition, the following hypotheses were established to further analyze whether these relationships differ depending on levels of functional value and economic value. Based on prior research, the following hypotheses are proposed.

H1. The technical characteristics of AI-based beauty product recommendation content will positively affect users' perceived convenience.

H1-1. Recency will positively affect convenience.

H1-2. Reliability will positively affect convenience.

H1-3. Shareability will enhance convenience.

H2. The technical characteristics of AI-based beauty product recommendation content will positively affect users' perceived usefulness.

H2-1. Recency will positively affect usefulness.

H2-2. Reliability will positively affect usefulness.

H2-3. Shareability will positively affect usefulness.

H3. Convenience will positively affect usefulness.

H4. The more users perceive AI-based beauty product recommendation content as convenient and useful, the higher their satisfaction with the recommended product will be.

H4-1. Convenience will positively affect satisfaction.

H4-2. Usefulness will positively affect satisfaction.

H5. Satisfaction with the product recommended via AI-based beauty product recommendation content will positively affect repurchase intention.

H6. The relationships among the characteristics of AI-based beauty product recommendation content, satisfaction, and repurchase intention will differ depending on consumers' perceived value levels.

H6-1. Differences will exist in these relationships depending on the level of functional value (high/low).

H6-2. Differences will exist in these relationships depending on the level of economic value (high/low).

RESULTS

The survey participants in this study were 400 consumers who had viewed AI-based short-form content and purchased beauty products within the past six months (Table 12). By age group, individuals in their 20s (35.3%) and 30s (32.3%) accounted

for the majority, indicating that generations familiar with digital environments and short-form content formed the core of the sample. Regarding occupation, office workers represented the largest proportion at 44.5%, followed by students (21.3%), full-time homemakers (13.3%), and freelancers (12.3%). Monthly income was highest in the 2–3 million KRW range (29.5%), followed by 1–2 million KRW (26.8%) and 3–4 million KRW (16.5%).

Regarding platform usage, 37.3% of respondents reported using both Instagram Reels and YouTube Shorts, the highest proportion, while the combined use of TikTok and other platforms was also substantial at 19.8%. These results suggest that short-form content consumption is expanding as a multi-platform behavior rather than being limited to a single service. As shown in Table 1, items with factor loadings below 0.6 were removed through the exploratory factor analysis (EFA).

Table 1. EFA results for recency, reliability, and shareability

Item	Factor 1	Factor 2	Factor 3
Reliability_5	0.871	0.125	0.218
Reliability_4	0.866	0.083	0.231
Reliability_1	0.839	0.086	0.305
Recency_3	0.067	0.877	0.11
Recency_1	0.1	0.876	0.175
Recency_2	0.113	0.875	0.177
Shareability_1	0.266	0.145	0.854
Shareability_2	0.241	0.198	0.836
Shareability_5	0.25	0.159	0.778

Note: compiled by authors

The variables Reliability_5 (0.871), Reliability_4 (0.866), and Reliability_1 (0.839) have high factor loadings on the first factor and low cross-loadings (<0.31), confirming their stable membership in a single design domain. The factor characterizes the perception of the accuracy and reliability of recommendations. Recency_3 (0.877), Recency_1 (0.876), and Recency_2 (0.875) indicators form the second factor, with high loadings and minimal cross-loadings with other components, indicating clear discriminant validity. The variables Shareability_1 (0.854), Shareability_2 (0.836), and Shareability_5 (0.778) demonstrate high loadings on the third factor and moderately low cross-loadings (<0.27), confirming the independence of this measurement. This factor describes the content's social and communication functionality.

The remaining variables satisfied the recommended thresholds, thereby confirming convergent validity. In addition, ERA results for convenience, usefulness, functional value, and economic value are presented in Table 2.

Table 2. EFA results for convenience, usefulness, functional value and economic value

Item	Factor 1	Factor 2	Factor 3	Factor 4
Usefulness_2	0.841	0.259	0.197	0.157
Usefulness_1	0.836	0.258	0.159	0.167
Usefulness_3	0.817	0.242	0.163	0.136
Usefulness_5	0.706	0.346	0.235	0.126
Convenience_3	0.313	0.738	0.209	0.048
Convenience_1	0.299	0.719	0.125	0.237
Convenience_2	0.155	0.714	0.162	0.25
Convenience_4	0.155	0.685	0.273	0.143
Convenience_5	0.306	0.661	0.145	0.113
EconomicValue_1	0.185	0.166	0.813	0.109
EconomicValue_2	0.186	0.176	0.788	0.194

EconomicValue_4	0.179	0.249	0.758	0.288
EconomicValue_3	0.173	0.261	0.664	0.393
FunctionalValue_2	0.139	0.195	0.224	0.835
FunctionalValue_1	0.13	0.16	0.203	0.833
FunctionalValue_3	0.265	0.243	0.386	0.656

Note: compiled by authors

The results of exploratory factor analysis confirm the presence of four independent latent structures corresponding to the theoretical research model: convenience, usefulness, functional value and economic value. The first factor combines utility indicators, with factor loadings ranging from 0.706 to 0.841, indicating high internal consistency and convergent validity. The second factor is composed of convenience variables with loadings of 0.661–0.738. Despite moderate cross-loadings, the dominant values are concentrated on the corresponding factor, confirming its empirical stability. The third factor is represented by indicators with loadings of 0.664–0.813. The main coefficients significantly exceed the cross-loadings, indicating acceptable discriminant validity, although one indicator shows a moderate overlap with the functional value factor. The fourth factor combines indicators of functional value, characterized by high loads of 0.656–0.835, which confirms their uniformity and conceptual independence.

EFA results for satisfaction and repurchase intention shows Table 3.

Table 3. EFA results for satisfaction and repurchase intention

Item	Factor 1	Factor 2
Repurchase Intention_1	0.859	0.255
Repurchase Intention_2	0.854	0.317
Repurchase Intention_4	0.848	0.324
Repurchase Intention_3	0.812	0.385
Satisfaction_5	0.236	0.812
Satisfaction_2	0.252	0.811
Satisfaction_4	0.366	0.808
Satisfaction_3	0.42	0.77

Note: compiled by authors

The first factor comprises indicators of repeat purchase intention, with high factor loadings of 0.812–0.859. At the same time, the cross-loadings on the second factor remain significantly lower than those on the main factor, indicating a clear factor affiliation and high convergent validity of the construct. The second factor combines satisfaction indicators with loads of 0.770–0.812. Despite moderate cross-loadings across individual indicators, the dominant loadings are concentrated on the corresponding factor, confirming the empirical independence of this measurement.

The composite reliability (CR) values ranged from 0.771 to 0.886, and the average variance extracted (AVE) values ranged from 0.523 to 0.722, all of which met the recommended thresholds (CR ≥ 0.70, AVE ≥ 0.50) (Table 4).

Table 4. EFA results for satisfaction and repurchase intention

Path			Standardized Loading	Measurement Error	CR	AVE
Recency_1	<---	Recency	0.862	0.199	0.886	0.722
Recency_2	<---		0.852	0.256		
Recency_3	<---		0.796	0.353		

Reliability_1	<---	Reliability	0.837	0.536	0.813	0.592
Reliability_4	<---		0.838	0.525		
Reliability_5	<---		0.861	0.414		
Shareability_1	<---	Shareability	0.852	0.526	0.766	0.523
Shareability_2	<---		0.849	0.447		
Shareability_5	<---		0.739	0.844		
Convenience_1	<---	Convenience	0.806	0.359	0.771	0.529
Convenience_2	<---		0.715	0.558		
Convenience_3	<---		0.749	0.616		
Usefulness _1	<---	Usefulness	0.876	0.329	0.876	0.639
Usefulness _2	<---		0.891	0.301		
Usefulness _3	<---		0.826	0.466		
Usefulness _5	<---		0.767	0.507		
Satisfaction _2	<---	Satisfaction	0.738	0.652	0.838	0.565
Satisfaction _3	<---		0.880	0.352		
Satisfaction _4	<---		0.866	0.402		
Satisfaction _5	<---		0.745	0.611		
Repurchase Intention _1	<---	Repurchase Intention	0.824	0.625	0.865	0.616
Repurchase Intention _2	<---		0.856	0.423		
Repurchase Intention _3	<---		0.886	0.406		
Repurchase Intention _4	<---		0.886	0.406		

Note: compiled by authors

The highest loadings are observed in the Usability construct (0.767–0.891) and the Repurchase Intention (0.824–0.886), indicating their stable latent structures. In general, the results confirm the correct separation of satisfaction and repeat purchase intention as two interrelated but conceptually distinct latent constructs, as specified in the theoretical research model. As a result of the confirmatory factor analysis (CFA), the standardized factor loading ranged from 0.715 to 0.893. Most constructs also demonstrated clear discriminant validity, as the square roots of their AVEs exceeded their inter-construct correlations (Table 5).

Table 5. Discriminate validity test results

Category	Recency	Reliability	Shareability	Convenience	Usefulness	Satisfaction	Repurchase Intention
Recency	0.850	-	-	-	-	-	-
Reliability	0.294	0.770	-	-	-	-	-
Shareability	0.436	0.631	0.723	-	-	-	-
Convenience	0.74	0.466	0.71	0.727	-	-	-
Usefulness	0.535	0.708	0.806	0.716	0.799	-	-
Satisfaction	0.324	0.85	0.65	0.499	0.698	0.752	-
Repurchase Intention	0.271	0.97	0.643	0.458	0.659	0.757	0.785

Note: compiled by authors

The results of the discriminant validity check are presented according to the Fornell–Larker criterion. The diagonal elements of the matrix (highlighted values) reflect the square root of AVE for each construct and in all cases exceed 0.72, which indicates sufficient convergent validity. The results of the assessment of the structural model's compliance with empirical data are presented in Table 6.

Table 6. Model fit indices of the research model

Category	χ^2 (CMIN)	df	CMIN/ DF	GFI	AGFI	CFI	RMSEA	P-value
Research Model	445.496	228	1.954	0.916	0.89	0.971	0.049	0

Note: compiled by authors

The chi-square statistic was $\chi^2 = 445.496$ with 228 degrees of freedom, and the CMIN/DF value of 1.954 met the recommended threshold (≤ 3). In addition, the GFI (0.916), CFI (0.971), and RMSEA (0.049) all satisfied the recommended criteria. The RMSEA value of 0.049 does not exceed 0.05, indicating good model fit.

According to the path analysis results, recency and shareability had significant positive effects on convenience ($\beta = 0.366$, $\beta = 0.600$, $p < .001$), while reliability positively influenced usefulness ($\beta = 0.266$, $p < .001$). In addition, convenience had a strong positive effect on usefulness ($\beta = 0.832$, $p < .001$), and usefulness significantly affected satisfaction ($\beta = 3.378$, $p < 0.001$), which in turn positively influenced repurchase intention ($\beta = 0.921$, $p < 0.001$). In contrast, the paths from reliability → convenience, recency → usefulness, and shareability → usefulness were not significant. Moreover, the path from convenience → satisfaction showed a negative effect ($\beta = -2.662$, $p < .001$), indicating that convenience alone does not directly lead to satisfaction (Table 7).

Table 7. Path analysis results of the research model

Path			Estimate	S.E.	C.R.	p
Convenience	<---	Recency	0.366	0.045	7.332	0***
Convenience	<---	Reliability	0.067	0.04	1.016	0.31
Convenience	<---	Shareability	0.6	0.04	8.628	0***
Usefulness	<---	Recency	-0.022	0.02	-1.461	0.144
Usefulness	<---	Reliability	0.266	0.044	5.45	0***
Usefulness	<---	Shareability	0.015	0.019	0.664	0.507
Usefulness	<---	Convenience	0.832	0.103	12.134	0***
Satisfaction	<---	Convenience	-2.662	0.738	-4.249	0***
Satisfaction	<---	Usefulness	3.378	0.488	5.42	0***
Repurchase Intention	<---	Satisfaction	0.921	0.096	13.744	0***
*p<0.05, **p<0.01, ***p<0.001						

Note: compiled by authors

To test the hypotheses put forward and evaluate the directions of cause-and-effect relationships between latent variables, the structural model was evaluated using the SEM method. The model confirms the significant roles of reliability and usefulness in the formation of satisfaction and repeated-purchase intention, with partial confirmation of the hypotheses regarding convenience. As can be seen from Figure 1, the technical characteristics of AI content have different effects on users' cognitive assessments.

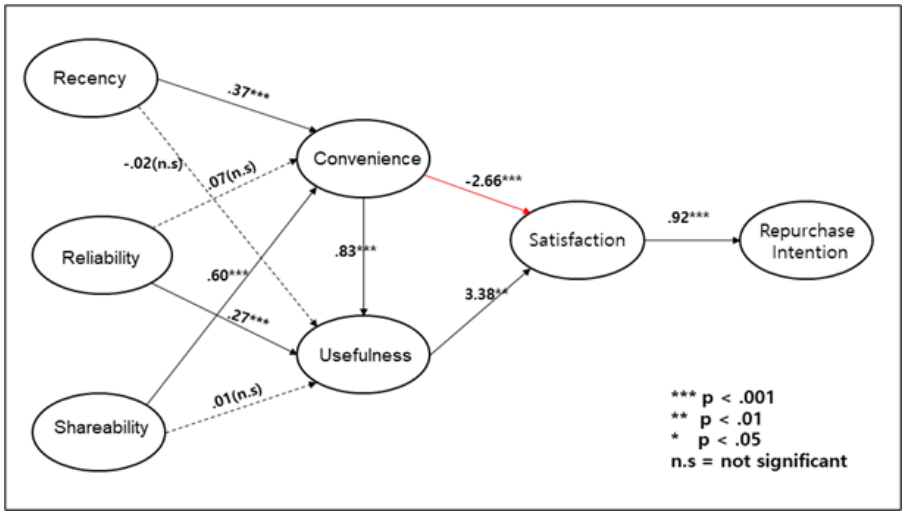


Figure 2. Path analysis of the research model

Recency did not exert a direct effect on satisfaction or repurchase intention; however, it indirectly influenced both outcomes through convenience and usefulness. The indirect effects were negative (β = -0.021, β = -0.028, p < 0.01), suggesting that information overload may induce content fatigue, thereby weakening satisfaction. In contrast, usefulness strongly affected repurchase intention through satisfaction, and convenience produced a positive indirect effect only when converted into usefulness. Overall, usefulness functioned as the key mediating variable, empirically confirming that consumers' satisfaction and behavioral intentions are reinforced when they experience content they perceive as genuinely helpful (Table 8).

Table 8. Mediation effect analysis results of the research mode

Category		Shareability	Reliability	Recency	Convenience	Usefulness	Satisfaction	Repurchase Intention
Convenience	Total Effect	0.344	0.04	0.327	0	0	0	0
	Direct Effect	0.344	0.04	0.327	0	0	0	0
	Indirect Effect	0	0	0	0	0	0	0
Usefulness	Total Effect	0.443	0.29	0.379	1.251	0	0	0
	Direct Effect	0.013	0.239	-0.03	1.251	0	0	0
	Indirect Effect	0.431	0.051	0.409	0	0	0	0
Satisfaction	Total Effect	0.094	0.641	-0.021**	0.176	2.647	0	0
	Direct Effect	0	0	0	-3.136	2.647	0	0
	Indirect Effect	0.094	0.641	-0.021**	3.311	0	0	0
Repurchase Intention	Total Effect	0.125	0.847	-0.028**	0.233	3.502	1.323	0
	Direct Effect	0	0	0	0	0	1.323	0
	Indirect Effect	0.125	0.847	-0.028**	0.233	3.502	0	0
*p<0.05, **p<0.01, ***p<0.001								

Note: compiled by authors

In this study, functional value and economic value were treated as moderating variables, and differences in relationships were examined across levels of each factor. Both constructs were measured using a 7-point Likert scale, and items grouped under the same factor through factor analysis were used to test the moderate effects. Functional value consisted of three items related to quality, functionality, and practicality, with a mean value of 3.55. Economic value was composed of four items reflecting price rationality, value perception, psychological satisfaction, and cost-effectiveness, with a mean value of 3.82.

Based on these results, each factor was divided into low and high groups using the mean value as the cut-off point, and multi-group analysis was conducted.

The results indicated partial moderating effects on both functional and economic values, suggesting that the perception structure varied by value level. In the high functional value group, the paths from recency to convenience, reliability to usefulness, and shareability to usefulness were relatively stronger, indicating that quality-oriented consumers perceive the technical completeness and reliability of content as utility. In contrast, the low functional value group showed a simplified structure in which shareability and convenience directly led to satisfaction (Table 9).

Table 9. Comparison of path estimates by functional value level

Category			Estimate	
			Low	High
Recency	→	Convenience	0.345**	0.625**
Reliability	→	Convenience	0.116	0.056
Shareability	→	Convenience	0.381**	0.209**
Recency	→	Usefulness	0.011	0.072
Reliability	→	Usefulness	0.118***	0.371***
Shareability	→	Usefulness	0.024***	0.344***
Convenience	→	Usefulness	1.112***	0.273***
Convenience	→	Satisfaction	-7.268	0.019
Usefulness	→	Satisfaction	6.443	0.544
Satisfaction	→	Repurchase Intention	1.058	1.148
*p<0.05, **p<0.01, ***p<0.001				

Note: compiled by authors

The results of the multi-group analysis according to economic value levels revealed significant differences between the two groups in the paths of recency → usefulness, convenience → usefulness, convenience → satisfaction, and satisfaction → repurchase intention. The low economic value group perceived recency as practical value and showed a strong influence on usefulness; however, this effect was weakened in the high economic value group. In contrast, in the high group, convenience had a positive effect on usefulness but a negative effect on satisfaction, while the path from satisfaction to repurchase intention was strengthened. In other words, consumers with low economic value tended to emphasize the "novelty" of information, whereas those with high economic value were more likely to consider efficiency and satisfaction experience as key criteria for purchase decisions (Table 10).

Table 10. Comparison of path estimates by economic value level

Category			Estimate	
			Low	High
Recency	→	Convenience	0.429	0.315
Reliability	→	Convenience	0.022	-0.061
Shareability	→	Convenience	0.394	0.4
Recency	→	Usefulness	0.235***	-0.084***
Reliability	→	Usefulness	0.378	0.365
Shareability	→	Usefulness	0.167	0.025
Convenience	→	Usefulness	0.322***	1.284***
Convenience	→	Satisfaction	-0.068***	-1.592***
Usefulness	→	Satisfaction	0.777	1.387
Satisfaction	→	Repurchase Intention	0.84***	1.745***

Note: compiled by authors

The results of hypothesis testing showed that, of the 12 hypotheses, seven were supported and five were rejected. Recency and shareability had significant effects on convenience, while reliability significantly influenced usefulness. Convenience also showed a positive effect on usefulness and was therefore supported. In addition, usefulness had a significant effect on satisfaction, and satisfaction significantly influenced repurchase intention, confirming these paths as core relationships within the research model. In contrast, convenience demonstrated a negative effect on satisfaction, suggesting that simple convenience does not necessarily lead directly to satisfaction. Finally, functional and economic value differed across certain paths, indicating partial moderating effects.

CONCLUSIONS

This study identified the structural relationships through which the technical characteristics (recency, reliability, and shareability) and cognitive characteristics (convenience and usefulness) of AI-based beauty product recommendation short-form content influence consumer satisfaction and repurchase intention. In addition, differences in perception according to consumers' perceived value levels (functional value and economic value) were empirically examined. The results showed that recency and shareability had positive effects on convenience, while reliability was a key factor influencing perceived usefulness. This suggests that, in the context of AI-based beauty product recommendation, short-form content and convenience may be perceived not as distinctive values but as basic system features that consumers expect by default. Furthermore, differences in structural paths were observed according to levels of functional and economic value, indicating that consumers' value orientations influence how the same content is interpreted and evaluated. Consumers with higher functional value tended to evaluate content based on technical completeness and reliability, whereas those with higher economic value formed satisfaction and repurchase intentions based on efficiency and practicality.

Overall, this study confirms that AI-based beauty product recommendation short-form content follows a sequential structure, extending from technical characteristics to cognitive evaluation and ultimately to emotional and behavioral outcomes. Future research should expand sample diversity, adopt longitudinal research designs, and explore other product categories and platforms to enhance generalizability. These findings suggest that AI-based recommendation short-form content serves as a key mechanism linking consumers' cognitive evaluations to behavioral intentions.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: JL and YS; research design: GL; data collection: YS; analysis and interpretation: GL and YS; writing draft preparation: GL and YS; supervision: GL and YS; correction of article: GL and YS; proofread and final approval of article: GL and YS. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Athira, A., Puspitarini, I., Abrahams, F.G., Indra, R., & Mani, L. (2024). Distribution in Coworking Space: Exploring Brand Experience and Brand Image on Brand Equity through Brand Loyalty. *Journal of Distribution Science, 22*(7), 13-22, https://doi.org/10.15722/jds.22.07.2024.07.13

Center for Social Value Enhancement Studies (CSES). (2023). Study on the impact of the Fourth Industrial Revolution technologies on future society. Seoul, Korea. Retrieved January 10 2026 from https://www.cses.re.kr

Chandra, V. (2025). Evolution of consumer behavior in subscription models and its impact on brand loyalty. *International Journal of Research Publication and Reviews, 6*(6), 4878–4887.

Epark. (2025). Personalised content in the era of digital experiences: Data and UX driving new possibilities in personalized marketing. Retrieved January 10 2026 from https://epark.com

Jeon, B. G., & Heo, S. Y. (2022). A study on the effects of experiential value of local food on food satisfaction and destination image. *Journal of Foodservice Management, 25*(2), 7–31. https://doi.org/10.47584/jfm.2022.25.2.7

Jung, S. Y., & Kwon, O. H. (2025). The effect of short-form beauty content on cosmetics selection and purchase intention. *Journal of Investigative Cosmetology, 21*(2), 347–353. https://doi.org/10.15810/jic.2025.21.2.018

Khanh, P. N., Phu, V. T., Hang, B. T.T., Cuong, N. A, (2026). Perceived Usefulness and Intention to Use Blockchain Technology Combined with AI in Monitoring and Managing Warehouse Capacity of Logistics Enterprises in Ho Chi Minh City, Vietnam. Journal of Distribution Science, 24(2), 49-63. https://doi.org/10.15722/jds.24.02.202602.49

Kim, S. H., & Kim, H. K. (2024). A study on the impact of service characteristics of AI recommendation algorithms on intention to continue using the service: Focus on Instagram. *Asia-Pacific Journal of Convergent Research Interchange, 10*(6), 171–182. https://doi.org/10.47116/apjcri.2024.06.14

Kim, D. G. (2025a). Effects of characteristics of AI-based O2O food delivery service on perceived usefulness, perceived ease of use, and continuous usage intention (Master's thesis, Kyonggi University Graduate School of Tourism and Leisure). Gyeonggi-do, Korea.

Kim, G. W. (2025b). The effects of AI-based hair cosmetics recommendation motivations and expected effects on purchase intention and brand trust (Master's thesis, Hansung University Graduate School of Arts). Seoul, Korea.

Kim, M. G. (2025c). The effects of short-form beauty content attributes on information credibility and behavioral intention (Master's thesis, Youngsan University Graduate School of Beauty and Arts). Gyeongsangnam-do, Korea.

Lee, S. (2023). The effects of service and product factors of consumer goods subscription services on subscription satisfaction and continued usage intention (Doctoral dissertation, Konkuk University Graduate School of Business Administration). Seoul, Korea.

Lee, H. (2024). The influence of online/offline purchase information characteristics on purchase intention: Focusing on the moderating effect of consumer type and purchase channel characteristics (Master's thesis, Chung-Ang University Graduate School of Media Communication).

Lee, S. Y. (2021). A study on the factors influencing customer satisfaction and purchase intention of senior customers in online shopping malls (Master's thesis, Kyung Hee University Graduate School of Journalism and Communication). Seoul, Korea.

Li, Y. Y. (2025). The influence of Newtro food collaboration package design on purchase intention of the MZ generation (Master's thesis, Jeonbuk National University Graduate School). Jeonbuk-do, Korea.

Park, S. M. (2024). The effects of beauty content characteristics and viewing motivation of short-form videos by generation on purchase intention (Doctoral dissertation, Westminster Graduate School of Theology). Gyeonggi-do, Korea.

Seong, G. Y. (2025). AI-based personalized services for enhancing e-commerce shopping experience (Master's thesis, Yonsei University Graduate School of Human Ecology). Seoul, Korea.

Sim, T. Y., & Yoon, S. J. (2020). The effects of online shopping mall characteristics on emotional response, perceived value, and reuse intention: Focusing on the extended technology acceptance model (TAM2). *Journal of the Korea Academia-Industrial Cooperation Society, 21*(4), 374–383. https://doi.org/10.5762/KAIS.2020.21.4.374

Tian, Y. A. (2022). A study on the effect of live commerce method on consumer purchase intention based on time-limited promotional method (Unpublished master's dissertation, Kyung Hee University). Seoul, Korea.

Thuc, D. T. (2023). Gen Z's Intention to Repurchase Food Online in The Context of a Crisis: A Case Study in Vietnam Under COVID-19. *Journal of Distribution Science, 21*(12), 23-34. https://doi.org/https://doi.org/10.15722/jds.21.12.202312.23

Yoon, J. S. (2024). A study on consumer behavior according to the characteristics of beauty short-form content (Master's thesis, Kyungmoon University Graduate School of Beauty Arts). Seoul, Korea.

Wardani, A., Adiwijaya, A., & Purbolaksono, M. (2022). Sentiment Analysis on Beauty Product Review Using Modified Balanced Random Forest Method and Chi-Square. Journal of Information System Research (JOSH), 4(1), 1-7. https://doi.org/10.47065/josh.v4i1.2047

Information about the authors

Ju-Ah Lim – PhD, Professor, Eulji University, Sujeong-gu, Seongnam-si, Gyeonggi-do, Republic of Korea, email: ibeauty1712@naver.com

***Young-Jin So** – PhD, Professor, Eulji University, Sujeong-gu, Seongnam-si, Gyeonggi-do, Republic of Korea, email: yjso@eulji.ac.kr

Автордар туралы мәліметтер

Лим Дж. – PhD, Professor, Юлджи университеті, 553 Сансон-дэро, Суджон-гу, Соннамси, Кенгидо, Корея Республикасы, email: ibeauty1712@naver.com

***Со Ю.** – PhD, PhD, Юлджи университеті, 553 Сансон-дэро, Суджон-гу, Соннамси, Кенгидо, Корея Республикасы, email: yjso@eulji.ac.kr

Сведения об авторах

Лим Дж. – PhD, Университет Юлджи, 553 Сансон-дэро, Суджон-гу, Соннамси, Кенгидо, Республика Корея, email: ibeauty1712@naver.com

***Со Ю.** – PhD, Университет Юлджи, 553 Сансон-дэро, Суджон-гу, Соннамси, Кенгидо, Республика Корея, email: yjso@eulji.ac.kr

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-93-109
МРНТИ 06.71.07
JEL: Q16, O32, O33

Check for updates
BY-NC 4.0

Digitalization of Agriculture: Bibliometric Analysis and Prospects for Future Research

Bagdaulet K. Naribek[a], Gulzhanar I. Abdikerimova[a]*, Darikul A. Kulanova[a], Marzhan T. Kalmenova[b], Luiza P. Moldashbayeva[c]

[a]M.Auezov South Kazakhstan University, st. Tauke khan 5, Shymkent, Kazakhstan; [b]I.Zhansugurov Zhetysu University, st. Zhansugurov 187A, Taldykorgan, Kazakhstan; [c]L.N Gumilyov Eurasian National University, st. A.Zhumanov 10A, Astana, Kazakhstan

For citation: Naribek, B.K., Abdikerimova, G.A., Kalmenova, M.T. & Moldashbayeva, L.P. (2026). Digitalization of Agriculture: Bibliometric Analysis and Prospects for Future Research. Economy: strategy and practice, 21(1), 93-109. https://doi.org/10.51176/1997-9967-2026-1-93-109

ABSTRACT

Digitalization of agriculture is one of the key factors in the structural transformation of the agricultural sector in the context of global challenges to food security and sustainable development. The purpose of this study is a comprehensive systematization and in-depth analysis of scientific publications on the digitalization of agriculture for the period 2001-2024 based on data from the international bibliographic database Scopus using bibliometric methods. The research methods include bibliometric analysis of publications indexed in the Scopus database using the TITLE-ABS-KEY protocol and VOSviewer software. The initial data covers 1,326 scientific articles for the period 2001-2024. The results showed that until 2017, only 28 publications were registered in the database, whereas in 2018-2019 their number increased from 7 to 62 (almost 10 times), and in 2020-2024 it reached the range of 129-318 articles annually. The leading positions are occupied by Russia (400 publications, about 30%), India (118), China (113), Germany (107) and Italy (90). Kazakhstan is represented by 22 publications (approximately 2%), which indicates the formation of a national research direction. The cluster analysis identified four key thematic blocks: economic and institutional, data and IoT management, sustainable development and climate, and digital platforms for the agricultural industry. The results obtained confirm that the digitalization of the agricultural sector is evolving from a technological focus to a comprehensive economic and institutional transformation and forms the basis for further empirical research on the effectiveness of digital solutions in agriculture.

KEYWORDS: Digital Economy, Digitalization, Agricultural Strategy, Agriculture, Sustainable Development, Bibliometric Analysis, Clustering

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT: the study was not sponsored (own resources)

Article history:
Received 14 December 2025
Accepted 02 March 2026
Published 30 March 2026

* **Corresponding author: Abdikerimova G.A.** – Cand. Sc. (Econ.), M. Auezov South Kazakhstan University, st. Tauke khan 5, Shymkent, Kazakhstan, email: abdikerimova71@mail.ru

Цифровизация сельского хозяйства: библиометрический анализ и перспективы будущих исследований

Нарибек Б.К.[a], Абдикеримова Г.И.[a]*, Куланова Д.А.[a], Кальменова М.Т.[b], Молдашбаева Л.П.[c]

[a]Южно-Казахстанский университет имени М.Ауэзова, ул. Тауке хана 5, Шымкент, Казахстан; [b]Жетысуский университет им. И.Жансугурова, ул. Жансугурова 187А, Талдыкорган, Казахстан; [c]Евразийский национальный университет им. Л.Н. Гумилева, ул. А. Жубанова 10А, Астана, Казахстан

Для цитирования: Нарибек Б.К., Абдикеримова Г.И., Куланова Д.А., Кальменова М.Т., Молдашбаева Л.П.(2026). Цифровизация сельского хозяйства: библиометрический анализ и перспективы будущих исследований. Экономика: стратегия и практика, 21(1), 93-109. https://doi.org/10.51176/1997-9967-2026-1-93-109

АННОТАЦИЯ

Цифровизация сельского хозяйства выступает одним из ключевых факторов структурной трансформации аграрного сектора в условиях глобальных вызовов продовольственной безопасности и устойчивого развития. Целью данного исследования является комплексная систематизация и углублённый анализ научных публикаций, посвящённых цифровизации сельского хозяйства, за период 2001–2024 гг. на основе данных международной библиографической базы Scopus с применением библиометрических методов. Методы исследования включают библиометрический анализ публикаций, индексированных в базе данных Scopus, с использованием протокола TITLE-ABS-KEY и программного обеспечения VOSviewer. Исходные данные охватывают 1 326 научных статей за период 2001–2024 гг. Результаты показали, что до 2017 г. в базе было зарегистрировано лишь 28 публикаций, тогда как в 2018–2019 гг. их число выросло с 7 до 62 (почти в 10 раз), а в 2020–2024 гг. достигло диапазона 129–318 статей ежегодно. Лидирующие позиции занимают Россия (400 публикаций, около 30%), Индия (118), Китай (113), Германия (107) и Италия (90). Казахстан представлен 22 публикациями (примерно 2%), что свидетельствует о формировании национального исследовательского направления. Кластерный анализ выявил четыре ключевых тематических блока: экономико-институциональный, данные и IoT-управление, устойчивое развитие и климат, цифровые платформы агроиндустрии. Полученные результаты подтверждают, что цифровизация аграрного сектора эволюционирует от технологического фокуса к комплексной экономико-институциональной трансформации и формирует основу для дальнейших эмпирических исследований эффективности цифровых решений в сельском хозяйстве.

КЛЮЧЕВЫЕ СЛОВА: Цифровая экономика, цифровизация, аграрная стратегия, сельское хозяйство, устойчивое развитие, библиометрический анализ, кластеризация

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ: исследование не имело спонсорской поддержки (собственные ресурсы)

История статьи:
Получено 14 декабря 2025
Принято 02 марта 2026
Опубликовано 30 марта 2026

***Корреспондирующий автор: **Абдикеримова Г.И.** – к.э.н., Южно-Казахстанский университет имени М. Ауэзова, ул. Тауке хана 5, Шымкент, Казахстан, email: abdikerimova71@mail.ru

КІРІСПЕ

Ауыл шаруашылығын цифрландыру тақырыбы қазіргі әлемде өте өзекті болып қала береді. Ауыл шаруашылығы көптеген елдердің азық-түлік қауіпсіздігі мен тұрақты дамуын қамтамасыз етуде шешуші рөл атқарады. Алайда, климаттың өзгеруі, әлем халқының көбеюі және өнімділікті арттыру қажеттілігі сияқты заманауи сын-қатерлер ауылшаруашылық өндірісін басқарудың жаңа тәсілдерін қажет етеді. Цифрландыру ауыл шаруашылығының тиімділігі мен тұрақтылығын айтарлықтай жақсартатын бірқатар инновациялық шешімдерді ұсынады. Топырақ құрамы мен өсімдіктерді бақылау үшін датчиктер мен дрондарды пайдаланудан бастап, дақылдарды басқару процестерін оңтайландыру үшін жасанды интеллект жүйелерін енгізуге дейін цифрлық технологиялар фермерлердің өз шаруашылықтарын басқару тәсілдерін өзгертеді. Сонымен қатар, қала халқының өсуі және қол жетімді ауылшаруашылық жерлерінің азаюы жағдайында цифрландыру ауыл шаруашылығының тиімді және экологиялық тұрақты болуына көмектеседі, мысалы, тік егіншілікті енгізу немесе гидропониканы қолдану арқылы.

Ауыл шаруашылығын цифрландыру – агроөнеркәсіптік сектордағы құрылымдық трансформацияның негізгі драйверлерінің бірі. Ол үлкен деректер, IoT, жасанды интеллект және бұлттық есептеулер сияқты озық технологияларды аграрлық өндіріс үдерістеріне интеграциялауды білдіреді. Бұл технологиялар өнімділікті арттыруға, ресурстарды тиімді пайдалануға және агроэкожүйелердің тұрақты дамуын қамтамасыз етуге мүмкіндік береді. Дегенмен, цифрлық шешімдердің нақты экономикалық және институционалдық салдарлары ғылыми әдебиетте әлі де бірізді және жүйелі түрде талданбаған.

Соңғы жылдары цифрлық трансформацияны зерттеуде библиометриялық әдістер кеңінен қолданыла бастады. Бұл тәсіл ғылыми жарияланымдар динамикасын жүйелі бағалауға, тақырыптық құрылымдарды айқындауға және зерттеулердің эволюциясын картаға түсіруге мүмкіндік береді. Бұрынғы библиометриялық зерттеулер цифрлық ауыл шаруашылығы саласындағы жетекші журналдарды, елдерді және институттарды анықтағанымен, кілттік сөздердің өзара байланысы мен тақырыптық кластерлердің құрылымын терең талдаумен жеткілікті деңгейде айналыспаған (Kumari et al., 2024; Xu et al., 2024). Нәтижесінде, саланың тұжырымдамалық шеңбері мен ғылыми шекаралары толық айқындалмай отыр.

Осы зерттеу дәл осы олқылықты толтыруды мақсат етеді. Оның басты ғылыми міндеті – цифрлық ауыл шаруашылығы саласындағы ғылыми ландшафтты жүйелеу, негізгі тақырыптық кластерлерді және олардың өзара байланысын анықтау, сондай-ақ зерттеулердің стратегиялық траекторияларын айқындау. Кеңейтілген библиометриялық әдіснама негізінде бұл жұмыс сандық ауыл шаруашылығы бойынша қалыптасқан ғылыми құрылымды картаға түсіріп, жоғары ықпалға ие жарияланымдарды, ғылыми ынтымақтастық желілерін және басым бағыттарды анықтайды.

Қазақстанда аграрлық секторды цифрландыру үдерісі қарқынды дамып келеді. Бұл жағдай ұлттық аграрлық саясатты қалыптастыру және даму стратегияларын әзірлеу үшін жаһандық ғылыми трендтерді терең түсінудің маңызын арттырады. Осы тұрғыдан алғанда, халықаралық зерттеулердің құрылымы мен бағытын талдау Қазақстан үшін институционалдық және инвестициялық шешімдерді негіздеудің аналитикалық құралы бола алады.

Ғылыми әдебиеттердің жыл сайын цифрлық ауыл шаруашылығына деген жаһандық қызығушылықтың тұрақты артып келе жатқанын көрсетеді (Abdullahi et al., 2023; Schmidt et al., 2024). Библиометриялық тәсіл ғылыми саланың зияткерлік құрылымын картаға түсіруге, білімнің қалыптасу траекторияларын айқындауға және негіз қалаушы еңбектерді анықтауға мүмкіндік береді. Осы әдістің көмегімен агроөнеркәсіптік кешенді цифрландыру саласындағы зерттеулердің экономикалық, технологиялық және институционалдық өлшемдерін кешенді түрде бағалауға болады.

Осылайша, мақала мынадай зерттеу сұрағына жауап беруге бағытталған: цифрлық ауыл шаруашылығы саласындағы ғылыми зерттеулер қандай тақырыптық құрылымда қалыптасқан және бұл құрылым аграрлық сектордың болашақ экономикалық және институционалдық дамуы туралы қандай стратегиялық қорытындылар жасауға мүмкіндік береді? Мақала

теориялық және библиографиялық аспектіге ие болғандықтан, қарастырылған материалдар болашақта ауыл шаруашылығын цифрландырудың практикалық және кеңес беру мәселелерін зерттеу үшін регрессиялық талдау жасауға көмектеседі. Бұл тәсіл алынған нәтижелерді тек сипаттаумен шектелмей, оларды саясатты әзірлеу мен стратегиялық шешімдер қабылдауға қолдануға негіз қалайды.

ӘДЕБИЕТТЕРГЕ ШОЛУ

Соңғы жылдары цифрлық ауыл шаруашылығы саласындағы ғылыми зерттеулер қарқынды түрде кеңеюде. Библиометриялық талдаулар бұл бағыттағы білім құрылымын жүйелеудің негізгі құралдарының біріне айналды. Мысалы, Chamorro-Padial et al. (2025) 2001–2023 жж. аралығындағы 252 жарияланым негізінде ауыл шаруашылығы деректерін пайдалануға қатысты зерттеулердің тақырыптық эволюциясын талдап, деректермен жұмыс істеудің негізгі бағыттарын айқындады. Bertoglio et al. (2021) сандық ауыл шаруашылығы бойынша кілттік сөздердің бірлесіп кездесуі (co-occurrence) негізінде осы саланың тұжырымдамалық құрылымын картаға түсірді. Sott et al. (2021) еңбектерінде цифрландыру стратегияларын өңірлік контекске бейімдеудің маңыздылығы көрсетілген. Бұл зерттеулер жаһандық технологиялық трендтерді ұлттық аграрлық жүйемен ұштастыру қажеттігін негіздейді (Abu et al., 2022). Алайда бұл еңбектер көбінесе жарияланымдардың жалпы құрылымын сипаттаумен шектеліп, тақырыптық кластерлердің өзара байланысын және олардың стратегиялық маңызын терең интерпретациялауға жеткілікті назар аудармайды.

Ғылыми әдебиетте цифрлық трансформацияның технологиялық өлшемі басым орын алады. Көптеген зерттеулер заттар интернетінің (IoT) ақылды ауыл шаруашылығын қалыптастырудағы шешуші рөлін көрсетеді (Schmidt et al., 2024). IoT нақты уақыт режимінде деректер жинауды қамтамасыз етіп, дәстүрлі аграрлық тәжірибелерді түбегейлі өзгертеді және операциялық тиімділікті арттырады. Big Data мен цифрлық платформалардың интеграциясы аграрлық секторды деректерге негізделген басқару моделіне көшірудің басты тетігі ретінде қарастырылады (Iaksch et al., 2021; Rolandi et al., 2021). Бұл үдеріс тек технологиялық жаңғыртумен шектелмей, институционалдық реформалар мен тұрақты даму стратегияларымен ұштасуы тиіс (Wang et al., 2025). Maulana et al. (2024) және Paudel et al. (2024) библиометриялық шолулары AI, IoT және үлкен деректердің ауыл шаруашылығында парадигмалық өзгеріс тудырып жатқанын көрсетеді. Дегенмен, бұл зерттеулерде технологиялық трендтер басым сипатталып, олардың экономикалық және институционалдық салдарлары жүйелі түрде талданбайды.

Қазақстандық зерттеулер де цифрлық ауыл шаруашылығының аймақтық ерекшеліктерін ашуға бағытталған. Атап айтқанда, Sadenova et al. (2022) Шығыс Қазақстан облысындағы жаздық бидай өндірісі мысалында егін шаруашылығын цифрландырудың климатқа бейімделген (climate-optimized) модельдерін негіздеп, аграрлық өндірісті деректерге негізделген басқаруға көшірудің практикалық тетіктерін көрсетті. Toguzova et al. (2023) дәлме-дәл егіншілік элементтерін енгізу тәжірибесін талдай отырып, өңірлік деңгейде технологиялық инфрақұрылымның, кадрлық әлеуеттің және институционалдық қолдаудың жеткіліксіздігі цифрлық трансформацияның негізгі шектеуші факторларының бірі екенін айқындады. Сонымен қатар, халықаралық әдебиеттерде «smart agriculture», «IoT», «sensor», «model», «network» терминдерінің жиі қайталануы ауыл шаруашылығы проблемаларын технологиялық шешімдер арқылы еңсеруге бағытталған конвергенттік үрдісті айғақтайды (Ayaz & Ayaz, 2025).

Ауыл шаруашылығын цифрландыру тақырыбы зерттеушілердің, мемлекеттік органдардың, агробизнестің және жұртшылықтың назарын аудара отырып, қазіргі аграрлық сектордағы басты тақырыптардың біріне айналды. Мәселе бұрыннан өзекті болды, бірақ оның даму деңгейі белгілі бір аймақтың контексті мен даму деңгейіне байланысты өзгеріп отырады. Ауыл шаруашылығын ақпараттандыруды дамыту және әлеуметтік дамудың цифрлық моделін қалыптастыру мәселелерін зерттеудің теориялық және әдіснамалық негіздері Д.Белл, Э.Гидденс, Дж.Гэлбрейт, П.Друкер, М.Кастельс, Ф.Махлуп, Н.Негропонте, Д.Тапскотт, Э.Тоффлер және басқалар. М.Имашева, А.Ахметов, С.Абай, Т.Барановская, О.Кусакина, Е.Луценко,

В.Меденников, Н.Морозов, А.Немчинов, И.Романенко, Ю.Огнивцев, И.Санду және басқалардың жұмыстары ауыл шаруашылығын ақпараттандыру және цифрландыру теориясы мен практикасын дамытуға және аграрлық өндіріс жүйесінде ақпараттық технологияларды пайдалануға арналған. Жалпы, ауыл шаруашылығын цифрландыру проблемасы озық технологиялар белсенді қолданылатын дамыған елдерде жоғары дәрежеде әзірленген. Сонымен қатар, дамушы елдерде осы салада өсу мен дамудың айтарлықтай әлеуеті бар, бұл халықаралық қауымдастықтың технологияларды тарату, оқыту және қолдау бойынша одан әрі күш-жігерді қажет етеді.

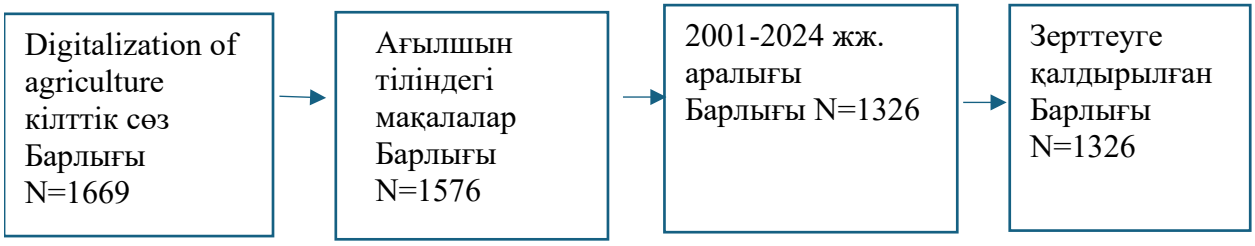
Қазақстан бойынша жүргізілген салыстырмалы библиометриялық зерттеуде Web of Science дерекқоры негізінде халықаралық ынтымақтастық, қазақстандық жарияланымдар және болашақ зерттеу бағыттары талданды (Naribek et al., 2025). Алайда бұл жұмыс тек бір дерекқормен шектеліп, жаһандық ғылыми ландшафтты толық қамти алмады. Қарастырылып отырған ауқым осы тақырыпты зерттеудің толық көрінісін бермейді; сондықтан бұл мақала тренд жасушаларын ашуға бағытталған және осы әдістің арқасында қай тренд аз зерттелгенін, әсіресе Қазақстан үшін одан әрі зерттеуді қажет ететінін қарастыруға болады. Осылайша, қолданыстағы жұмыстар цифрлық ауыл шаруашылығының жеке аспектілерін ашады; олар әртүрлі тақырыптық салалардың өзара байланысын және олардың экономикалық және институционалдық маңыздылығын толық көрсететін кешенді библиометриялық картаны ұсынбайды.

Осы зерттеу дәл осы олқылықты толтыруға бағытталған: Scopus дерекқоры негізінде цифрлық ауыл шаруашылығы саласындағы ғылыми бағыттардың құрылымын, олардың эволюциясын және өзара байланысын жүйелі түрде талдап, алынған кластерлерді экономикалық және стратегиялық тұрғыдан интерпретациялайды. Бұл тәсіл технологиялық трендтерді сипаттаумен шектелмей, олардың агроөнеркәсіптік кешеннің дамуына ықпалын кешенді бағалауға мүмкіндік береді.

МАТЕРИАЛДАР МЕН ӘДІСТЕР

Зерттеудің теориялық-әдіснамалық және әдістемелік базасы ғалымдардың ауыл шаруашылығын ақпараттандыру және цифрландыру мәселелері және аграрлық өндірісті басқаруда ақпараттық және цифрлық технологияларды пайдалану, цифрлық экономика субъектілерінің өзара іс-қимылының жекелеген аспектілерін реттейтін заңнамалық және нормативтік актілер, бағдарламалық құжаттар, әртүрлі бизнес-процестерді цифрландыру және өзара іс-қимыл жүйесін жетілдіру мәселелері бойынша материалдар мен әзірлемелер негізінде қалыптасты цифрлық экономика субъектілері.

Зерттеу 2001–2024 жж. аралығында Scopus дерекқорында индекстелген жарияланымдар негізінде жүргізілді. Деректерді іріктеу үшін TITLE-ABS-KEY өрісі бойынша «digitalization of agriculture» кілттік тіркесі қолданылды. 1-суретте кілт сөздерді іріктеу көрсетілген.



Сурет 1. Scopus базасында кілт сөздерді іздеу стратегиясы
Figure 1. Keyword search strategy in the Scopus database

Іздеу нәтижесінде бастапқыда 1 669 құжат анықталды. Тек ағылшын тіліндегі ғылыми мақалаларды (articles) қалдыру арқылы 1 576 жазба іріктелді. 2025 ж. толық аяқталмағандықтан, талдау 2001–2024 жж. шектеліп, соңғы үлгі 1 326 құжаттан тұрды. Деректер жылдар бойынша жарияланымдар динамикасын, елдер мен институттар арасындағы үлесті, авторлық желі-

лерді, қаржыландыру көздерін және кілттік сөздерді талдауға мүмкіндік берді.

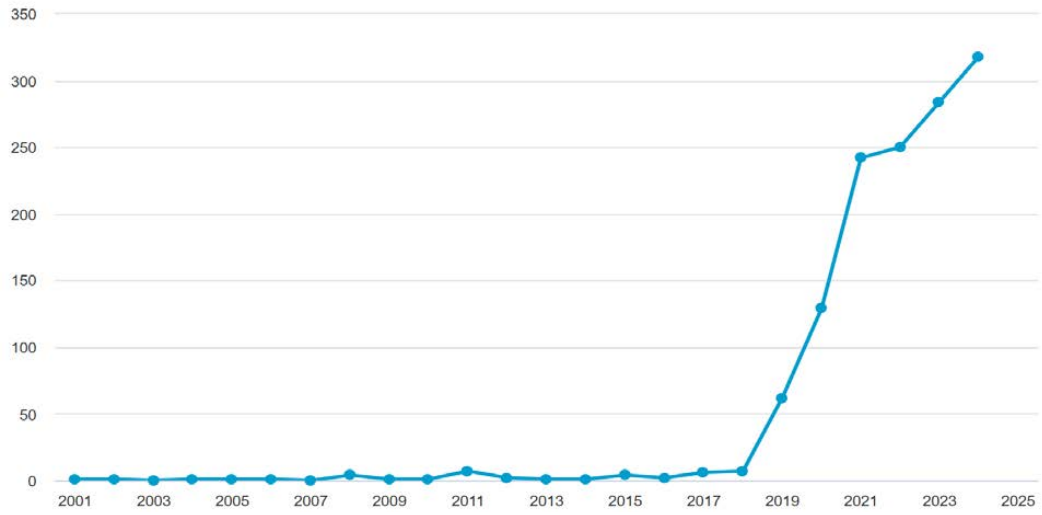
Библиометриялық желілерді құру және визуализациялау үшін VOSviewer бағдарламасы пайдаланылды. Талдауда кілттік сөздердің бірлесіп пайда болуы (co-occurrence), авторлық және институционалдық байланыстар (co-authorship) қарастырылды. Кілттік сөздер картасын құруда ең аз кездесу шегі (minimum occurrences) 5 ретінде белгіленді, ал нормализация үшін association strength әдісі қолданылды. Network, overlay және density визуализация түрлері пайдаланылып, тақырыптық кластерлердің құрылымы мен эволюциясы анықталды.

Материалдарды талдау барысында жарияланымдардың сипаттамалық көрсеткіштері – мақалалар саны, дәйексөздер, тең авторлық жұмыстар, елдер мен мекемелердің үлесі қарастырылды. Қазақстандық авторлардың үлесі және олардың халықаралық ғылыми ынтымақтастықтағы орны жеке талданды. Осы әдіснамалық тәсіл цифрлық ауыл шаруашылығы саласындағы ғылыми ландшафтты жүйелі картаға түсіруге, негізгі тақырыптық бағыттарды анықтауға және агроөнеркәсіптік кешенді цифрландырудың жаһандық әрі өңірлік үрдістерін салыстырмалы түрде бағалауға мүмкіндік береді.

НӘТИЖЕЛЕР МЕН ТАЛҚЫЛАУ

Бұл бөлімде библиометриялық нәтижелер сипаттаумен шектелмей, олардың құрылымдық және институционалдық себептері интерпретацияланады. Алынған деректер аграрлық сектордағы цифрлық трансформацияның ғылыми дискурста қалай қалыптасқанын және оның қандай факторлармен жеделдегенін талдауға мүмкіндік береді. Scopus дерекқорындағы мәліметтер 2001–2017 жж. аралығында цифрлық ауыл шаруашылығы бойынша жарияланымдар санының төмен болғанын көрсетеді (28 мақала). Бұл кезеңде цифрландыру аграрлық саясаттың басым бағыты ретінде айқындалмаған. 2017 ж. бастап жарияланымдар санының айтарлықтай өсуі дәл егіншілік, IoT және деректерге негізделген басқару жүйелерінің аграрлық практикаға енуімен сәйкес келеді, яғни ғылыми белсенділік нақты экономикалық сұраныспен өзара байланысты. Scopus дерекқорындағы ғылыми мақалалар санының жылдар бойынша динамикасы.

2 сурет Scopus дерекқорындағы ғылыми мақалалар санының жылдар бойынша динамикасын көрсетеді.



Сурет 2. Scopus дерекқорындағы ғылыми мақалалар санының жылдар бойынша динамикасы
Figure 2. Dynamics of the number of scientific articles in the Scopus database by years

Ауыл шаруашылығы азық-түлік қауіпсіздігі мен әлеуметтік-экономикалық дамудың тұрақтылығын қамтамасыз ететін әлемдік экономиканың негізгі салаларының бірі болып табылады. Соңғы онжылдықтарда цифрландыру, заманауи ақпараттық және коммуникациялық

технологияларды енгізу ауыл шаруашылығы өндірісінің ажырамас бөлігіне айналды. Бұл процесс аграрлық сектордың жұмысын ұйымдастыру мен тиімділігіне елеулі өзгерістер әкелді. Бұл зерттеу цифрлық технологиялардың өндірістік процестерге, нарықтық бәсекеге қабілеттілікке және аграрлық Бизнестің тұрақтылығына әсерін қоса алғанда, ауыл шаруашылығын цифрландырудың экономикалық даму көрсеткіштері мен факторларын талдауға бағытталған. Цифрлық трансформацияның өсіп келе жатқан рөлі контекстінде оның ауыл шаруашылығы секторын дамытуға әсер етуінің негізгі аспектілерін түсіну оңтайлы даму стратегияларын анықтау және тұрақты экономикалық өсуге қол жеткізу үшін барған сайын маңызды бола түсуде. Осылайша, ауыл шаруашылығын цифрландыру стратегияларын әзірлеу кезінде осы факторларды түсіну және ескеру осы саланың тұрақты экономикалық дамуына, ауыл тұрғындарының өнімділігін, бәсекеге қабілеттілігін және өмір сүру деңгейін арттыруға ықпал ете алады.

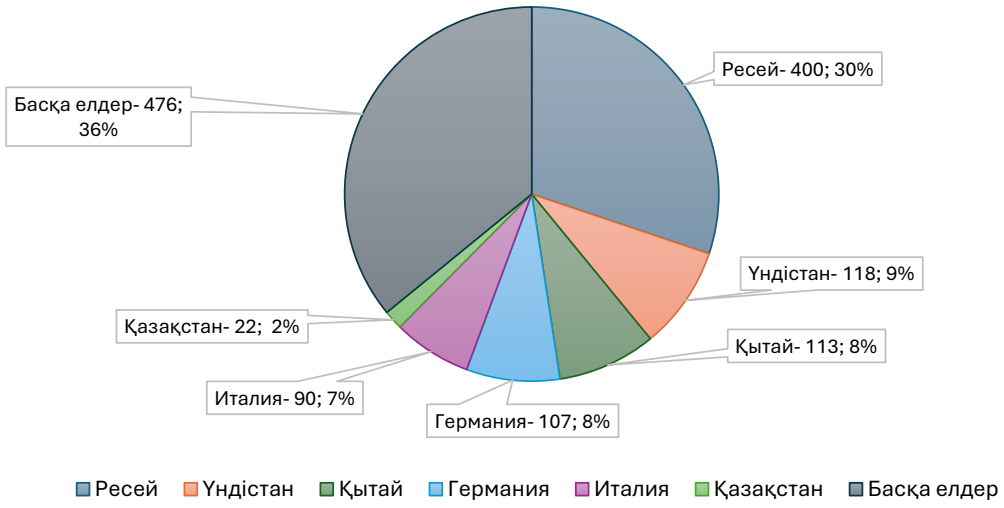
2018–2019 жж. жарияланымдар саны 7-ден 62-ге дейін өсті (10 есеге), ал 2020–2024 жж.129–318 аралығына жетті (2,5 есеге) (сурет 2). Бұл динамика цифрлық ауыл шаруашылығының институционалдық деңгейде орнығып, агроөнеркәсіптік кешенді жаңғыртудың жүйелік бағытына айналғанын көрсетеді. Зерттеулердің өсуі технологиялық прогрестен гөрі, аграрлық сектордағы құрылымдық өзгерістермен және басқару модельдерінің эволюциясымен байланысты.

Елдер бойынша бөлініс ғылыми белсенділіктің институционалдық негізін айқындайды. Ресей Федерациясы 400 жарияланыммен жетекші орында (шамамен 30%), бұл агроөнеркәсіптік кешенді цифрландыруға бағытталған мемлекеттік бағдарламалардың жүйелі іске асырылуымен байланысты. Үндістан (118) мен Қытай (113) агросекторды цифрландыруды ұлттық даму стратегияларының басым бағыты ретінде қарастырып, ауылдық аумақтардағы цифрлық инфрақұрылым мен фермерлік инновацияларды қолдауға бағытталған зерттеулерді кеңейтуде.

Германия (107) мен Италия (90) зерттеулері агротехнологиялық шешімдермен қатар деректерді басқару және институционалдық бейімделу мәселелеріне назар аударады. Бұл елдерде цифрландыру аграрлық сектордың экономикалық тиімділігі мен экологиялық орнықтылығын арттыру құралы ретінде қарастырылады.

Қазақстан бойынша жарияланымдар 2019 ж. басталып, 22 құжатқа жетті (шамамен 2%). Көптеген зерттеушілер ауыл шаруашылығы мәселелерімен айналысуда, ал агроөнеркәсіптік кешендегі цифрландыру 2021 ж. бастап өзекті бола бастады, бірақ цифрландыру процесі ҚР Президент Қ.-Ж. Тоқаевтың Жолдауынан кейін (2025 ж. қыркүйегі) күшейе түсті. Бұл көрсеткіш ұлттық реформалар мен мемлекеттік бағдарламалардың ғылыми кеңістікке әсер ете бастағанын және цифрлық ауыл шаруашылығы саласындағы ғылыми әлеуеттің қалыптасу сатысын сипаттайды.

Елдер арасындағы айырмашылықтар цифрлық стратегиялардың, экономикалық даму деңгейінің және институционалдық қолдаудың ерекшеліктерімен түсіндіріледі. Бұл нәтиже аграрлық секторды цифрландырудың тиімділігі технологиялардан гөрі, оларды енгізетін институционалдық ортаға тәуелді екенін көрсетеді. 3-сурет деректері агроөнеркәсіптік кешенді цифрландыру бойынша зерттеулердің кең географиялық ауқымын және аймақтық ерекшеліктерін көрсетеді.



Сурет 3. Scopus дерекқорындағы жарияланған мақалалар саны және елдер үлесі
Figure 3. Number of published articles and percentage of countries in the Scopus database

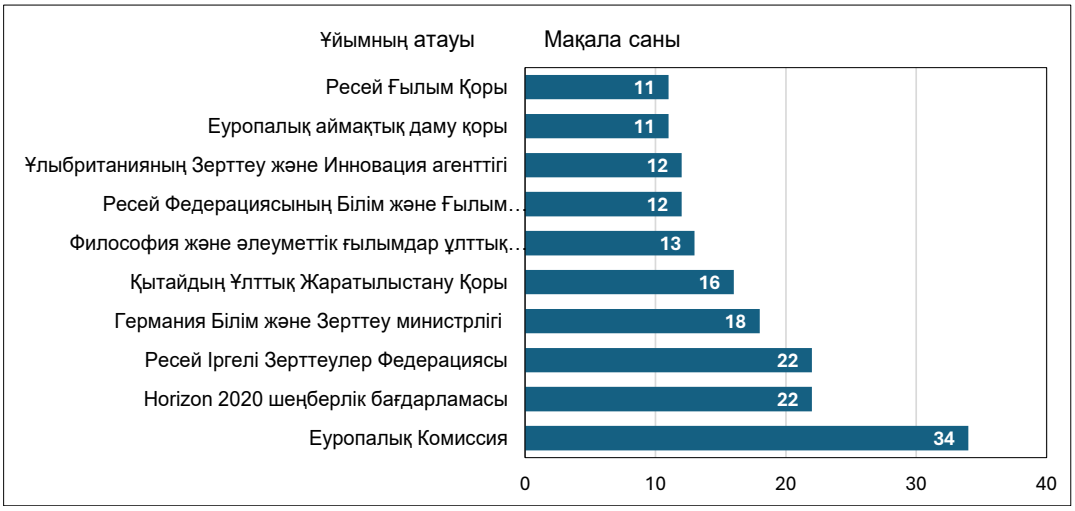
Жетекші орынды Ресей Федерациясы иеленіп отыр (400 жарияланым, шамамен 30%). Бұл көрсеткіш агроөнеркәсіптік кешенді цифрландыруға бағытталған мемлекеттік бағдарламалардың жүйелі іске асырылуымен және ғылыми-институционалдық инфрақұрылымның қалыптасуымен байланысты. Үндістан (118) мен Қытай (113) екінші және үшінші орындарды иеленеді. Бұл елдерде агросекторды цифрландыру ұлттық даму стратегияларының құрамдас бөлігі ретінде қарастырылып, ауылдық аумақтардағы цифрлық инфрақұрылымды дамыту, фермерлік инновацияларды енгізу және цифрлық теңсіздікті төмендету мәселелеріне басымдық беріледі. Еуропада Германия (107) мен Италия (90) теориялық және әдіснамалық үлестерімен ерекшеленеді. Германия зерттеулері агротехнологиялық инновациялар мен цифрлық логистиканы талдауға бағытталса, Италияда деректерді басқару және цифрлық экожүйелердің институционалдық бейімделуі негізгі тақырыптарға жатады. Ұлыбритания, АҚШ және Испанияда да тұрақты ғылыми белсенділік байқалады.

Қазақстан бойынша жарияланымдар 2019 ж. басталып, 22 құжатқа жетті (шамамен 2%). Бұл көрсеткіш дамыған елдермен салыстырғанда төмен болғанымен, Web of Science дерекқорындағы нәтижелермен салыстырғанда жоғары және ұлттық реформалар мен мемлекеттік бағдарламалардың ғылыми кеңістікке әсер ете бастағанын көрсетеді**.** Көршілес елдерде Өзбекстанда 15, Қырғызстанда 11 жарияланым тіркелген.

Елдердің агроөнеркәсіптік кешенді цифрландыру саласындағы жарияланымдық белсенділігі цифрлық басымдықтардың ұлттық даму стратегияларына қаншалықты интеграцияланғанын және ғылыми зерттеулерді институционалдық қолдау деңгейін көрсетеді. Ресейдің көшбасшылығы мемлекеттік бағдарламаларды жүйелі түрде жүзеге асыруға және дамыған ғылыми және институционалдық инфрақұрылымға байланысты, ал Үндістан мен Қытайдың жоғары көрсеткіштері ауылдық жерлерді жаңғыртуға, инновацияларға және цифрлық алшақтықты азайтуға бағытталғандықтан туындайды. Еуропа елдері, ең алдымен, цифрлық ауыл шаруашылығы технологияларын теориялық және әдіснамалық тұрғыдан түсінуге, саланың ғылыми негізін нығайтуға тұрақты үлес қосып келеді. Жалпы алғанда, анықталған айырмашылықтар ауыл шаруашылығы секторындағы цифрлық трансформацияның тиімділігі тек технологиялық факторлармен ғана емес, сонымен қатар зерттеудің стратегиялық қорытындыларын тұжырымдау үшін маңызды болып табылатын институционалдық ортаның жетілгендігімен де анықталатынын растайды.

Жалпы алғанда, зерттеу нәтижелері аграрлық секторды цифрландыру тақырыбының көптеген елдерде ғылыми және практикалық

маңызға ие екенін көрсетеді. Аймақтар арасындағы айырмашылықтар ұлттық цифрлық стратегиялардың, экономикалық даму деңгейінің және институционалдық қолдау тетіктерінің ерекшеліктерімен түсіндіріледі. Бұл агроөнеркәсіптік кешенді цифрландырудың тиімділігі технологиялармен қатар институционалдық ортаның дамуына тәуелді екенін айқындайды. 4-сурет Scopus дерекқорындағы ғылыми мақалаларды қаржыландырудағы ұйымдар үлесі көрсетеді.



Сурет 4. Scopus дерекқорындағы ғылыми мақалаларды қаржыландырудағы ұйымдар үлесі
Figure 4. The share of organizations in financing scientific articles in the Scopus database

Зерттеу нәтижелері 2001–2024 жж. аралығында ауыл шаруашылығын цифрландыру тақырыбы бойынша жарияланған ғылыми еңбектерді қаржыландыруда жетекші рөлді еуропалық ғылыми ұйымдар атқарғанын көрсетеді. Барлығы 1 326 құжат талданды. Ең ірі қаржыландыру көздері ретінде Еуропалық комиссия (34 құжат) және Horizon 2020 бағдарламасы (22 құжат) анықталды. Бұл көрсеткіштер Еуропалық одақтың агроөнеркәсіптік кешенді цифрландыруды экономикалық өсудің стратегиялық бағыты ретінде институционалдық деңгейде бекіткенін көрсетеді. Horizon 2020 және кейінгі Horizon Europe бағдарламалары шеңберінде смарт-агрономия, «ақылды ферма» технологиялары, үлкен деректерді талдау және автоматтандыру жүйелерін енгізуге бағытталған жобалар жүйелі түрде қолдау тапқан.

Келесі орындарда Ресейдің Іргелі зерттеулер қоры (22 құжат), Германияның Білім және зерттеу министрлігі (18 құжат) және Қытайдың Ұлттық жаратылыстану қоры (16 құжат) орналасқан. Бұл ұйымдардың белсенділігі аграрлық секторды цифрландыруды ұлттық деңгейде өнімділікті арттырудың негізгі тетігі ретінде қарастырумен байланысты. Сонымен қатар Философия және әлеуметтік ғылымдар ұлттық басқармасы, Ресей Федерациясының Білім және ғылым министрлігі, Ұлыбританияның Research and Innovation агенттігі және Еуропалық аймақтық даму қоры да осы бағыттағы зерттеулерді институционалдық тұрғыдан қолдап отыр.

Алынған деректер цифрлық ауыл шаруашылығы бойынша зерттеулердің негізгі бөлігі еуропалық және азиялық ғылыми қауымдастықтардың қатысуымен жүзеге асатынын көрсетеді. Бұл үрдіс аграрлық сектордағы цифрлық трансформацияның жаһандық сипатқа ие болғанын және халықаралық ғылыми әріптестіктің маңызын арттырғанын дәлелдейді.

Scopus дерекқоры бойынша Қазақстанда қаржыландырушы ұйымдар ретінде тек екі құжат тіркелген: Қазақстан Республикасы Ауыл шаруашылығы министрлігі – 1 құжат және Қазақстан Республикасы Ғылым және жоғары білім министрлігі – 1 құжат. Бұл 22 қазақстандық жарияланымның ішінде мемлекеттік қолдаумен жүзеге асқан зерттеулер үлесінің шектеулі

екенін көрсетеді. Бұл жағдай цифрлық ауыл шаруашылығы саласында ұлттық ғылыми саясаттың әлеуеті толық пайдаланылмай отырғанын айқындайды.

Осыған байланысты аграрлық секторды цифрландыру бойынша қойылған стратегиялық міндеттерді іске асыру үшін мемлекеттік органдардың ғылыми зерттеулерді қаржыландыруды жүйелі түрде арттыруы қажет. Бұл цифрлық жобалардың ауқымын кеңейтіп, агроөнеркәсіптік кешенде инновациялық шешімдердің институционалдық негізде орнығуына мүмкіндік береді. 1-кесте Scopus дерекқорындағы ең көп мақала жариялаған институттар тізімі көрсетеді. Кестеде 2001–2024 жж. аралығында «ауыл шаруашылығын цифрландыру» тақырыбы бойынша жарияланған ғылыми құжаттардың ұйымдар бойынша бөлінісін көрсетеді. Талдау үшін жарияланым саны ең жоғары алғашқы 10 ұйым іріктелді. 1-кестеде Scopus дерекқорындағы ең көп мақала жариялаған институттар тізімі ұсынылған.

Кесте 1. Scopus дерекқорындағы ең көп мақала жариялаған институттар тізімі
Table 1. List of institutions that have published most articles in the Scopus database

№	Мекеме атауы	Орналасқан жері	Мақала саны
1	Ресей мемлекеттік аграрлық университеті – К.А. Тимирязев атындағы Мәскеу ауылшаруашылық академиясы	Ресей	25
2	Ресей ғылым академиясы.	Ресей	22
3	Вагенинген университеті және ғылыми-зерттеу орталығы.	Нидерланд	20
4	Кубан мемлекеттік аграрлық университеті.	Ресей	19
5	Пиза университеті.	Италия	19
6	Қазан мемлекеттік аграрлық университеті.	Ресей	18
7	Г. В. Плеханов атындағы Ресей экономикалық университеті.	Ресей	16
8	Дон мемлекеттік техникалық университеті.	Ресей	15
9	Ұлттық зерттеулер кеңесі (Италия).	Италия	14
10	Орал мемлекеттік экономика университеті.	Ресей	14

Ескертпе: Scopus дерекқорынан алынған мәліметтер негізінде автормен құрастырылған

Нәтижелер Ресей мемлекеттік аграрлық университеті – К.А. Тимирязев атындағы Мәскеу ауылшаруашылық академиясының көшбасшылығын көрсетеді (25 құжат). Ресей ғылым академиясы 22 жарияланыммен екінші орында тұр. Бұл деректер Ресейде аграрлық секторды цифрландыру бойынша тұрақты ғылыми инфрақұрылым қалыптасқанын және зерттеулердің институционалдық деңгейде шоғырланғанын көрсетеді.

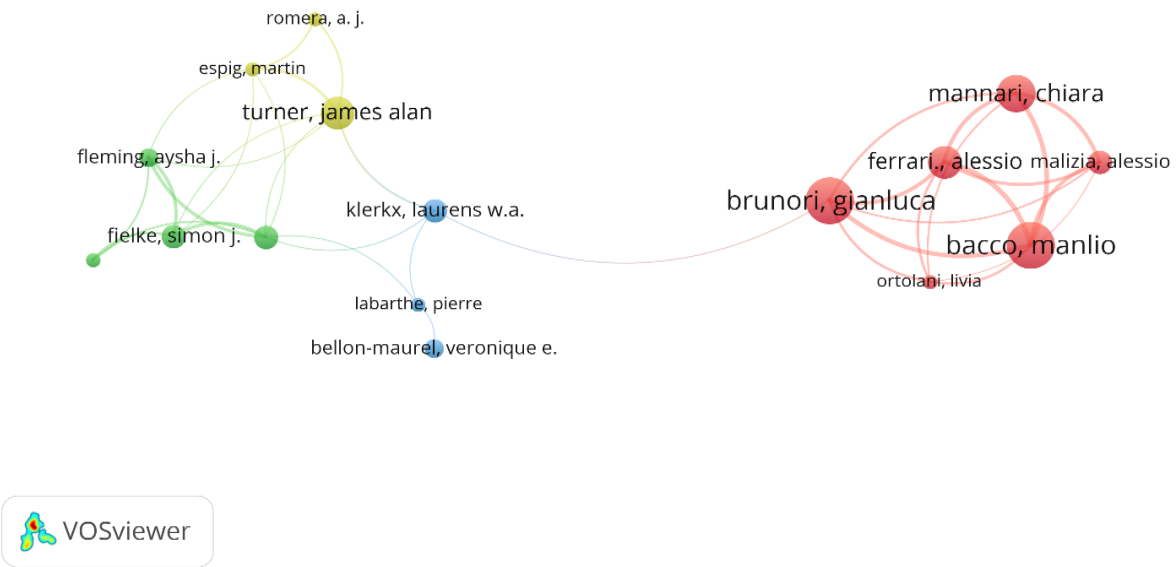
Нидерландыдағы Вагенинген университеті және ғылыми-зерттеу орталығы 20 жарияланыммен халықаралық деңгейдегі жоғары белсенділікті көрсетеді. Кубан мемлекеттік аграрлық университеті мен Италиядағы Пиза университеті 19 жарияланымнан тіркеген. Аталған ұйымдардың географиялық әртүрлілігі цифрлық ауыл шаруашылығының жаһандық ғылыми күн тәртібіне айналғанын және Еуропада агротехнологияны жаңғыртуға бағытталған зерттеулердің жүйелі жүргізілетінін көрсетеді. Ресейлік ұйымдардың үлесінің жоғары болуы бұл елде аграрлық және экономикалық университеттердің цифрландыру тақырыбында ғылыми хабтар қалыптастырып отырғанын айғақтайды.

Жалпы үрдіс бойынша алғашқы он ұйымның кемінде жетеуі Ресейден. Бұл аграрлық секторды цифрландыруға ұлттық деңгейде басымдық беріліп отырғанын көрсетеді. Сонымен қатар тізімде экономикалық бағыттағы университеттердің болуы цифрландырудың тек технологиялық емес, экономикалық тиімділік пен басқару модельдері тұрғысынан да зерттелетінін дәлелдейді.

Қазақстан бойынша деректер бұл бағыттың қалыптасу сатысында екенін көрсетеді. Scopus мәліметтері Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Жәңгір хан атындағы Батыс Қазақстан аграрлық-техникалық университеті және Қазақ ұлттық аграрлық зерттеу университеті тарапынан үш жарияланымнан тіркелгенін көрсетеді. Әл-Фараби атындағы Қазақ ұлттық университеті, Д. Серікбаев атындағы Шығыс Қазақстан техникалық университеті, Нархоз университеті және өзге жоғары оқу орындары екі жарияланымнан ұсынған. 2019–2024 жж. барлығы 22 мақала жарияланған.

Алынған деректер негізінде Scopus және Web of Science басылымдарында ауыл шаруашылығын цифрландыру бойынша қазақстандық басылымдардың салыстырмалы түрде төмен көрсетілуі құрылымдық және институционалдық факторлардың үйлесіміне байланысты. Тарихи тұрғыдан алғанда, елдегі ауыл шаруашылығы саласындағы зерттеулер негізінен өндіріс және табиғи ресурстар аспектілеріне бағытталған, ал саланың цифрлық трансформациясы соңғы жылдары ғана жүйелі ғылыми қызығушылық тудырды. Зерттеушілердің халықаралық ғылыми желілерге жеткіліксіз интеграциялануы, индекстелген журналдардағы жоғары бәсекелестік және тілдік кедергілер де нәтижелерді жаһандық академиялық қауымдастықта жариялау мүмкіндігін шектейді. Бәсекеге қабілетті зерттеулер үшін қажетті заманауи цифрлық платформаларға, деректерге және пәнаралық зерттеу құралдарына шектеулі қолжетімділік қосымша фактор болып табылады. Сонымен қатар, ауыл шаруашылығы секторын цифрлық дамыту және жаңғырту бойынша қазіргі үкіметтік бағдарламалар ғылыми белсенділіктің артуы үшін институционалдық алғышарттар жасауда. Бұл цифрлық ауыл шаруашылығы саласындағы ғылыми мектептің дамуындағы өтпелі кезеңді көрсетеді, онда басылымдардың қатысуы біртіндеп кеңейеді деп күтілуде. Ұзақ мерзімді перспективада халықаралық ынтымақтастықты нығайту және ғылыми инфрақұрылымға инвестиция салу қазақстандық зерттеушілердің жаһандық ғылыми күн тәртібіне қосқан үлесін айтарлықтай арттыра алады.

Бұл көрсеткіш Қазақстанда цифрлық ауыл шаруашылығы саласындағы ғылыми белсенділіктің қалыптасу кезеңінде тұрғанын және институционалдық қолдау артқан жағдайда бұл бағыттың жедел дамуына әлеует бар екенін көрсетеді. 5-суретте Scopus дерекқорынан алынған мәліметтер және VOSviewer бағдарламасы негізінде ауыл шаруашылығын цифрландыру саласындағы зерттеушілер арасындағы ғылыми байланыстардың желілік құрылымы және ең өнімді авторларды көрсетеді.



Сурет 5. Ауыл шаруашылығын цифрландыру бойынша зерттеушілердің ғылыми байланыстарының визуализациясы

Figure 5. Visualization of scientific contacts of researchers on the digitalization of agriculture

Авторлық желілерді талдау бұл салада тұрақты ғылыми қауымдастықтардың қалыптасқанын және зерттеулердің жеке бастамалардан гөрі кооперативтік модельге негізделгенін көрсетеді. Ең белсенді зерттеушілер ретінде Brunori et al. (2025) және Manlio et al. (2021) анықталды (әрқайсысы – 10 жарияланым). Олардың еңбектері цифрлық ауыл шаруашылығының технологиялық және институционалдық аспектілерін жүйелі түрде зерттеуге бағытталған.

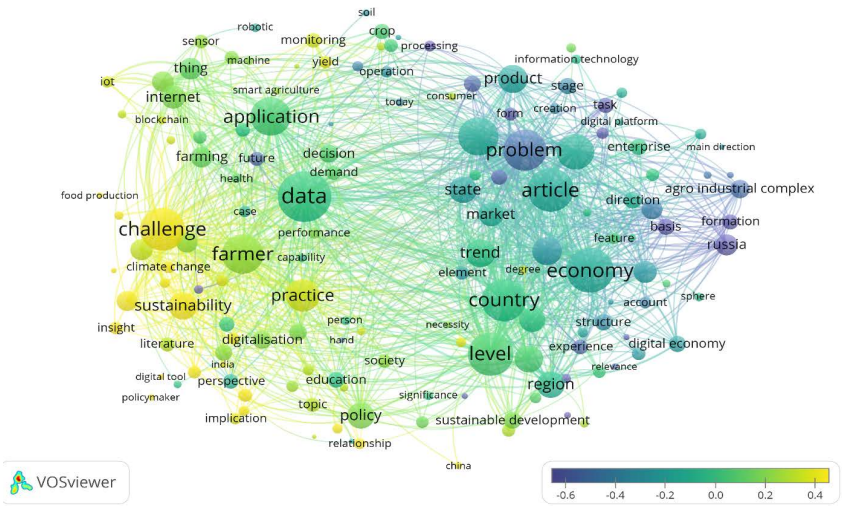
Одан кейін Mannari et al. (2024) (әрқайсысы – 8 мақала), сондай-ақ Abdullahi et al. (2023) (әрқайсысы – 7 мақала) орналасқан. Turner et al. (2023) авторларының әрқайсысының үлесі – 6 жарияланым.

Бұл құрылым саланың көпорталықты (polycentric) ғылыми сипатын және зерттеулердің бірнеше жетекші мектептер төңірегінде шоғырланғанын көрсетеді. Ең жоғары дәйексөзге ие жұмыс – Klerkx et al. (2019) авторларының *"A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda"* атты мақаласы (959 сілтеме). Бұл зерттеу цифрлық ауыл шаруашылығы мен Agriculture 4.0 үдерістерінің әлеуметтік, экономикалық және институционалдық салдарын кешенді түрде талдайды. Авторлар цифрландырудың фермерлік тәжірибеге, деректерге меншік құқығына, басқару құрылымдарына және инновациялық жүйелерге әсерін жүйелей отырып, болашақ зерттеулер үшін әлеуметтік ғылымдардың рөлін айқындайды.

Аталған жұмыс саланың технологиялық емес, институционалдық және әлеуметтік өлшемдерін ғылыми күн тәртібіне енгізуімен ерекшеленеді. Екінші жоғары дәйексөзге ие еңбек – Mondejar et al. (2021) авторлардың *"Digitalization to achieve sustainable development goals: Steps towards a smart green planet"* мақаласы (631 сілтеме). Бұл жұмыс ауыл шаруашылығындағы экологиялық тәуекелдерді, ластаушы заттардың таралуын және олардың қоршаған ортаға әсерін модельдеу арқылы цифрлық технологиялардың тұрақты даму мақсаттарындағы рөлін негіздейді. Мақала цифрландыруды экологиялық қауіптерді басқарудың құралдары ретінде қарастырып, саланың «жасыл трансформациямен» байланысын күшейтеді.

Қазақстандық авторлар арасынан Kashina et al. (2021) жұмысы *"Impact of digital farming on sustainable development and planning in agriculture and increasing the competitiveness of the agricultural business"* 48 рет дәйексөз алған. Бұл мақалада цифрлық технологиялардың (GPS, смарт-техника, деректерге негізделген басқару) агробизнесті оңтайландырудағы рөлі көрсетіліп, цифрлық егіншіліктің экономикалық және экологиялық тиімділігі негізделеді. Бұл нәтижелер қазақстандық зерттеулердің жаһандық ғылыми дискурсқа интеграциялану сатысында тұрғанын және институционалдық қолдау күшейген жағдайда олардың ықпалының артуына әлеует бар екенін көрсетеді. Сонымен қатар, жетекші еңбектердің мазмұны цифрлық ауыл шаруашылығының негізгі ғылыми векторлары технологиялық жаңалықтармен қатар әлеуметтік, экономикалық және институционалдық мәселелерге қарай кеңейіп отырғанын дәлелдейді.

6-суретте ауыл шаруашылығы саласындағы зерттеулерде қолданылған кілт сөздердің арасындағы байланыс визуализациясы мен корреляция шамасы көрсетілген.



Сурет 6. Ауыл шаруашылығы саласындағы зерттеулерде қолданылған кілт сөздердің арасындағы байланыс визуализациясы мен корреляция шамасы

Figure 6. Correlation visualization and correlation magnitude between keywords used in agricultural research

VOSviewer бағдарламасы арқылы жасалған бұл визуализация ауыл шаруашылығы саласындағы зерттеулерде қолданылған кілт сөздердің арасындағы байланысты көрсетеді. Визуализацияда түстер кілт сөздердің топтастырылуын (кластерлерді), түйіндердің көлемі терминдердің жиілігін, ал байланыс сызықтарының қалыңдығы олардың өзара байланыс деңгейін білдіреді. Бұл тәсіл ғылыми бағыттардың құрылымын ғана емес, олардың өзара ықпалдасу логикасын да айқындауға мүмкіндік береді.

2-кестеде кілттік сөздер бойынша қалыптасқан кластерлердің сипаттамасы көрсетіледі. Талдау нәтижесінде төрт негізгі кластер мен олардың корреляциялық шамасы анықталды.

Кесте 2. Кілттік сөздер бойынша қалыптасқан кластерлердің сипаттамасы
Table 2. Description of clusters formed by key words

№	Кластер	Кілттік сөздер	Корреляция шамасы
1	көк-жасыл	Экономика, аймақ, нарық, агроөнеркәсіп секторы, кәсіпорын, цифрлық экономика,	$-0.6 \leq r < -0.3$
2	жасыл	Деректер, фермер, практика және цифрландыру, мониторинг, кірістілік, шешім, сұраныс,	$-0.3 \leq r < -0.1$
3	сары	Тұрақты даму, климат, экологиялық сын-қатерлер, салдары, тамақ өндірісі, денсаулық	$-0.1 \leq r < 0.2$
4	күлгін-көк	Агроөнеркәсіп кешені, цифрлық платформа, негізгі бағыты, есептік жазба, мүмкіндік	$0.2 \leq r \leq 0.4$

Ескертпе: Scopus дерекқорынан алынған мәліметтер негізінде VOSviewer бағдарламасымен құрастырылған

Бірінші кластер (көк-жасыл) ауыл шаруашылығының экономикалық аспектілерін, аймақтық даму, нарық, агроөнеркәсіптік сектор және цифрлық экономика мәселелерін қамтиды. Бұл кластер цифрландырудың аграрлық сектордағы экономикалық тиімділік пен құрылымдық өзгерістерге әсерін зерттеуге бағытталған.

Екінші кластер (жасыл) деректерді пайдалану, фермерлік тәжірибе, мониторинг, кірістілік және шешім қабылдау процестерін қамтиды. Бұл бағытта IoT және сенсорлық жүйелер сияқты технологиялардың қолданылуы қарастырылады. Аталған кластер аграрлық басқарудың деректерге негізделген моделіне көшу үрдісін көрсетеді.

Үшінші кластер (сары) тұрақты даму, климат, экологиялық мәселелер, тамақ өндірісі және денсаулық аспектілерін біріктіреді. Бұл кластер цифрлық ауыл шаруашылығының экологиялық және әлеуметтік өлшемдерін айқындап, зерттеулердің жаһандық тұрақты даму күн тәртібімен байланысын көрсетеді.

Төртінші кластер (күлгін-көк) агроөнеркәсіптік кешен мен цифрлық платформаларға қатысты зерттеулерді қамтиды, есеп беру жүйелері мен институционалдық тәжірибелерді талдайды. Бұл бағыт цифрландырудың ұлттық саясаттар мен басқару модельдеріне ықпалына назар аударады.

Overlay visualization нәтижелері бойынша кілт сөздердің нормаланған мәндері –0.6-дан +0.4-ке дейін өзгеріп отырады. Көк түстер салыстырмалы түрде ертерек қалыптасқан немесе төмен цитаталанатын тақырыптарды, жасыл түс тұрақты дамып келе жатқан классикалық бағыттарды, ал сары және күлгін-көк түстер соңғы жылдардағы жаңа трендтерді білдіреді. Мысалы, «тұрақты даму», «климаттық өзгерістер», «IoT», «сенсор» терминдері соңғы кезеңнің өзекті бағыттары ретінде көрінеді, ал «экономика», «аймақ», «нарық» ұғымдары дәстүрлі зерттеу объектілері ретінде сақталған.

Осылайша, визуализация нәтижелері цифрлық ауыл шаруашылығы зерттеулерінің төрт негізгі ғылыми векторын айқындайды: экономикалық-өңірлік талдау, деректерге негізделген басқару, экологиялық тұрақтылық және институционалдық платформалар. Бұл құрылым саланың технологиялық бағыттан кеңірек – экономикалық және басқарушылық трансформацияға қарай эволюцияланып отырғанын көрсетеді.

Библиометриялық бірлескен кілт сөз картасы бойынша қорытынды жасай отырып, ауыл шаруашылығын цифрландыру бойынша ғылыми зерттеулердің құрылымын көрсететін бірнеше өзара байланысты тақырыптық кластерлерді анықтайды. «Data» терминінің айналасында

ұйымдастырылған Орталық кластер зерттеу өрісінің өзегін құрайды және цифрлық агротехнологияның негізгі ресурсы ретінде деректердің үстемдігін көрсетеді. Онымен байланысты “application”, “decision”, “monitoring” және “smart agriculture” ұғымдары процестерді автоматтандыруға, аналитикаға және басқару шешімдерін қолдауға байланысты технологиялық бағдарланған бағытты сипаттайды.

“Экономика”, “country”, “market”, “enterprise” және “policy” терминдерін қамтитын экономикалық-институционалдық кластер цифрландырудың, институционалдық бейімделудің және цифрлық экожүйелерді қалыптастырудың макроэкономикалық әсерлеріне арналған зерттеулерді көрсетеді. Оның технологиялық ядромен тығыз байланысы цифрлық шешімдердің агросектордың экономикалық құрылымдарына интеграциялануын көрсетеді.

“Тұрақтылық», “challenge” және “farmer” ұғымдарының айналасында топтастырылған жеке Тақырыптық блок тұрақты дамуға, технологияларды енгізудің әлеуметтік аспектілеріне және фермерлік тәжірибелерді бейімдеуге өсіп келе жатқан назарды көрсетеді. Бұл кластер цифрлық трансформация контекстінде экологиялық, әлеуметтік және басқару факторлары қарастырылатын зерттеулердің пәнаралық сипатын көрсетеді.

Картаның түс динамикасы зерттеу фокусының цифрлық саясат, тұрақты даму және цифрлық платформаларды біріктіру мәселелеріне ауысуын көрсетеді, бұл ғылыми күн тәртібінің технологиялық шешімдерден агросекторды цифрлық басқарудың жүйелік модельдеріне эволюциясын көрсетеді. Тұтастай алғанда, желі құрылымы технологиялық инновациялар, экономикалық механизмдер мен әлеуметтік сын-қатерлер Ауыл шаруашылығын цифрлық трансформациялаудың өзара тәуелді элементтері ретінде қарастырылатын кешенді ғылыми бағыттың қалыптасуын растайды.

ҚОРЫТЫНДЫ

Зерттеу барысында 2001–2024 жж. аралығында Scopus дерекқорында жарияланған 1 326 ғылыми еңбекке библиометриялық талдау жүргізілді. Алынған нәтижелер 2017 ж. бастап ауыл шаруашылығын цифрландыру саласындағы ғылыми белсенділіктің айтарлықтай өскенін көрсетті. Бұл серпін дәл егіншілік, IoT, деректерге негізделген басқару жүйелері және тұрақты даму күн тәртібімен тікелей байланысты. Талдау зерттеулердің негізгі траекториялары экономикалық тиімділік, цифрлық технологияларды аграрлық практикаға ықпалдастыру, экологиялық орнықтылық және институционалдық даму мәселелеріне шоғырланғанын көрсетті. VOSviewer арқылы жүргізілген кілт сөздерді талдау тұрақты даму мен климаттық өзгерістерге қатысты тақырыптардың соңғы жылдары басым бағыттарға айналғанын растады.

Бұл зерттеудің бірқатар шектеулері бар. Атап айтқанда, талдау тек Scopus дерекқорымен шектелді, бұл басқа халықаралық және ұлттық дерекқорларда жарияланған еңбектердің толық қамтылмауына әкелуі мүмкін. Сонымен қатар, зерттеу тек ағылшын тіліндегі мақалаларды қамтыды, сондықтан өңірлік тілдердегі ғылыми жұмыстар ескерілмеді. Үшіншіден, библиометриялық әдістер негізінен сандық көрсеткіштерге сүйенетіндіктен, жекелеген зерттеулердің мазмұндық тереңдігі мен практикалық тиімділігі толық бағаланбады.

Алынған нәтижелерге сәйкес, болашақ зерттеулер ауыл шаруашылығын цифрландыруды тек технологиялық үрдіс ретінде емес, экономикалық және институционалдық трансформация тұрғысынан кешенді талдауға бағытталуы тиіс. Цифрлық технологиялардың ауыл шаруашылығы өнімділігіне, шығындарды қысқартуға және фермерлік шаруашылықтардың бәсекеге қабілеттілігіне нақты эмпирикалық әсерін бағалау өзекті болып табылады.

Болашақта көп дереккөзді библиометриялық талдауларды (Scopus, Web of Science және ұлттық дерекқорлар негізінде), сондай-ақ Қазақстан жағдайына бағытталған өңірлік кейс-зерттеулерді жүргізу ұсынылады. Сонымен қатар, цифрлық ауыл шаруашылығының әлеуметтік салдарын, цифрлық теңсіздік мәселелерін және цифрландырудың тұрақты даму мен климаттық өзгерістерге бейімделуге ықпалын зерттейтін пәнаралық жұмыстардың маңызы арта түседі.

Жалпы алғанда, бұл зерттеу цифрлық ауыл шаруашылығының агроөнеркәсіптік кешенді жаңғыртудағы стратегиялық рөлін айқындай отырып, саланың ғылыми құрылымын жүйелеу-

ге және болашақ зерттеулер үшін теориялық әрі қолданбалы негіз қалыптастыруға мүмкіндік береді. Жалпы тұжырымдар жасай отырып, мақалада библиометриялық сурет бейнеленген, ол жыл сайын қалыптасатын мақалаларды растайды Ауыл шаруашылығын цифрландыру процесі жыл сайын артып келеді. Басылым ландшафты Ауыл шаруашылығын цифрландыру пәнаралық өріс ретінде дамып келе жатқанын көрсетеді: IoT, мониторинг және деректерді талдаумен қатар институттар, нарықтар, басқару, цифрлық саясат және тұрақтылық бойынша зерттеулер блогы күшейтілуде. Бұл дегеніміз, технологиялық шешімдер енді оқшауланбайды — олар өнімділікке, тәуекелге, жеткізу тізбегіне және ресурстарды басқаруға әсер ету арқылы бағаланады.

Дәйекті бағдарламалары мен тұрақты қаржыландыруы бар елдерде неғұрлым тығыз зерттеу желісі және одан жоғары халықаралық көріну қалыптасады. Тәжірибе көрсеткендей, шашыраңқы мақалалар үлкен әсер етпейді, бірақ байланыстыру: ауылдағы цифрлық инфрақұрылым + деректер стандарттары + бизнеске ынталандыру + кадрларды даярлау + табысты шешімдерді масштабтау тетіктері.

Агросектордағы жобалық шешімдер санының өсуіне қарамастан, енгізу мен ғылым арасындағы алшақтық жиі сақталады: жобалардың деректері стандартталмаған, қолжетімділігі шектеулі, өңірлер мен маусымдар арасында салыстыруға келмейді. Бұл қайталанатын модельдердің құрылысын тежейді (өнімділікті болжау, нақты егіншіліктің тиімділігін бағалау, Климаттық тәуекелдер, шығындарды оңтайландыру) және жоғары рейтингті журналдардағы басылымдардың үлесін азайтады. Сондықтан эмпирикалық деректер мен оларға қол жетімділік зерттеулердің сапасы мен «дәйексөзін» анықтайды.

Іс жүзінде мониторинг шешімдері (спутниктік және сенсорлық деректер), шаруашылықты басқарудың цифрлық платформалары, дәл егіншілік элементтері, субсидияларды цифрландыру/есепке алу және логистика кең таралған. Алайда, іске асыру фактісінің өзі ғылыми тұрғыдан маңызды емес, бірақ өлшенетін нәтижелер: өнімділіктің артуы, шығындардың төмендеуі, Климаттық күйзелістерге төзімділік, өзін-өзі ақтау, жұмыспен қамтуға әсер ету және цифрлық теңсіздік. Мұны «тұжырымдаманың дәлелі» әсері бар, бірақ өнімділікті бағалауды қажет ететін ауыл шаруашылығындағы ағымдағы цифрландыру жобалары арқылы зерттеуге болады.

Библиометриялық талдау бойынша жалпы шолу: цифрландырудың тиімділігі технологиядан кем емес институционалдық ортаға байланысты. Реттеуші айқындық, цифрлық қызметтерге деген сенім, деректерді қорғау, платформалардың үйлесімділігі және пайдаланушыларды даярлау болмаса, технологиялық әсерлер Жергілікті болып шығады. Сондықтан зерттеудің Болашақ күн тәртібі технологиялық көрсеткіштерді институттармен байланыстыруы керек: ережелер, ынталандырулар, мемлекет–бизнес–ғылым кооперациясы және технологиялар трансферті механизмдері.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: BN; research design: BN, GA and DK; data collection: MK and LM; analysis and interpretation: BN, GA, DK, MK and LM; writing draft preparation: BN, GA and DK; supervision: DK, MK and LM; correction of article: MK and LM; proofread and final approval of article: BN, GA, DK, MK and LM. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Abdullahi, H. O., Mahmud, M., Hassan, A. A., & Ali, A. F. (2023). A bibliometric analysis of the evolution of IoT applications in smart agriculture. *Ingénierie des Systèmes d'Information, 28*(6), 1495–1504. https://doi.org/10.18280/isi.280606

Abu, N. S., Bukhari, W. M., Ong, C. H., Kassim, A. M., Izzuddin, T. A., Sukhaimie, M. N., Norasikin, M. A., & Rasid, A. F. A. (2022). Internet of Things applications in precision agriculture: A review. *Journal of Robotics and Control*, *3*(3), 338–347. https://doi.org/10.18196/jrc.v3i3.14159

Ayaz, A., & Ayaz, R. (2025). A bibliometric and thematic approach to digital agriculture research. *Uygulamalı Mühendislik ve Tarım Dergisi, 2*(1), 1–10.

Bertoglio, R., Corbo, C., Renga, F. M., & Matteucci, M. (2021). The digital agricultural revolution: A bibliometric analysis literature review. *IEEE Access, 9*, 134762–134782. https://doi.org/10.1109/ACCESS.2021.3115258

Brunori, G., Bacco, M., Pinero, C.P., Borzacchiello, M.T., & Stormer, E. (2025). Agri-food data spaces: Highlighting the need for a farm-centered strategy. *Data*

in Brief, 59, 111388. https://doi.org/10.1016/j.dib.2025.111388

Chamorro-Padial, J., Virgili-Gomá, J., Gil, R., Teixidó, M., & García, R. (2025). Agriculture data sharing review. *Heliyon, 11*(1), e41109. https://doi.org/10.1016/j.heliyon.2024.e41109

Iaksch, J., Fernandes, E., & Borsato, M. (2021). Digitalization and big data in smart farming: A review. *Journal of Management Analytics, 8*(2), 333–349. https://doi.org/10.1080/23270012.2021.1897957

Kashina, E., Yanovskaya, G., Fedotkina, E., Tesalovsky, A., Vetrova, E., Shaimerdenova, A., & Aitkazina, M. (2022). Impact of digital farming on sustainable development and planning in agriculture and increasing the competitiveness of the agricultural business. *International Journal of Sustainable Development and Planning, 17*(8), 2413–2420. https://doi.org/10.18280/ijsdp.170808

Klerkx, L., Jakku, E., & Labarthe, P. (2019). A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda. *NJAS: Wageningen Journal of Life Sciences, 90–91*(1), 1–16. https://doi.org/10.1016/j.njas.2019.100315

Kumari, P., Soor, S., Shetty, A., & Nair, A.M. (2025). A UNet Model for Accelerated Preprocessing of CRISM Hyperspectral Data for Mineral Identification on Mars. *ArXiv, abs/2505.02046*. https://doi.org/10.48550/arXiv.2505.02046

Manlio, B., Paolo, B., Alberto, G., & Massimiliano, R. (2021). *Unmanned Aerial Vehicles for Agriculture: an Overview of IoT-Based Scenarios*. Autonomous Airborne Wireless Networks, John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119751717.ch11

Mannari, C., Ferrari, A., & Bacco, M. (2024). Socio-technical Process Modelling to Foster Sustainable Digitalisation of Rural Areas. ERCIM News, 2024.

Maulana, F. I., Adi, P. D. P., Arifin, M. N., Hamim, M., & Pramono, A. (2024). Analyzing and visualizing knowledge structures of research and development trends in Internet of Things for smart agriculture: A decade overview. *E3S Web of Conferences, 501*, 01015. https://doi.org/10.1051/e3sconf/202450101015

Mondejar, M. E., Avtar, R., Baños Diaz, H. L., Dubey, R. K., Esteban, J., Gómez-Morales, A., Hallam, B., Mbungu, N. T., Okolo, C. C., Prasad, K. A., She, Q., & Garcia-Segura, S. (2021). Digitalization to achieve sustainable development goals: Steps towards a smart green planet. *Science of the Total Environment, 794*, 148539. https://doi.org/10.1016/j.scitotenv.2021.148539

Naribek B., Abdikerimova G., Kulanova D., & Moldashbaeva L. (2025). Bibliometricheskiy analiz nauchnykh issledovaniy v tsifrovizatsii agropromyshlennogo kompleksa [Bibliometric analysis of scientific research in digitalization of the agro-industrial complex]. *Bulletin of the Khalel Dosmukhamedov Atyrau University, 78*(3), 390–401. https://doi.org/10.47649/vau.25.v78.i3.33

Paudel, B., Riaz, S., Teng, S. W., Kolluri, R. R., & Sandhu, H. (2025). The digital future of farming: A bibliometric analysis of big data in smart farming research. *Cleaner and Circular Bioeconomy, 10*, 100132. https://doi.org/10.1016/j.clcb.2024.100132

Rolandi, S., Brunori, G., Bacco, M., & Scotti, I. (2021). The Digitalization of Agriculture and Rural Areas: Towards a Taxonomy of the Impacts. *Sustainability, 13(9)*, 5172. https://doi.org/10.3390/SU13095172

Sadenova, M. A., Beisekenov, N. A., Varbanov, P. S., Kulenova, N. A., Abitaev, F., & Kamenev, Y. (2022). Digitalization of crop production for transition to climate-optimized agriculture using spring wheat in East Kazakhstan as an example. *Chemical Engineering Transactions, 96*, 415–420. https://doi.org/10.3303/CET2296070

Schmidt, D., Casagranda, L. F., Butturi, M. A., & Sellitto, M. A. (2024). Digital technologies, sustainability, and efficiency in grain post-harvest activities: A bibliometric analysis. *Sustainability, 16*(3), 1244. https://doi.org/10.3390/su16031244

Sott, M. K., Nascimento, L. d. S., Foguesatto, C. R., Furstenau, L. B., Faccin, K., Zawislak, P. A., Mellado, B., Kong, J. D., & Bragazzi, N. L. (2021). A bibliometric network analysis of recent publications on digital agriculture to depict strategic themes and evolution structure. Sensors, 21(23), 7889. https://doi.org/10.3390/s21237889

Toguzova, M., Shaimardanova, B., Shaimardanov, Z., Assylkhanova, Z. A., & Rakhymberdina, M. (2023). Analysis of the introduction of precision farming elements in East Kazakhstan: Problems and prospects of development. *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLVIII-5/W2-2023*, 125–130. https://doi.org/10.5194/isprs-archives-XLVIII-5-W2-2023-125-2023

Turner, J.A., Guesmi, B., Gil, J.M., Heanue, K., Sierra, M., Percy, H., Bortagaray, I., Chams, N., & Milne, C.E. (2022). Evaluation capacity building in response to the agricultural research impact agenda: Emerging insights from Ireland, Catalonia (Spain), New Zealand, and Uruguay. *Evaluation and program planning, 94*, 102127. https://doi.org/10.1016/j.evalprogplan.2022.102127

Xu, J., Li, Y., Zhang, M., & Zhang, S. (2024). Sustainable agriculture in the digital era: Past, present, and future trends by bibliometric analysis. *Heliyon, 10*(14), e34612. https://doi.org/10.1016/j.heliyon.2024.e34612

Wang, S., Yang, Y., Yin, H., Zhao, J., Wang, T., Yang, X., Ren, J., & Yin, C. (2025). Towards digital transformation of agriculture for sustainable development in China: Experience and lessons learned. *Sustainability, 17*(8), 3756. https://doi.org/10.3390/su17083756

Information about the authors

Bagdaulet K. Naribek – PhD student, M. Auezov South Kazakhstan University, Shymkent, Kazakhstan, email: bagdaulet98narbek@gmail.com, ORCID ID: https://orcid.org/0009-0004-1453-6014

***Gulzhanar I. Abdikerimova** – Cand. Sc. (Econ.)., M. Auezov South Kazakhstan University, Shymkent, Kazakhstan, email: abdikerimova71@mail.ru, ORCID ID: https://orcid.org/0000-0003-2495-1209

Darikul A. Kulanova – Cand. Sc. (Econ.), M.Auezov South Kazakhstan University, Shymkent, Kazakhstan, email: k_dana_a@mail.ru, ORCID ID: https://orcid.org/0000-0001-9188-5243

Marzhan T. Kalmenova – Cand. Sc. (Econ.), Associate Professor, I.Zhansugurov Zhetysu University, Taldykorgan, Kazakhstan, email: kalmenovamarzhan78@gmail.com, ORCID ID: https://orcid.org/0009-0001-3360-4308

Luiza P. Moldashbayeva – Cand. Sc. (Econ.), Associate, L.N Gumilyov Eurasian National University, Astana, Kazakhstan, email: luizamoldashbayeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-4491-9567

Авторлар туралы мәліметтер

Нәрібек Б.Қ – PhD докторант, М.Әуезов атындағы Оңтүстік Қазақстан университеті, Шымкент, Қазақстан, email: bagdaulet98narbek@gmail.com, ORCID ID: https://orcid.org/0009-0004-1453-6014

***Абдикеримова Г.И.** – э.ғ.к., М. Әуезов атындағы Оңтүстік Қазақстан университеті, Шымкент, Қазақстан, email: abdikerimova71@mail.ru, ORCID ID: https://orcid.org/0000-0003-2495-1209

Куланова Д.А. – э.ғ.к., М. Әуезов атындағы Оңтүстік Қазақстан университеті, Шымкент,Қазақстан, email: k_dana_a@mail.ru, ORCID ID: https://orcid.org/0000-0001-9188-5243

Кальменова М.Т. – э.ғ.к., қауымдастырылған профессор, І.Жансүгіров атындағы Жетісу университеті, Талдықорған, Қазақстан, email: kalmenovamarzhan78@gmail.com, ORCID ID: https://orcid.org/0009-0001-3360-4308

Молдашбаева Л.П. – э.ғ.к., қауымдастырылған профессор, Л.Н. Гумилев атындағы Еуразиялық Ұлттық университеті, Астана, Қазақстан, email: luizamoldashbayeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-4491-9567

Сведения об авторах

Нарибек Б.К. – PhD докторант, Южно-Казахстанский университет им. М.Ауэзова, Шымкент, Казахстан, email: bagdaulet98narbek@gmail.com, ORCID ID: https://orcid.org/0009-0004-1453-6014

***Абдикеримова Г.И.** – к.э.н., Южно-Казахстанский университет им. М.Ауэзова, Шымкент, Казахстан, email: abdikerimova71@mail.ru, ORCID ID: https://orcid.org/0000-0003-2495-1209

Куланова Д.А. – к.э.н., Южно-Казахстанский университет им. М.Ауэзова, Шымкент, Казахстан, email: k_dana_a@mail.ru, ORCID ID: https://orcid.org/0000-0001-9188-5243

Кальменова М.Т. – к.э.н., ассоциированный профессор, Жетысуский университет им. И.Жансугурова, Талдыкорган, Казахстан, email: kalmenovamarzhan78@gmail.com, ORCID ID: https://orcid.org/0009-0001-3360-4308

Молдашбаева Л.П. – к.э.н., ассоциированный профессор, Евразийский национальный университет имени Л.Н. Гумилева, Астана, Казахстан, email: luizamoldashbayeva@gmail.com, ORCID ID: https://orcid.org/0000-0002-4491-9567

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-110-127
МРНТИ 06.52.17
JEL: J24, O11, O33

Check for updates
BY-NC 4.0

The Impact of Artificial Intelligence on the Structural Transformation of Kazakhstan's Economy

Yevgeniy V. Varavin[a], Marina V. Kozlova[a]*, Madina U. Rakhimberdinova[a], Ozay Ozpence[b]

[a]D. Serikbayev East Kazakhstan Technical University, 19 D. Serikbayev Str., Ust-Kamenogorsk, Kazakhstan; [b]Pamukkale University, Çamlaraltı Mahallesi, Kınıklı Yerleşkesi, No. 11, 20160, Denizli, Turkey

For citation: Varavin, Ye. V., Kozlova, M. V., Rakhimberdinova, M. U. & Ozpence, O. (2026). The Impact of Artificial Intelligence on the Structural Transformation of Kazakhstan's Economy. Economy: strategy and practice, 21(1), 110-127. https://doi.org/10.51176/1997-9967-2026-1-110-127

ABSTRACT

In the context of accelerating digital transformation, quantification of the impact of artificial intelligence (AI) on the structural dynamics of resource–dependent economies is becoming particularly relevant. The purpose of the study is to develop and test an integrated dynamic model to quantify the impact of AI on Kazakhstan's structural transformation and diversification. The methodological framework includes the integration of the Bass model of innovation diffusion, an expanded production function with endogenous technological progress and the task-oriented Acemoglu–Restrepo approach, as well as a multi-criteria system of industry prioritisation. The empirical basis was based on industry data from the Bureau of National Statistics of the Republic of Kazakhstan for 2020-2024. The simulation results show that for the period 2025-2035. The cumulative increase in gross value added in the analysed industries will amount to 35.3 p.p., of which 16.8 percentage points are attributable to AI. The level of AI adoption in priority sectors reaches 86.8–93.8 p.p by 2035, which exceeds the indicators of non-priority industries by 13-32 p.p. The share of priority industries in the GDP structure increases by 6.3 p.p, while total employment increases by 22.4 p.p (+1.3 million jobs). At the same time, across all sectors, there is a steady excess of the effect of creating new tasks over the effect of automation, reflecting the specifics of a resource-dependent economy with a shortage of qualified personnel. The results confirm the expediency of concentrating government support on a limited number of industries with the greatest potential for structural transformation.

KEYWORDS: Artificial Intelligence, Digitalization, Structural Transformation, Diversification, Resource-Dependent Economy, Economic Growth, Labor Market, Employment

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT: the study was not sponsored (own resources).

Article history:
Received 11 January 2026
Accepted 20 February 2026
Published 30 March 2026

*** Corresponding author: Kozlova M.V.** – Cand. Sc. (Econ.), Professor, D. Serikbayev East Kazakhstan Technical University, 19 Serikbayev Str., Ust-Kamenogorsk, Kazakhstan, email: mkozlova@edu.ektu.kz

Влияние искусственного интеллекта на структурную трансформацию экономики Казахстана

Варавин Е.В.[a], Козлова М.В.[a]*, Рахимбердинова М.У.[a], Озпенче О.[b]

[a]Восточно-Казахстанский технический университет им. Д.Серикбаев, ул. Д.Серикбаева 19, Усть-Каменогорск, Казахстан; [b]Университет Памуккале, Чамлараль ты, Кыныклы, № 11, 20160, Денизли, Турция

Для цитирования: Варавин Е.В., Козлова М.В., Рахимбердинова М.У., Озпенче О. (2026). Влияние искусственного интеллекта на структурную трансформацию экономики Казахстана. Экономика: стратегия и практика, 21(1), 110-127. https://doi.org/10.51176/1997-9967-2026-1-110-127

АННОТАЦИЯ

В условиях ускоряющейся цифровой трансформации особую актуальность приобретает количественная оценка воздействия искусственного интеллекта (далее – ИИ) на структурную динамику ресурсозависимых экономик. Цель исследования заключается в разработке и апробации интегрированной динамической модели количественной оценки воздействия ИИ на структурную трансформацию и диверсификацию экономики Казахстана. Методологический аппарат включает интеграцию модели диффузии инноваций Басса, расширенной производственной функции с эндогенным технологическим прогрессом и задачно-ориентированного подхода Асемоглу–Рестрепо, а также многокритериальную систему отраслевой приоритизации. Эмпирическую основу составили отраслевые данные Бюро национальной статистики Республики Казахстан за 2020–2024 гг. Результаты моделирования показывают, что за период 2025–2035 гг. совокупный прирост валовой добавленной стоимости в анализируемых отраслях составит 35,3 п.п., из которых 16,8 п.п. обеспечиваются вкладом ИИ. Уровень внедрения ИИ в приоритетных секторах достигает 86,8–93,8 п.п. к 2035 г., что превышает показатели неприоритетных отраслей на 13–32 п.п. Доля приоритетных отраслей в структуре ВВП увеличивается на 6,3 п.п., тогда как совокупная занятость возрастает на 22,4 п.п. (+1,3 млн рабочих мест). При этом во всех секторах наблюдается устойчивое превышение эффекта создания новых задач над эффектом автоматизации, что отражает специфику ресурсозависимой экономики с дефицитом квалифицированных кадров. Полученные результаты подтверждают целесообразность концентрации государственной поддержки на ограниченном числе отраслей с максимальным потенциалом структурной трансформации.

КЛЮЧЕВЫЕ СЛОВА: искусственный интеллект, цифровизация, структурная трансформация, диверсификация, ресурсозависимая экономика, экономический рост, рынок труда, занятость

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ: исследование не имело спонсорской поддержки (собственные ресурсы).

История статьи:
Получено 11 января 2026
Принято 20 февраля 2026
Опубликовано 30 марта 2026

***Корреспондирующий автор: Козлова М. В.** – к.э.н., профессор, Восточно-Казахстанский технический университет им. Д.Серикбаев, ул. Д.Серикбаева 19, Усть-Каменогорск, Казахстан, email: mkozlova@edu.ektu.kz

ВВЕДЕНИЕ

Современная мировая экономика переживает период глубокой технологической трансформации, движущей силой которой служит стремительное развитие искусственного интеллекта (далее – ИИ). По своей природе ИИ представляет собой технологию общего назначения, способную проникать во все сектора экономики и генерировать каскады зависимых инноваций, сопоставимые по масштабу с влиянием паровой машины и электричества (Bresnahan & Trajtenberg, 1995; Cockburn et al., 2018). Стратегическая значимость этой трансформации определяется не столько скоростью распространения отдельных технологических решений, сколько ее системным воздействием на структуру производства, рынки труда и паттерны международной специализации.

Вместе с тем существует принципиальный структурный разрыв между экономиками, которые получают наибольшее внимание исследователей, и теми, для которых технологическая трансформация наиболее актуальна. Подавляющее большинство академических работ по воздействию ИИ сосредоточено на развитых странах с диверсифицированной производственной базой, развитыми институтами и высокой цифровой готовностью. При этом развивающиеся ресурсозависимые экономики – с высокой концентрацией экспорта на сырьевых товарах, низкой экономической сложностью и значительными институциональными барьерами модернизации – остаются существенно недоисследованными, хотя именно для них технологическая диверсификация представляет стратегический императив.

Казахстан представляет собой аналитически значимый пример ресурсозависимой развивающейся экономики, сталкивающейся с необходимостью структурной диверсификации. Структурная уязвимость экономики, обусловленная доминированием горнодобывающего сектора, широко освещена в научной литературе (Bulkhairova et al., 2023), тогда как Концепция развития искусственного интеллекта на 2024–2029 годы закрепляет амбициозные направления цифровой трансформации (Government of the Republic of Kazakhstan, 2024). Вместе с тем реализация данных направлений требует обоснованного методологического инструментария для количественной оценки отраслевых эффектов внедрения ИИ, который в казахстанском контексте остается недостаточно разработанным.

Теоретическую основу анализа взаимодействия технологического прогресса и экономического роста формируют взаимодополняющие исследовательские направления. Неоклассическая и эндогенная теории роста объясняют механизмы долгосрочного технологического развития (Solow, 1956; Romer, 1990; Aghion & Howitt, 1992), модель диффузии инноваций Басса описывает S-образные траектории распространения технологий (Bass, 1969), а также задачно-ориентированный подход Асемоглу и Рестрепо разграничивает эффекты автоматизации и создания новых трудовых задач (Acemoglu & Restrepo, 2018, 2019). Прикладные исследования подтверждают значительный производительный потенциал генеративного ИИ, а теория экономической сложности обеспечивает концептуальную основу для анализа процессов диверсификации (Hausmann et al., 2014; Hidalgo & Hausmann, 2009; Brynjolfsson et al., 2023; Dell'Acqua et al., 2023; Eloundou et al., 2023). В то же время исследования по Казахстану остаются фрагментарными: они либо ограничиваются отраслевыми оценками автоматизируемости задач без их интеграции в макроэкономические модели, либо сосредоточены на эконометрическом анализе ИКТ-инвестиций без выделения специфического вклада ИИ и без отраслевой дифференциации (Workforce Development Center, 2023; Aitnazarov et al., 2024).

Таким образом, в литературе наблюдается исследовательский пробел: отсутствуют интегрированные калиброванные модели, синтезирующие теории диффузии инноваций, эндогенного роста и задачно-ориентированный подход применительно к ресурсозависимым развивающимся экономикам с отраслевой дифференциацией параметров и прогнозным горизонтом, релевантным задачам стратегического планирования. Устранение данного пробела составляет ключевую методологическую задачу настоящего исследования.

Цель исследования заключается в разработке и апробации интегрированной динамической модели количественной оценки воздействия

ИИ на структурную трансформацию и диверсификацию экономики Казахстана. Основная гипотеза состоит в том, что ИИ способен выступать катализатором ускоренной диверсификации при условии концентрации государственной поддержки на ограниченном числе приоритетных отраслей с высоким синергетическим потенциалом. Научная новизна исследования заключается в разработке первой для ресурсозависимых экономик калиброванной интегрированной модели, объединяющей механизмы диффузии технологий, эндогенного роста и задачно-ориентированного подхода в единую прогнозную архитектуру с отраслевой дифференциацией параметров.

ЛИТЕРАТУРНЫЙ ОБЗОР

Теоретический фундамент исследования формируется на пересечении четырех взаимосвязанных научных направлений: теорий экономического роста и технологического прогресса, моделей диффузии инноваций, задачно-ориентированных подходов к анализу рынка труда, а также теорий экономической сложности и ресурсной зависимости. Их систематизация позволяет выявить как область концептуального пересечения, так и структурные пробелы, определяющие актуальность настоящего исследования.

Первое направление представлено теориями экономического роста и технологического прогресса. Неоклассическая модель Солоу рассматривает технологический прогресс как экзогенный фактор, определяющий устойчивый рост подушевого дохода; эмпирические оценки показывают, что вклад совокупной факторной производительности в рост развитых экономик достигает 50–75% (Solow, 1957; Hall & Jones, 1999). Теория эндогенного роста преодолевает данное ограничение, интерпретируя технологический прогресс как результат целенаправленных инвестиций в исследования и разработки (Romer, 1990; Aghion & Howitt, 1992). Концепция технологий общего назначения дополняет данный подход, утверждая, , что фундаментальные инновации, прежде всего ИИ, порождают каскады зависимых инноваций с существенным временным лагом между изобретением и реализацией полного экономического эффекта, что объясняет «парадокс производительности Солоу» назначения (Bresnahan & Trajtenberg, 1995; Cockburn et al., 2018; Trajtenberg, 2018). Сравнительный анализ этих подходов обнаруживает общее ограничение: все три разработаны применительно к развитым экономикам с высокой технологической готовностью и не учитывают специфику ресурсозависимых стран с институциональными барьерами модернизации.

Второе направление представлено моделями диффузии инноваций. Классическая модель Басса описывает динамику принятия новых продуктов через взаимодействие двух механизмов: внешнего влияния (коэффициент инноваций p) и межфирменных коммуникаций (коэффициент имитации q), с эмпирически верифицированными диапазонами p = 0,001-0,03 и q = 0,3-0,5 (Bass, 1969; Sultan et al., 1990). По сравнению с более ранними описательными моделями диффузии, модель Басса обладает аналитической строгостью и допускает калибровку по отраслевым данным. Технологии ИИ, в отличие от классических инноваций, проявляют выраженные сетевые эффекты и экономию от масштаба на стороне предложения данных, что порождает более крутые траектории диффузии (Goldfarb & Tucker, 2019). Важное значение имеет вывод о существенном сокращении технологического лага в развивающихся странах — со 100 до менее чем 20 лет (Comin & Hobijn, 2010). Данный результат обосновывает возможность параметрической калибровки модели Басса для ресурсозависимых экономик при активной государственной поддержке диффузии ИИ. В то же время подобный подход остается не реализованным в существующих исследованиях по Казахстану.

Третье направление представлено задачно-ориентированным подходом к анализу воздействия технологий на рынок труда. В отличие от агрегированных макроэкономических оценок, трактующих автоматизацию как однозначное замещение труда, Асемоглу и Рестрепо концептуализируют производство как выполнение непрерывного набора задач: часть из них поддается автоматизации, тогда как другая часть формирует новые трудовые функции, требующие специфических компетенций (Ас-

emoglu & Restrepo, 2018; Acemoglu & Restrepo, 2019). Эмпирические оценки на данных США за 1947–2017 гг. показывают, что автоматизация привела к снижению доли труда в национальном доходе примерно на 4 п.п., в то время как создание новых задач компенсировало около 2 п.п.

Современные прикладные исследования расширяют данную рамку применительно к генеративному ИИ. Так, Элундоу и соавторы показывают, что большие языковые модели потенциально затрагивают около 80% рабочих мест в США (Eloundou et al., 2023). Далпее, Бриньолфссон и соавторы фиксируют прирост производительности сотрудников контакт-центров на 14% (Brynjolfsson et al., 2023). И наконец, Делл'Аква и соавторы выявляют увеличение производительности на 25% в условиях управляемого эксперимента с консультантами McKinsey (Dell'Acqua et al., 2023). Вместе с тем принципиальным ограничением данного корпуса исследований является их фокус на развитых экономиках с высоким уровнем автоматизации и насыщенным рынком квалифицированной рабочей силы. Соответственно, перенос полученных параметров на ресурсозависимые экономики с дефицитом технологически компетентных кадров методологически некорректен без специальной калибровки.

Четвертое направление представлено синтезом теории экономической сложности и концепции ресурсного проклятия. Теория экономической сложности исходит из того, что диверсификация экономики определяется не столько накоплением физического капитала, сколько разнообразием производственных знаний и компетенций, воплощенных в структуре экспорта (Hausmann et al., 2014; Hidalgo & Hausmann, 2009). Концепция ресурсного проклятия фиксирует, что ресурсообилие систематически снижает темпы долгосрочного роста через механизмы голландской болезни, подавление обрабатывающего сектора и деградацию институтов (Sachs & Warner, 1995, 2001; Mehlum et al., 2006). Вместе с тем эмпирика опровергает детерминизм этой концепции: опыт Норвегии, Чили и Ботсваны подтверждает, что целенаправленная политика диверсификации способна преодолеть ресурсную зависимость (Hausmann & Klinger, 2007). В этой связи ключевым остается вопрос о том, каким образом технологии искусственного интеллекта могут ускорить накопление экономической сложности в ресурсозависимой экономике с низким исходным уровнем диверсификации. При этом теория экономической сложности не располагает операциональными инструментами для количественной оценки данного процесса в динамическом разрезе.

Систематизация четырех рассмотренных направлений позволяет сформулировать ключевой исследовательский пробел. Во-первых, теории экономического роста и диффузии инноваций развивались преимущественно разрозненно по отношению к задачно-ориентированным подходам: первые описывают агрегированную динамику производительности, тогда как вторые фокусируются на трансформации структуры занятости. При этом интегрированные модели, объединяющие диффузию технологий, рост производительности и изменение структуры занятости в единую количественную рамку, в литературе практически отсутствуют. Во-вторых, все четыре направления преимущественно разработаны для развитых экономик либо для анализа ИКТ-инвестиций в целом без выделения искусственного интеллекта как самостоятельного фактора. В контексте Казахстана существующие исследования остаются фрагментарными: они ограничиваются либо экспертными оценками автоматизируемости отдельных профессий без интеграции в макроэкономические модели (Workforce Development Center, 2023), либо анализом совокупного влияния ИКТ без отраслевой дифференциации (Aitnazarov et al., 2024).В-третьих, в существующей литературе отсутствуют подходы к отраслевой приоритизации, обосновывающие концентрацию государственной поддержки на ограниченном числе секторов с максимальным синергетическим потенциалом для диверсификации ресурсозависимой экономики.

Настоящее исследование направлено на преодоление указанных ограничений посредством разработки интегрированной динамической модели, калиброванной для казахстанского контекста.

МЕТОДОЛОГИЯ

Разработанная интегрированная динамическая модель включает три взаимосвязанных аналитических модуля. Первый модуль описывает диффузию технологий искусственного интеллекта на основе расширенной модели Басса с отраслевой дифференциацией параметров. Второй модуль моделирует воздействие на производительность и валовую добавленную стоимость через расширенную производственную функцию с эндогенным технологическим прогрессом. Третий модуль отражает трансформацию структуры занятости на основе задачно-ориентированного подхода Асемоглу и Рестрепо (Acemoglu & Restrepo, 2018; Acemoglu & Restrepo, 2019). Методологической основой выбора отраслей является двухэтапная процедура. На первом этапе из 19 отраслей по ОКЭД отобрано десять. При этом из рассмотрения исключены: (1) горнодобывающая промышленность как сектор, не связанный с задачами диверсификации; (2) отрасли с долей менее 1% ВВП и низким потенциалом применения ИИ; (3) отрасли с доминированием государственного сектора.

На первом этапе из 19 отраслей по ОКЭД отобрано десять, с исключением горнодобывающей промышленности как сектора диверсификации, с долей менее 1% ВВП и низким потенциалом ИИ, а также отраслей с доминированием государственного сектора. Эмпирическую основу для отраслевой калибровки модели составляют официальные статистические данные Бюро национальной статистики Агентства по стратегическому планированию и реформам Республики Казахстан за 2020–2024 гг. В таблице 1 представлены базовые характеристики отобранных отраслей, включая объем валовой добавленной стоимости (ВДС) и ее долю в ВВП по итогам 2024 г., численность занятых, а также среднегодовой темп прироста индекса физического объема (ИФО) за 2020–2024 гг.

Таблица 1. Исходные статистические данные отобранных отраслей экономики Казахстана за 2020-2024
Table 1. Source statistical data of selected sectors of Kazakhstan economy for 2020-2024

Вид экономической деятельности	ВДС, млн тг	Доля в ВВП, %	Занятость, тыс. чел.	Ср. прирост ИФО, %
Сельское, лесное и рыбное хозяйство	5 306 833,1	3,8	1 027,9	103,53
Обрабатывающая промышленность	16 941 133,3	12,4	625,9	104,61
Строительство	8 178 000,0	6,0	665,5	104,20
Оптовая и розничная торговля	26 007 101,5	19,0	1 529,0	104,47
Транспорт и складирование	7 752 756,9	5,7	670,1	101,92
Информация и связь	3 013 049,3	2,2	188,5	107,06
Финансовая и страховая деятельность	4 649 709,1	3,4	202,5	102,98
Операции с недвижимым имуществом	11 576 195,0	8,5	162,9	102,98
Профессиональная, научная и техническая деятельность	4 252 469,0	3,1	263,6	101,89
Административное обслуживание	3 210 188,6	2,4	277,2	102,98
ВДС – валовая добавленная стоимость. ИФО – индекс физического объема.				

Примечание: составлено авторами на основе данных Bureau of National Statistics (2024)

На втором этапе реализована многокритериальная система оценки, включающая пять критериев с дифференцированными весами: K_1 (30%) — потенциал диверсификации экономики; K_2 (25%) — потенциал применения ИИ; K_3 (20%) — потенциал создания рабочих мест; K_4 (15%) — уровень цифровизации и инфраструктурной готовности; K_5 (10%) — экспортный потенциал и интеграция в глобальные цепочки создания стоимости (Denissova et al., 2025).

Интегральная оценка отрасли *i* рассчитывается по формуле (1):

$$S_i = 0{,}30 \cdot K_{1,i} + 0{,}25 \cdot K_{2,i} + 0{,}20 \cdot K_{3,i} + 0{,}15 \cdot K_{4,i} + 0{,}10 \cdot K_{5,i} \quad (1)$$

где:

S_i – интегральный индекс приоритетности отрасли *i*;

$K_{1,i}$ – $K_{5,i}$ – значения критериев для отрасли *i*, нормированные по шкале от 1 до 10 баллов.

Входными данными служат официальная статистика Бюро национальной статистики, международные исследования воздействия ИИ на производительность и занятость, а также стратегические документы. Взаимодействие трех моделирующих блоков обеспечивает последовательное распространение эффектов: ускоренная диффузия технологий транслируется в прирост производительности, который формирует дополнительный спрос на квалифицированные кадры. Агрегирование результатов дает три группы выходных показателей: структурные сдвиги ВВП, воздействие на занятость и результаты сценарного анализа. Далее, концептуальная архитектура модели схематически представлена на рисунке 1.

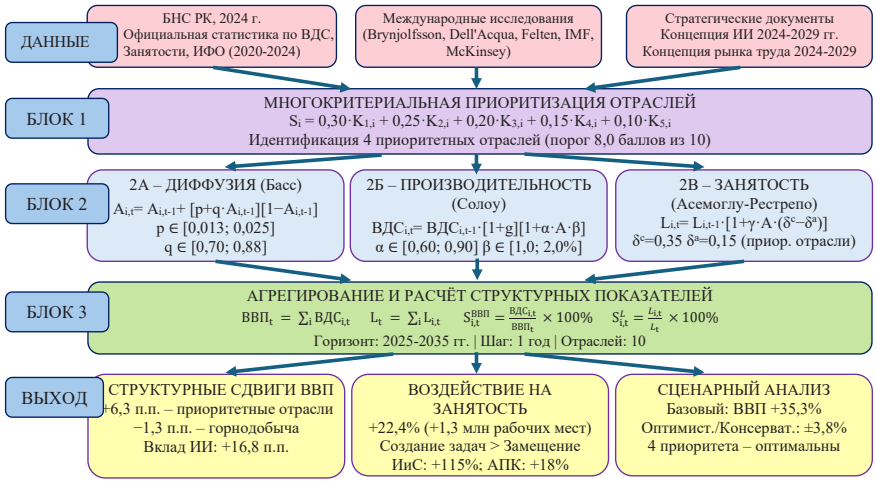


Рисунок 1. Концептуальная архитектура интегрированной динамической модели количественной оценки воздействия ИИ на структурную трансформацию
Figure 1. Conceptual architecture of the integrated dynamic model for quantitative assessment of AI impact on structural transformation

Математическая спецификация модели включает три взаимосвязанных блока уравнений (рисунок 1), каждый из которых описывает отдельный механизм воздействия ИИ. Первый блок моделирует диффузию технологий ИИ по отраслям; второй – трансляцию уровня внедрения в прирост производительности и валовой добавленной стоимости; третий – воздействие на структуру занятости. Параметры каждого уравнения калиброваны на основе отраслевых данных таблицы 1 и международных эмпирических исследований, указанных ниже. Динамика распространения технологий ИИ в отрасли *i* моделируется следующим рекуррентным соотношением на основе модели Басса согласно формуле (2):

$$A_{i,t} = A_{i,t-1} + \left[p_i + q_i \cdot A_{i,t-1}\right] \cdot \left[1 - A_{i,t-1}\right] \quad (2)$$

где:

$A_{i,t} \in [0, 1]$ – уровень внедрения ИИ в отрасли i в период t;

p_i – коэффициент инноваций, отражающий внешнее влияние;

q_i – коэффициент имитации, описывающий межфирменные коммуникации.

Начальный уровень установлен как $A_{i,2025} = 0{,}01$ для всех отраслей. С учетом институциональных ограничений вводится верхняя граница внедрения, которая представлена по формуле (3):

$$A_{i,t} = \min\left(A_{i,t-1} + \Delta A_{i,t};\ 0{,}95\right) \quad (3)$$

Коэффициент инноваций p_i для приоритетных отраслей установлен в диапазоне 0,013-0,025, коэффициент имитации q_i – в диапазоне 0,70-0,88, что отражает выраженные сетевые эффекты ИИ и активную государственную под-

держку. Выбор параметров в верхней части наблюдаемого диапазона обусловлен ускоренным сокращением временного лага технологического заимствования в развивающихся экономиках (Comin & Hobijn, 2010).

Валовая добавленная стоимость (ВДС) отрасли *i* в период *t* определяется через расширенную модель производительности согласно формуле (4):

$$ВДС_{i,t} = ВДС_{i,t-1} \cdot \left[1 + \frac{g_i}{100}\right] \cdot \cdot \left[1 + \frac{\alpha_i \cdot A_{i,t} \cdot \beta_i}{100}\right] \quad (4)$$

где:

g_i – среднегодовой темп прироста индекса физического объема за 2020-2024 гг., характеризующий базовую траекторию роста отрасли;

α_i – коэффициент восприимчивости отрасли к воздействию ИИ, отражающий долю производственных задач отрасли, которые могут быть трансформированы или дополнены технологиями ИИ; принимает значения в диапазоне 0,60-0,90, где максимальное значение соответствует отрасли информации и связи, а минимальное – сельскому хозяйству; калиброван по методологии Фелтена и соавторов на основе индекса ИИ-экспозиции профессий (Felten et al., 2021, Felten et al., 2023);

β_i – коэффициент эластичности производительности по уровню внедрения ИИ, количественно определяющий, на сколько процентных пунктов возрастает годовая производительность отрасли при увеличении уровня внедрения ИИ на одну единицу; составляет 1,0-2,0 п.п. для различных отраслей; верхняя граница диапазона обоснована эмпирическими оценками прироста производительности от генеративного ИИ в диапазоне 14-25% (Brynjolfsson et al., 2023; Dell'Acqua et al., 2023), масштабированными на горизонт полного внедрения.

Произведение $\alpha_i \cdot A_{i,t} \cdot \beta_i$ количественно определяет процентный прирост производительности, обусловленный внедрением ИИ. Значения α_i калиброваны по методологии Фелтена и соавторов (Felten et al., 2021, Felten et al., 2023); значения β_i определены на основе метаанализа исследований, выявивших 14-25-процентный прирост производительности при использовании генеративного ИИ (Brynjolfsson et al., 2023; Dell'Acqua et al., 2023).

Воздействие на занятость моделируется в рамках задачно-ориентированного подхода согласно формуле (5):

$$L_{i,t} = L_{i,t-1} \cdot \left[1 + \gamma_i \cdot A_{i,t} \cdot \cdot (\delta_i^c - \delta_i^a)\right] \quad (5)$$

где:

γ_i – коэффициент масштаба трансформации трудовых функций в отрасли i под влиянием ИИ, принимающий значение 1,0 для приоритетных отраслей и 0,8 для неприоритетных, что отражает более интенсивную реструктуризацию занятости в секторах с концентрированной государственной поддержкой;

δ_i^c – коэффициент создания новых задач, требующих специфических компетенций в области ИИ; для высокотехнологичных приоритетных отраслей принят равным 0,35, что означает: при полном внедрении ИИ в отрасли формируется трудовый спрос, эквивалентный 35% исходной численности занятых в новых функциях; обоснован структурным дефицитом ИИ-компетенций в казахстанской экономике согласно методологии Асемоглу и Рестрепо (Acemoglu and Restrepo, 2019);

δ_i^a – коэффициент автоматизации существующих задач, количественно определяющий долю исходных трудовых функций, замещаемых ИИ при полном внедрении; для приоритетных отраслей принят равным 0,15, что более чем вдвое ниже δ_i^c, обеспечивая устойчивое доминирование эффекта создания задач над эффектом замещения; калиброван на основе оценок WDC (2023) по 423 группам занятий казахстанской экономики.

Для высокотехнологичных приоритетных отраслей коэффициент создания новых задач $\delta_i^c = 0,35$ более чем вдвое превышает коэффициент автоматизации $\delta_i^a = 0,15$. Это означает, что внедрение ИИ порождает больше новых рабочих функций, чем упраздняет существующих, что согласуется с теорией Асемоглу и Рестрепо: в условиях нехватки квалифицированных кадров эффект создания задач закономерно доминирует над эффектом замещения (Acemoglu & Restrepo, 2019).

Далее, совокупный ВВП и совокупная занятость рассчитываются путем агрегирования отраслевых показателей согласно формулам (6) и (7):

$$ВВП_t = \sum_i ВДС_{i,t} \quad (6)$$

$$L_t = \sum_i L_{i,t} \quad (7)$$

Далее, отраслевые доли в ВВП и занятости (относительные показатели) определяются по формулам (8) и (9):

$$S_{i,t}^{ВВП} = \frac{ВДС_{i,t}}{ВВП_t} \times 100\% \quad (8)$$

$$S_{i,t}^{L} = \frac{L_{i,t}}{L_t} \times 100\% \quad (9)$$

Изменения отраслевых долей за 2025-2035 гг. количественно характеризуют масштаб и направленность структурной трансформации. Таким образом, разработанная интегрированная динамическая модель объединяет три ключевых механизма воздействия ИИ (диффузию технологий, рост производительности и трансформацию структуры занятости) в единую количественную рамку с отраслевой дифференциацией параметров. В отличие от существующих подходов, модель обеспечивает согласованное описание взаимосвязей между технологическим внедрением, экономическим ростом и изменениями на рынке труда, что позволяет учитывать как макроэкономические, так и структурные эффекты ИИ. Калибровка параметров на основе отраслевых данных Казахстана и международных эмпирических исследований обеспечивает прикладную релевантность модели для анализа ресурсозависимой экономики. Полученная методологическая конструкция служит основой для проведения сценарного моделирования и количественной оценки структурных сдвигов, результаты которых представлены в следующем разделе.

РЕЗУЛЬТАТЫ

Применение разработанной многокритериальной методологии к десяти отобранным отраслям экономики на основе пяти взвешенных критериев (потенциала диверсификации, применимости искусственного интеллекта, создания рабочих мест, уровня цифровизации и экспортного потенциала) позволило выявить эндогенно сформированное пороговое значение на уровне 8,0 балла. Данное значение выполняет функцию разделяющего критерия, отделяющего группу из четырёх приоритетных отраслей (с интегральной оценкой в диапазоне 8,03–9,10 балла из 10) от остальных секторов с более низким потенциалом структурной трансформации. Полученный результат свидетельствует о наличии выраженной дифференциации отраслей по их способности выступать драйверами экономической диверсификации в условиях внедрения ИИ. Полные результаты многокритериальной оценки представлены в таблице 2.

Таблица 2 Результаты многокритериальной оценки приоритетности отраслей экономики
Table 2. Results of multi-criteria prioritization of economic sectors

Отрасль	**$К_1$ (30%)**	**$К_2$ (25%)**	**$К_3$ (20%)**	**$К_4$ (15%)**	**$К_5$ (10%)**	**Интегральная оценка**
Информация и связь	9,5	10,0	8,5	9,0	7,0	9,10
Транспорт и складирование	8,0	8,5	9,0	7,0	8,5	8,23
Обрабатывающая промышленность	9,0	7,5	8,5	7,5	8,0	8,20
Сельское, лесное и рыбное хозяйство	8,5	7,0	9,5	6,5	8,5	8,03
Профессиональная, научная и техническая деятельность	7,5	8,5	7,0	8,0	7,0	7,68
Финансовая и страховая деятельность	7,0	9,0	6,5	8,5	6,5	7,58
Оптовая и розничная торговля	6,5	7,5	8,0	7,5	7,0	7,25
Строительство	7,0	6,5	8,5	6,0	6,5	6,98
Административное обслуживание	5,5	6,5	7,0	6,0	5,0	6,08
Операции с недвижимым имуществом	6,0	6,0	5,5	7,0	5,5	6,00

Примечание: составлено авторами

Четыре приоритетные отрасли обладают принципиально различными, взаимодополняющими конкурентными характеристиками. Отрасль информации и связи выступает технологическим ядром трансформации, демонстрируя максимальные значения по потенциалу применения ИИ и диверсификации. Транспорт и складирование обеспечивает масштабную платформу для создания рабочих мест, обрабатывающая промышленность – крупнейший из приоритетов – генерирует продукцию с высокой добавленной стоимостью и интенсивные межотраслевые связи, а сельское хозяйство с занятостью свыше 1 млн человек способно дать наибольший социальный эффект при внедрении технологий точного земледелия и агро-ИИ. Совокупная доля четырех приоритетных отраслей в ВДС десяти анализируемых секторов составляет 24,1% (~17,5% ВВП всей экономики), что обеспечивает достаточный масштаб для значимого структурного воздействия.

Калиброванная модель Басса генерирует S-образные траектории диффузии в приоритетных отраслях, включающие три последовательные фазы: медленного роста (2025–2027 гг.), ускоренного распространения (2028–2032 гг.) и замедления по мере приближения к насыщению (2033–2035 гг.). Прогнозные траектории представлены в таблице 3.

Таблица 3. Прогнозные траектории диффузии искусственного интеллекта в отраслях экономики, %
Table 3. Forecast AI diffusion trajectories across economic sectors, %

Отрасль	2025	2027	2029	2032	2034	2035
Информация и связь	1,0	8,2	22,5	50,3	76,8	93,8
Транспорт и складирование	1,0	5,8	16,8	40,2	68,4	88,2
Обрабатывающая промышленность	1,0	5,5	15,9	38,7	66,8	87,5
Сельское, лесное и рыбное хозяйство	1,0	5,2	15,1	37,1	65,2	86,8
Финансовая и страховая деятельность	1,0	4,2	11,8	28,5	52,3	72,4
Профессиональная деятельность	1,0	4,5	12,6	30,2	55,1	75,2
Оптовая и розничная торговля	1,0	3,8	10,5	25,4	47,8	68,1
Строительство	1,0	3,5	9,7	23,6	45,2	65,3
Операции с недвижимостью	1,0	3,2	8,9	21,8	42,5	62,4
Административное обслуживание	1,0	3,4	9,3	22,7	43,8	63,7

Примечание: составлено автором на основе результатов моделирования

Приоритетные отрасли характеризуются существенно более высокими темпами внедрения ИИ. Так, к 2035 г. уровень проникновения достигает 86,8–93,8 п.п., тогда как в неприоритетных секторах он ограничивается диапазоном 62,4–75,2 п.п. Наиболее интенсивная динамика наблюдается в отрасли информации и связи, где уровень внедрения возрастает с 1 п.п. в 2025 г. до 93,8 п.п. к 2035 г., отражая высокий потенциал технологической восприимчивости. В то же время такие отрасли, как операции с недвижимостью и административное обслуживание, демонстрируют более умеренные темпы диффузии, что обусловлено более низкой ИИ-экспозицией производственных задач. Разрыв в темпах внедрения между приоритетными и неприоритетными отраслями к 2035 г. составляет 13-32 п.п., формируя структурный дифференциал роста производительности и предпосылки для перераспределения долей в ВВП.

Далее, рисунок 2 наглядно иллюстрирует ключевую закономерность: приоритетные отрасли (сплошные кривые) демонстрируют принципиально иную траекторию диффузии по сравнению с неприоритетными (пунктирные кривые).

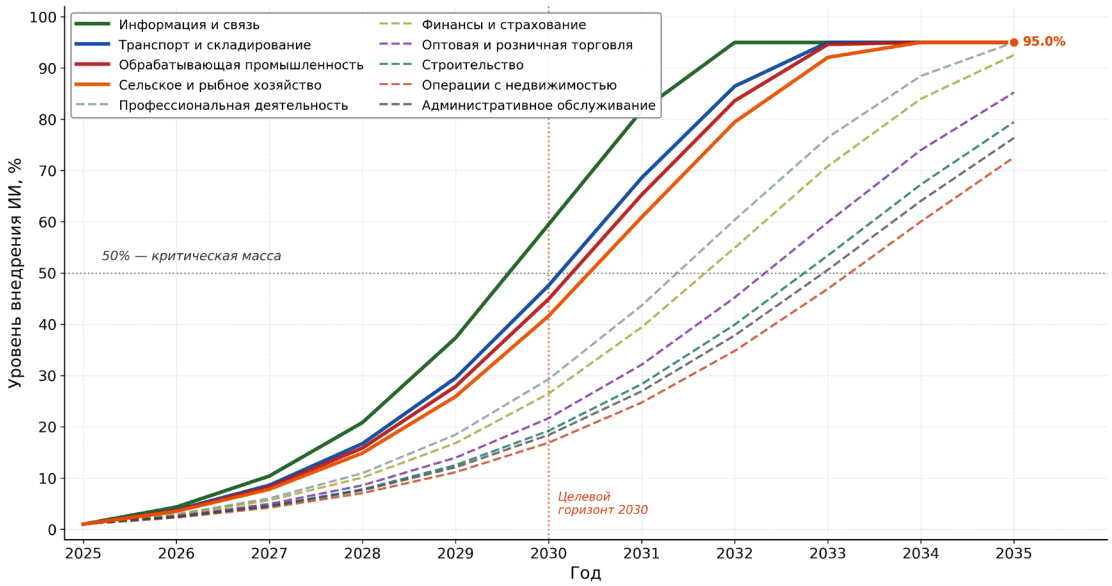


Рисунок 2. Прогнозные траектории диффузии ИИ по отраслям экономики Казахстана за 2025-2035
Figure 2. Forecast AI diffusion trajectories by economic sector of Kazakhstan for 2025-2035

К 2029 г. разрыв в уровнях внедрения достигает 7-12 п.п., а к 2035 г. – 13-32 п.п., что количественно подтверждает стратегическую обоснованность концентрации государственной поддержки на ограниченном числе секторов с максимальной ИИ-восприимчивостью. Согласно результатам моделирования, за 2025-2035 гг. совокупная валовая добавленная стоимость десяти анализируемых отраслей, на которые приходится около 70% ВВП Казахстана, вырастет на 35,3%. Из них 18,5 п.п. обеспечивает базовый экономический рост, еще 16,8 п.п. – непосредственный вклад ИИ в производительность. При этом прогнозный прирост ВДС четырех приоритетных секторов составит от 36% до 78%, тогда как для остальных отраслей – лишь от 22% до 27% (таблица 4).

Таблица 4. Прогнозное воздействие на валовую добавленную стоимость и структуру производства
Table 4. Forecast impact on gross value added and production structure

Отрасль	**ВДС 2024, млн тг**	**Доля ВДС 10 отраслей, 2024, %**	**ВДС 2035, млн тг**	**Доля ВДС 10 отраслей, 2035, %**	**Прирост ВДС, %**	**Изм. доли, п.п.**
Информация и связь	3 013	3,8	5 372	5,3	78,4	+1,5
Транспорт и складирование	7 753	9,7	11 072	10,8	42,8	+1,1
Обрабатывающая промышленность	16 941	21,3	23 596	23,1	39,3	+1,8
Сельское, лесное и рыбное хозяйство	5 307	6,7	7 216	7,1	36,0	+0,4
Финансовая и страховая деятельность	4 650	5,8	6 324	6,2	36,0	+0,4
Профессиональная деятельность	4 252	5,3	5 798	5,7	36,3	+0,4
Оптовая и розничная торговля	26 007	32,6	33 129	32,5	27,4	−0,1
Строительство	8 178	10,2	10 263	10,1	25,5	−0,1
Операции с недвижимостью	11 576	14,5	14 125	13,8	22,0	−0,7
Административное обслуживание	3 210	4,0	3 984	3,9	24,1	−0,1
Доли рассчитаны относительно совокупной ВДС десяти анализируемых отраслей (~79 500 млн тг).						

Примечание: составлено автором на основе результатов моделирования

Наиболее значимым структурным сдвигом является динамика обрабатывающей промышленности, чья доля в совокупной ВДС возрастает на 1,8 п.п. при приросте добавленной стоимости на 39,3%. В совокупности доля четырех приоритетных отраслей увеличивается на 6,3 п.п. при одновременном сокращении доли горнодобывающей промышленности на 1,3 п.п. – динамика, наглядно отражена на рисунке 3, где левая панель показывает эволюцию отраслевой структуры ВВП, а правая – асимметрию абсолютных значений ВДС между высокотехнологичными и ресурсным секторами.

На рисунке 3 представлена двухпанельная визуализация структурной трансформации: левая панель отображает динамику долей приоритетных отраслей и горнодобывающей промышленности в ВВП за 2024-2035 гг., правая – сравнение абсолютных значений ВДС.

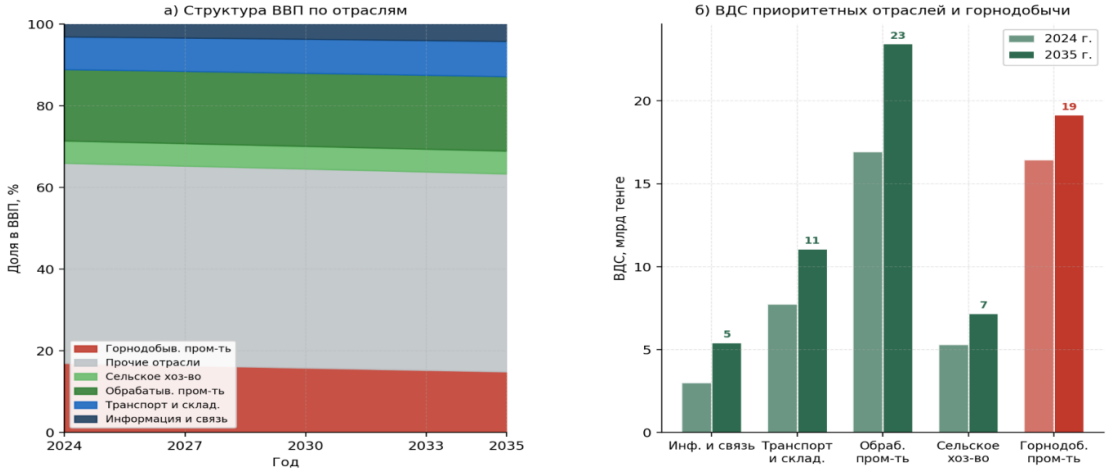


Рисунок 3. Структурная трансформация ВВП Казахстана под воздействием ИИ за 2024-2035
Figure 3. AI-driven structural transformation of Kazakhstan GDP for 2024-2035

Совокупный прирост доли четырех приоритетных отраслей (+6,3 п.п.) при одновременном сокращении доли горнодобывающей промышленности (−1,3 п.п.) наглядно иллюстрирует механизм ИИ-индуцированной диверсификации ресурсозависимой экономики. По прогнозам модели, совокупная занятость в десяти анализируемых отраслях вырастет с 5,8 млн человек в 2024 г. до 7,1 млн к 2035 г. (+22,4 п.п.). Прирост распределен неравномерно: наибольший рост ожидается в отрасли информации и связи – 115,2 п.п., что объясняется высоким спросом на специалистов по разработке, внедрению и обслуживанию ИИ-систем. Детальные результаты представлены в таблице 5.

Таблица 5. Прогнозное воздействие на занятость и структуру рынка труда
Table 5. Forecast impact on employment and labour market structure

Отрасль	Занятость 2024, тыс. чел.	Доля 2024, %	Занятость 2035, тыс. чел.	Доля 2035, %	Прирост, %	Изм. доли, п.п.
Информация и связь	188,5	3,2	405,7	5,7	115,2	+2,5
Транспорт и складирование	670,1	11,5	883,2	12,4	31,8	+0,9
Обрабатывающая промышленность	625,9	10,7	781,4	11,0	24,8	+0,3
Сельское, лесное и рыбное хозяйство	1 027,9	17,6	1 214,3	17,1	18,1	−0,5
Финансовая и страховая деятельность	202,5	3,5	267,3	3,8	32,0	+0,3
Профессиональная деятельность	263,6	4,5	352,0	5,0	33,5	+0,5
Оптовая и розничная торговля	1 529,0	26,2	1 819,7	25,6	19,0	−0,6
Строительство	665,5	11,4	785,3	11,0	18,0	−0,4

Операции с недвижимостью	162,9	2,8	187,7	2,6	15,2	−0,2
Административное обслуживание	277,2	4,8	326,1	4,6	17,6	−0,2

Примечание: составлено автором на основе результатов моделирования

Принципиальный теоретический результат состоит в том, что ИИ выступает драйвером роста занятости: во всех секторах Казахстана эффект появления новых трудовых функций устойчиво превышает эффект вытеснения труда автоматизацией. В развитых странах картина обратная – зрелый рынок труда и высокий исходный уровень автоматизации обусловливают преобладание эффекта замещения. Суммарный чистый прирост занятости к 2035 г. составит около 1,3 млн рабочих мест. Рисунок 4 представляет декомпозицию воздействия ИИ на занятость по каждой из десяти анализируемых отраслей.

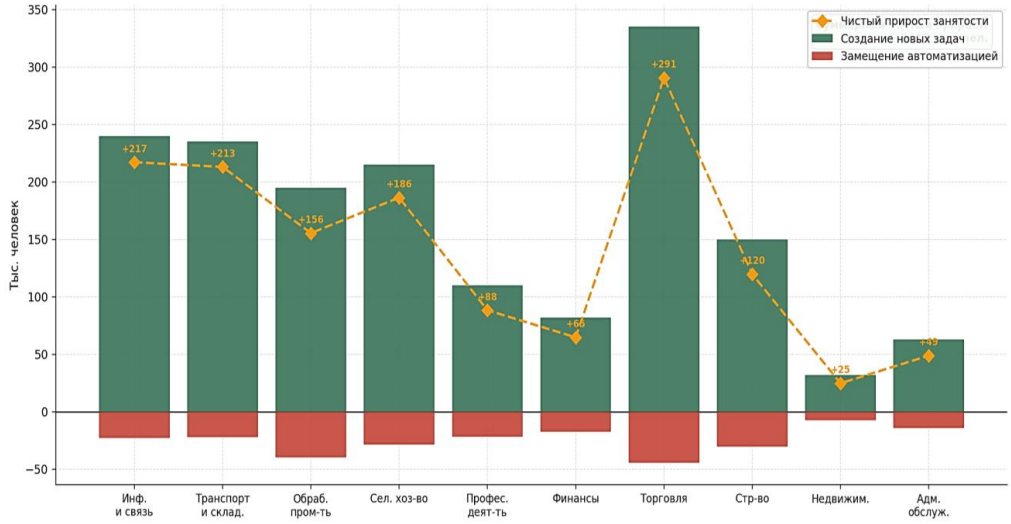


Рисунок 4. Декомпозиция воздействия ИИ на занятость в экономике Казахстана к 2035 с учетом эффектов создания новых задач и автоматизации (тыс. чел.)
Figure 4. Decomposition of the impact of AI on employment in the economy of Kazakhstan by 2035, considering the effects of creating new tasks and automation (thousand people)

Столбцы отражают два конкурирующих эффекта в абсолютном выражении (тыс. чел.): прирост занятости за счет создания новых трудовых функций (эффект δ^c) и сокращение за счет автоматизации существующих задач (эффект δ^a). Устойчивое превышение первого эффекта над вторым во всех без исключения отраслях подтверждает специфику ресурсозависимой экономики с дефицитом квалифицированных кадров, принципиально отличающую ее от паттернов развитых стран. Доля четырех приоритетных отраслей в совокупной занятости возрастает с 26,8% до 29,4% (+2,6 п.п.), что согласуется с динамикой их доли в ВВП и подтверждает одновременный рост производительности труда и его абсолютного количества.

Для проверки устойчивости базового сценария разработаны три альтернативных варианта. Сравнительный анализ всех сценариев представлен в таблице 6.

Таблица 6. Сравнительный анализ альтернативных сценариев структурной трансформации
Table 6. Comparative analysis of alternative structural transformation scenarios

Сценарий	ВВП 2035, млрд тг	Общий прирост ВВП, %	Вклад ИИ, п.п.	Доля приор. отраслей, %	Занятость 2035, млн чел.	Прирост занятости, %
Базовый сценарий	147,2	35,3	16,8	30,4	7,1	22,4

Оптимистический сценарий	152,8	39,1	20,6	31,2	7,3	25,9
Консервативный сценарий	141,6	31,5	13,0	29,5	6,9	18,9
Расширенная приоритизация (6 отраслей)	149,1	36,6	18,1	36,2	7,2	23,7

Примечание: составлено автором на основе результатов моделирования

Результаты показывают, что общий прирост ВВП варьируется в диапазоне от 31,5% в консервативном сценарии до 39,1% в оптимистическом, при этом вклад ИИ составляет от 13,0 до 20,6 п.п. Базовый сценарий демонстрирует сбалансированное соотношение между темпами роста и структурными изменениями, обеспечивая прирост ВВП на уровне 35,3% при доле приоритетных отраслей 30,4%. Расширение числа приоритетных отраслей до шести приводит лишь к незначительному дополнительному эффекту (+1,3 п.п. к ВВП), что указывает на наличие убывающей отдачи от расширения периметра государственной поддержки.

Рисунок 5 представляет сравнительную визуализацию четырех сценариев по ключевым показателям (совокупному приросту ВВП, вкладу ИИ и доле приоритетных отраслей).

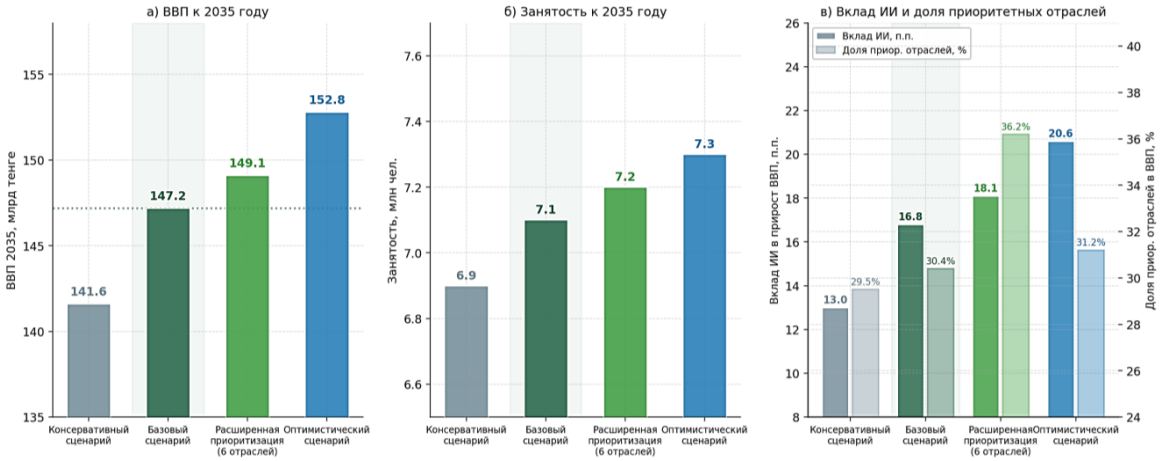


Рисунок 5. Сравнительный анализ альтернативных сценариев структурной трансформации экономики Казахстана

Figure 5. Comparative analysis of alternative structural transformation scenarios for Kazakhstan

Диапазон между консервативным и оптимистическим сценариями составляет 7,6 п.п. по ВВП (31,5-39,1 п.п.), что свидетельствует об умеренной чувствительности результатов к вариации параметров диффузии и подтверждает устойчивость базового прогноза. Сценарий расширенной приоритизации (шесть отраслей вместо четырех) дает лишь 1,3 дополнительных п.п. к ВВП относительно базового: распыление ресурсов государственной поддержки замедляет диффузию ИИ в исходных приоритетах, нивелируя выигрыш от расширения охвата и количественно подтверждая принцип стратегической концентрации.

ОБСУЖДЕНИЕ

Полученные результаты эмпирически подтверждают основную гипотезу исследования: искусственный интеллект выступает катализатором ускоренной экономической диверсификации при условии концентрации государственной поддержки на приоритетных отраслях. Количественные оценки демонстрируют существование естественной пороговой точки, разделяющей секторы по потенциалу внедрения ИИ; значимый дифференциал темпов диффузии между

приоритетными и неприоритетными отраслями; а также устойчивое доминирование эффекта создания рабочих мест над эффектом замещения в условиях дефицита квалифицированных кадров.

Полученные результаты поддаются интерпретации в рамках всех четырех теоретических направлений, задействованных в модели. Доминирование эффекта создания задач над эффектом замещения согласуется с задачно-ориентированной моделью Асемоглу и Рестрепо: в условиях структурного дефицита квалифицированных кадров предельная производительность новых трудовых функций превышает предельную производительность автоматизируемых, что и обеспечивает чистый прирост занятости. S-образная форма траекторий диффузии воспроизводит предсказания модели Басса и согласуется с выводом Коэмина и Хобайна о сокращении лага внедрения в развивающихся странах. Структурный дифференциал между приоритетными и неприоритетными отраслями, в свою очередь, отражает механизм экономической сложности: концентрация ИИ в секторах с высоким потенциалом диверсификации ускоряет накопление разнообразных производственных компетенций, необходимых для преодоления ресурсной зависимости.

Результаты согласуются с глобальными трендами внедрения ИИ. Прогнозируемый 50% уровень проникновения в приоритетных отраслях к 2029 г. соответствует траекториям Сингапура и Южной Кореи; оценка вклада ИИ в производительность (16,8 п.п. за десятилетие) находится в середине диапазона прогнозов McKinsey Global Institute (13-26%) и PwC (≈14%) (McKinsey Global Institute, 2023; PwC, 2017). Принципиальное отличие Казахстана от развитых экономик – качественно иное соотношение эффектов: тогда как для США и Западной Европы зафиксировано преобладание эффекта замещения (Acemoglu & Restrepo, 2019), Казахстан демонстрирует выраженное доминирование эффекта создания задач вследствие структурного дефицита технологически компетентной рабочей силы.

Полученные результаты позволяют сформулировать практические следствия для государственной политики. Принцип стратегической концентрации, количественно подтвержденный сценарным анализом, предполагает приоритетное направление ресурсов – целевых грантов, налоговых льгот и инновационных кластеров – в четыре отобранных сектора. Одновременно прогнозируемый дефицит порядка 1,3 млн рабочих мест с ИИ-компетенциями к 2035 г. диктует необходимость масштабной подготовки кадров при координации государства, бизнеса и системы образования. Реализация производительного потенциала ИИ обусловлена также качеством цифровой инфраструктуры: без развития сетей связи, облачных мощностей и национальной платформы данных параметры диффузии модели не будут достигнуты. Наконец, формирование регуляторной среды – стандартов этического использования ИИ и механизмов мониторинга социально-экономических последствий автоматизации – является необходимым условием устойчивости трансформации, поскольку институциональные барьеры способны существенно снизить реально достигаемый потолок внедрения ИИ относительно технологически возможного максимума.

Среди методологических ограничений исследования выделяются четыре основных: отраслевой уровень агрегации скрывает внутриотраслевую гетерогенность по размеру и технологической зрелости предприятий; отсутствие пространственного измерения не учитывает разрыв между агломерациями и периферией; экзогенная институциональная среда не отражает адаптивных изменений, индуцируемых самим внедрением ИИ; за рамками анализа остались распределительные эффекты – влияние трансформации на неравенство доходов и поляризацию рынка труда. Эти ограничения определяют повестку будущих исследований.

ЗАКЛЮЧЕНИЕ

Настоящее исследование расширяет теоретическую базу анализа воздействия ИИ на экономическое развитие по трём направлениям. В теоретическом отношении разработана интегрированная аналитическая рамка, впервые синтезирующая модель диффузии инноваций Басса, расширенную производственную функцию с эндогенным технологическим

прогрессом и задачно-ориентированный подход Асемоглу-Рестрепо в единую калиброванную модель применительно к контексту ресурсозависимой развивающейся экономики. Объединение этих трех теоретических концепций, развивавшихся независимо, позволяет учитывать взаимозависимости между диффузией технологий, производительностью труда и структурой занятости, недостижимые при изолированном применении каждого подхода.

В прикладном отношении исследование демонстрирует принципиальную значимость отраслевой дифференциации: агрегированные общеэкономические оценки воздействия ИИ скрывают структурный дифференциал, который и является ключевым механизмом трансформации ресурсозависимой экономики. Обнаруженный компромисс «концентрация-охват» имеет непосредственные следствия для государственной политики как Казахстана, так и других ресурсозависимых стран: расширение периметра поддерживаемых отраслей сопряжено с убывающей отдачей, поэтому стратегическая фокусировка на секторах с максимальным синергетическим потенциалом предпочтительнее широкой горизонтальной программы субсидирования ИИ.

Перспективы исследования определяются тремя направлениями. Первое – подотраслевая дезагрегация, позволяющая выявить внутриотраслевые кластеры с неоднородной ИИ-восприимчивостью и точнее настроить инструменты политики. Второе – включение пространственного измерения: разрыв между агломерациями и периферией в условиях цифровой трансформации способен усиливать региональное неравенство, что требует отдельного моделирования. Третье – эндогенизация институциональной динамики, поскольку качество регуляторной среды, защита данных и системы образования не только влияют на параметры диффузии ИИ, но и сами трансформируются под его воздействием. Реализация этих направлений позволит перейти от прогнозной модели к инструменту политического планирования с обратной связью между технологической диффузией и институциональными изменениями.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: YV, MK and MR; research design: YV and OO; data collection: YV, MK, MR and OO; analysis and interpretation: YV, MK and MR; writing draft preparation: YV, MK, MR and OO; supervision: YV; correction of article: MK and OO; proofread and final approval of article: YV and MR. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Acemoglu, D., & Restrepo, P. (2018). The race between man and machine: Implications of technology for growth, factor shares, and employment. American Economic Review, 108(6), 1488–1542. https://doi.org/10.1257/aer.20160696

Acemoglu, D., & Restrepo, P. (2019). Automation and new tasks: How technology displaces and reinstates labor. Journal of Economic Perspectives, 33(2), 3–30. https://doi.org/10.1257/jep.33.2.3

Aghion, P., & Howitt, P. (1992). A model of growth through creative destruction. Econometrica, 60(2), 323–351. https://doi.org/10.2307/2951599

Aitnazarov, T. M., Andabayeva, G. K., & Kakizhanova, T. I. (2024). The role of digital technologies and their impact on the economy of Kazakhstan. Central Asian Economic Review, 3, 86–99. https://doi.org/10.52821/2789-4401-2024-3-86-99 (In Russ.)

Bass, F. M. (1969). A new product growth model for consumer durables. Management Science, 15(5), 215–227. https://doi.org/10.1287/mnsc.15.5.215

Bresnahan, T. F., & Trajtenberg, M. (1995). General purpose technologies: Engines of growth? Journal of Econometrics, 65(1), 83–108. https://doi.org/10.1016/0304-4076(94)01598-T

Brynjolfsson, E., Li, D., & Raymond, L. R. (2023). Generative AI at work (NBER Working Paper No. 31161). National Bureau of Economic Research. https://doi.org/10.3386/w31161

Bulkhairova, Zh. S., Alpeissova, Sh. E., & Kossymbayeva, Sh. I. (2023). [The current state and problems of economic digitalization in Kazakhstan]. Vestnik ENU im. L. N. Gumilyova. Ekonomicheskaya seriya = Bulletin of L.N. Gumilyov ENU. Economic Series, 1, 32–39. https://bulecon.enu.kz/index.php/main/article/view/110 (In Russ.)

Bureau of National Statistics. (2024). Bureau of National Statistics of the Republic of Kazakhstan. Retrieved December 15, 2025 from https://stat.gov.kz/en

Cockburn, I. M., Henderson, R., & Stern, S. (2018). The impact of artificial intelligence on innovation (NBER Working Paper No. 24449). National Bureau of Economic Research. https://doi.org/10.3386/w24449

Comin, D., & Hobijn, B. (2010). An exploration of technology diffusion. American Economic Review, 100(5), 2031–2059. https://doi.org/10.1257/aer.100.5.2031

Dell'Acqua, F., McFowland, E., Mollick, E. R., Lifshitz-Assaf, H., Kellogg, K., Rajendran, S., Krayer, L., Candelon, F., & Lakhani, K. R. (2023). Navigating the jagged technological frontier: Field experimental evidence of the effects of AI on knowledge worker productivity and quality (Harvard Business School Working Paper No. 24-013). Harvard Business School. https://doi.org/10.2139/ssrn.4573321

Denissova, O., Konurbayeva, Z., Kulisz, M., Yussubaliyeva, M., & Suieubayeva, S. (2025). Measuring the digital economy in Kazakhstan: From global indices to a contextual composite index (IDED). Economies, 13(8), 225. https://doi.org/10.3390/economies13080225

Eloundou, T., Manning, S., Mishkin, P., & Rock, D. (2023). GPTs are GPTs: An early look at the labor market impact potential of large language models. Science, 381(6654), 187–192. https://doi.org/10.1126/science.adh2586

Felten, E., Raj, M., & Seamans, R. (2021). Occupational, industry, and geographic exposure to artificial intelligence: A novel dataset and its potential uses. Strategic Management Journal, 42(12), 2195–2217. https://doi.org/10.1002/smj.3286

Felten, E., Raj, M., & Seamans, R. (2023). How will language modelers like ChatGPT affect occupations and industries? arXiv. https://doi.org/10.48550/arXiv.2303.01157

Goldfarb, A., & Tucker, C. (2019). Digital economics. Journal of Economic Literature, 57(1), 3–43. https://doi.org/10.1257/jel.20171452

Government of the Republic of Kazakhstan (2024). Concept for the development of artificial intelligence in the Republic of Kazakhstan for 2024–2029 [Kontseptsiya razvitiya iskusstvennogo intellekta v Respublike Kazakhstan na 2024–2029 gody] (Resolution No. 592, July 24, 2024). https://adilet.zan.kz/rus/docs/P2400000592 (In Russ.)

Hall, R. E., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? Quarterly Journal of Economics, 114(1), 83–116. https://doi.org/10.1162/003355399555954

Hausmann R., & Klinger B. (2007). The structure of the product space and the evolution of comparative advantage. CID Working Paper No. 146. Harvard University. Retrieved December 15, 2025 from https://www.hks.harvard.edu/sites/default/files/centers/cid/files/publications/faculty-working-papers/146.pdf

Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Simoes, A., & Yildirim, M. A. (2014). The atlas of economic complexity: Mapping paths to prosperity. MIT Press. https://doi.org/10.7551/mitpress/9647.001.0001

Hidalgo, C. A., & Hausmann, R. (2009). The building blocks of economic complexity. Proceedings of the National Academy of Sciences, 106(26), 10570–10575. https://doi.org/10.1073/pnas.0900943106

International Monetary Fund. (2024). Gen-AI: Artificial intelligence and the future of work (IMF Staff Discussion Note No. 2024/001). https://doi.org/10.5089/9798400262548.006

McKinsey Global Institute. (2023). The economic potential of generative AI: The next productivity frontier. McKinsey & Company. Retrieved December 15, 2025 from https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. Economic Journal, 116(508), 1–20. https://doi.org/10.1111/j.1468-0297.2006.01045.x

PricewaterhouseCoopers. (2017). Sizing the prize: What's the real value of AI for your business and how can you capitalise? PwC. Retrieved December 15, 2025 from https://www.pwc.com.au/government/pwc-ai-analysis-sizing-the-prize-report.pdf

Romer, P. M. (1990). Endogenous technological change. Journal of Political Economy, 98(5), S71–S102. https://doi.org/10.1086/261725

Sachs, J. D., & Warner, A. M. (1995). Natural resource abundance and economic growth (NBER Working Paper No. 5398). National Bureau of Economic Research. https://doi.org/10.3386/w5398

Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. European Economic Review, 45(4–6), 827–838. https://doi.org/10.1016/S0014-2921(01)00125-8

Solow, R. M. (1956). A contribution to the theory of economic growth. Quarterly Journal of Economics, 70(1), 65–94. https://doi.org/10.2307/1884513

Solow, R. M. (1957). Technical change and the aggregate production function. Review of Economics and Statistics, 39(3), 312–320. https://doi.org/10.2307/1926047

Sultan, F., Farley, J. U., & Lehmann, D. R. (1990). A meta-analysis of applications of diffusion models. Journal of Marketing Research, 27(1), 70–77. https://doi.org/10.2307/3172552

Trajtenberg, M. (2018). AI as the next GPT: A political-economy perspective (NBER Working Paper No. 24245). National Bureau of Economic Research. https://doi.org/10.3386/w24245

Workforce Development Center. (2023). Assessment of the impact of automation, robotization and artificial intelligence on the labour market of the Republic of Kazakhstan [Otsenka vliyaniya avtomatizatsii, robotizatsii i iskusstvennogo intellekta na rynok truda Respubliki Kazakhstan]. https://erdo.enbek.kz/news/271 (In Russ.)

Information about the authors

Yevgeniy V. Varavin – Cand Sc. (Econ.), Associate Professor, D. Serikbayev East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan, email: evaravin@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-7257-9213

* **Marina V. Kozlova** – Cand Sc. (Econ.), Professor, D. Serikbayev East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan, email: mkozlova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-3381-4997

Madina U. Rakhimberdinova – PhD, Professor, D. Serikbayev East Kazakhstan Technical University, Ust-Kamenogorsk, Kazakhstan, email: mrakhimberdinova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0001-9009-8686

Ozay Ozpence – PhD, Associate Professor, Pamukkale University, Denizli, Turkey, email: oozpence@pau.edu.tr, ORCID ID: https://orcid.org/0000-0003-1502-3240

Авторлар туралы мәліметтер

Варавин Е.В. – э.ғ.к., қауымдастырылған профессор, Д. Серікбаев атындағы Шығыс Қазақстан техникалық университеті, Өскемен, Қазақстан, email: evaravin@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-7257-9213

***Козлова М.В.** – э.ғ.к., профессор, Д. Серікбаев атындағы Шығыс Қазақстан техникалық университеті, Өскемен, Қазақстан, email: mkozlova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-3381-4997

Рахимбердинова М.У. – PhD, профессор, Д. Серікбаев атындағы Шығыс Қазақстан техникалық университеті, Өскемен, Қазақстан, email: mrakhimberdinova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0001-9009-8686

Озпенче Ө. – PhD, қауымдастырылған профессор, Памуккале университеті, Денизли, Түркия, email: oozpence@pau.edu.tr, ORCID ID: https://orcid.org/0000-0003-1502-3240

Сведения об авторах

Варавин Е.В. – к.э.н., ассоциированный профессор, Восточно-Казахстанский технический университет им. Д. Серикбаева, Усть-Каменогорск, Казахстан, email: evaravin@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-7257-9213

***Козлова М.В.** – к.э.н., профессор, Восточно-Казахстанский технический университет им. Д. Серикбаева, Усть-Каменогорск, Казахстан, email: mkozlova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0002-3381-4997

Рахимбердинова М.У. – PhD, профессор, Восточно-Казахстанский технический университет им. Д. Серикбаева, Усть-Каменогорск, Казахстан, email: mrakhimberdinova@edu.ektu.kz, ORCID ID: https://orcid.org/0000-0001-9009-8686

Озпенче Ө. – PhD, ассоциированный профессор, Университет Памуккале, Денизли, Турция, email: oozpence@pau.edu.tr, ORCID ID: https://orcid.org/0000-0003-1502-3240

Research paper / Оригинальная статья
https://doi.org/10.51176/1997-9967-2026-1-128-139
МРНТИ 06.71.07
JEL: Q16, O13, O33

Check for updates
BY-NC 4.0

Digital Finance and Agricultural Productivity Growth: Comparative Evidence from China and Kazakhstan

Yawen Sun[a], Nursaule Zh. Brimbetova[b], Zaure K. Chulanova[b]*, Dinara Zh. Rakhmatullayeva[a]

[a]Al-Farabi Kazakh National University, 71 Al-Farabi Ave., Almaty, Kazakhstan; [b]Institute of Economics CS MSHE RK, 28 Shevchenko Str., Almaty, Kazakhstan

For citation: Sun, Y., Brimbetova, N.Zh., Chulanova, Z.K. & Rakhmatullayeva, D. Zh. (2026). Digital Finance and Agri-cultural Productivity Growth: Comparative Evidence from China and Kazakhstan. Economy: strategy and practice, 21(1), 128-139. https://doi.org/10.51176/1997-9967-2026-1-128-139

ABSTRACT

The digital transformation of the agricultural sector strengthens the role of digital infrastructure and financial inclusion as factors of productivity growth in agriculture in the context of structural modernization of the economy. The aim of the study is to assess the impact of digital infrastructure on agricultural productivity and to identify the cross—country heterogeneity of effects in economies with different levels of digitalization and institutional development. A balanced panel for 2011-2023 (26 observations) based on data from the World Bank and the International Labour Organisation was used. In the combined model, digital infrastructure demonstrates a positive and statistically significant relationship with performance ($\beta = 0.7626$; $p < 0.01$), with a high quality of fit ($r2 = 0.946$). The exclusion of pandemic years confirms the stability of the effect ($\beta = 0.744$; $p < 0.01$; $r2 = 0.937$). The cross-country analysis revealed heterogeneity: in China, the effect of digital infrastructure is positive and significant ($\beta = 0.421$; $p < 0.01$), while in Kazakhstan the coefficient is negative and weakly significant at the level of 10% ($\beta = -0.483$; $p = 0.092$), indicating differences in institutional readiness and the level of digital maturity. The results obtained confirm the importance of digital infrastructure in improving the efficiency of the agricultural sector, but demonstrate that the institutional and structural environment determines the scale and direction of this impact.

KEYWORDS: Digital Economy, Digital Finance, Digital Infrastructure, Economic Growth, Agricultural Productivity, Kazakhstan, China

CONFLICT OF INTEREST: the authors declare that there is no conflict of interest

FINANCIAL SUPPORT: this study was supported by the Science Committee MSHE RK within the framework of the targeted financing program BR 28713593 “Sustainable development of the economy of Kazakhstan in the context of new challenges: foresight, strategies, and scenarios for modernization”

Article history:
Received 15 December 2025
Accepted 26 February 2026
Published 30 March 2026

*** Corresponding author: Chulanova Z.K.** – PhD, Leading Researcher, Institute of Economics CS MSHE RK, 28 Shevchenko Str., Almaty, Kazakhstan, 87077502351, email: chulanova.zaure@ieconom.kz

Цифровые финансы и рост производительности сельского хозяйства: сравнительный анализ Китая и Казахстана

Сунь Я.[a], Бримбетова Н.Ж.[b], Чуланова З.К.[b]*, Рахматуллаева Д.Ж.[a],

[a]Казахский национальный университет им. Аль-Фараби, пр. Аль-Фараби 71, Алматы, Казахстан; [b]Институт экономики КН МНВО РК, ул. Шевченко 28, Алматы, Казахстан

Для цитирования: Сунь Я., Бримбетова Н.Ж., Чуланова З.К., Рахматуллаева Д.Ж. (2026). Цифровые финансы и рост производительности сельского хозяйства: сравнительный анализ Китая и Казахстана. Экономика: страте-гия и практика, 21(1), 128-139. https://doi.org/10.51176/1997-9967-2026-1-128-139

АННОТАЦИЯ

Цифровая трансформация аграрного сектора усиливает роль цифровой инфраструктуры и финансовой инклюзии как факторов роста производительности в сельском хозяйстве в условиях структурной модернизации экономики. Цель исследования — оценить влияние цифровой инфраструктуры на производительность сельского хозяйства и выявить межстрановую гетерогенность эффектов в экономиках с различным уровнем цифровизации и институционального развития. Использована сбалансированная панель за 2011–2023 гг. (26 наблюдений) на основе данных Всемирного банка и Международной организации труда. В объединенной модели цифровая инфраструктура демонстрирует положительную и статистически значимую связь с производительностью ($\beta = 0{,}7626$; $p < 0{,}01$), при высоком качестве подгонки ($r^2 = 0{,}946$). Исключение пандемийных лет подтверждает устойчивость эффекта ($\beta = 0{,}744$; $p < 0{,}01$; $r^2 = 0{,}937$). Межстрановой анализ выявил гетерогенность: в Китае эффект цифровой инфраструктуры положителен и значим ($\beta = 0{,}421$; $p < 0{,}01$), тогда как в Казахстане коэффициент отрицателен и слабо значим на уровне 10% ($\beta = -0{,}483$; $p = 0{,}092$), что указывает на различия в институциональной готовности и уровне цифровой зрелости. Полученные результаты подтверждают значимость цифровой инфраструктуры как фактора повышения эффективности аграрного сектора, однако демонстрируют, что институциональная и структурная среда определяет масштаб и направленность этого воздействия.

КЛЮЧЕВЫЕ СЛОВА: цифровая экономика, цифровые финансы, цифровая инфраструктура, экономический рост, продуктивность сельского хозяйства, Казахстан, Китай

КОНФЛИКТ ИНТЕРЕСОВ: авторы заявляют об отсутствии конфликта интересов

ФИНАНСИРОВАНИЕ: статья выполнена при поддержке Комитета науки МНВО РК в рамках программы целевого финансирования BR 28713593 «Устойчивое развитие экономики Казахстана в условиях новых вызовов: форсайт, стратегии и сценарии модернизации»

История статьи:
Получено 15 декабря 2025
Принято 26 февраля 2026
Опубликовано 30 марта 2026

***Корреспондирующий автор: Чуланова З.К.** – к.э.н., ведущий научный сотрудник, Институт экономики КН МНВО РК, ул. Шевченко 28, Алматы, Казахстан, 87077502351, email: chulanova.zaure@ieconom.kz

INTRODUCTION

Over the past decade, the development of the digital economy has transformed resource allocation and production processes in agriculture. From a production factor perspective, the relationship between digital infrastructure and agricultural productivity has become a key issue in agricultural economics. This is particularly important for major agricultural countries such as China and Kazakhstan, which are seeking to modernize their agriculture and increase farmers' incomes while addressing land and water scarcity.

Existing research has shown that digital infrastructure can improve agricultural productivity by reducing transaction costs and increasing efficiency. However, most empirical evidence is based on country-specific analyses, and systematic comparisons of countries at different stages of economic development are lacking. Furthermore, the literature has not adequately explained whether the relationship between digital infrastructure and agricultural productivity varies across institutional and structural contexts. Therefore, this study examines whether there is a link between national-level digital infrastructure and agricultural productivity, and whether this relationship differs between China and Kazakhstan.

Beyond digital infrastructure, digital financial inclusion has emerged as a complementary driver of agricultural transformation. By expanding access to credit, insurance, and mobile payment systems, digital finance can alleviate liquidity constraints faced by rural households, reduce information asymmetries, and enhance investment in modern agricultural inputs and technologies. In developing and transition economies, where traditional financial systems often underserve rural areas, digital financial services may play a particularly significant role in facilitating productivity-enhancing investments and stabilizing farm incomes.

At the same time, the effectiveness of digital finance in promoting agricultural productivity may depend on national institutional capacity, regulatory frameworks, and the level of digital literacy. Differences in financial market development, rural infrastructure, and policy support between China and Kazakhstan provide a valuable comparative setting for examining heterogeneous impacts. By integrating digital infrastructure and digital financial inclusion into a unified analytical framework, this study contributes to a deeper understanding of how digital transformation influences agricultural productivity growth under diverse development conditions.

This study uses balanced panel data from 2011 to 2023 to examine this relationship using panel regression models and country-specific estimation methods. Digital infrastructure is measured by internet penetration, which reflects the degree of digital connectivity within a country using a uniform international metric. Empirical results show a positive correlation across the entire sample, but country-level estimates show differences between China and Kazakhstan. This paper provides comparable evidence on the role of digital infrastructure in agricultural productivity across different development contexts.

The purpose of this article is to examine whether digital financial inclusion improves agricultural productivity and compare its impact in countries with different levels of digitalization and economic development.

LITERATURE REVIEW

According to the definition of the Organization for Economic Cooperation and Development, digital infrastructure refers to communications and information systems that support the generation, transmission, and processing of data (OECD, 2019). Digital infrastructure includes fixed and mobile broadband networks, fibre optic transmission systems, data centres, and cloud computing services. The International Telecommunication Union points out that internet usage, broadband subscriber numbers, and network coverage are key indicators of the level of digital connectivity (ITU, 2022). From an economic perspective, Greenstein (2021) argued that digital infrastructure is not a single device or technology but rather a multi-layered connectivity architecture comprising application, transport, internet, and connectivity layers. Its structural characteristics enable the efficient transmission of information and resources between individuals, businesses, and governments. Based on this definition, this paper defines national-level digital infrastructure as the level of digital connectivity and uses individual internet usage as a proxy variable. Given that agricultural production is spatially dispersed and subject to information asymmetry, improving digital connectivity may affect agricultural labor productivity.

This paper focuses on China and Kazakhstan to examine the correlation between each country's digital connectivity and agricultural labor productivity at the macro level.

Gollin (2023) argued that differences in agricultural productivity are important in explaining differences in income and structural transformation across countries, showing that spatial resource allocation and cropping patterns influence outcomes. Macours (2019) conducted a literature survey on the diffusion of agricultural innovations and argued that technology adoption depends not only on yield improvements but also on the characteristics, complexity, and availability of information. Hjort et al. (2019) examined variations in the deployment of submarine internet cables in Africa and used a difference-in-differences approach to estimate that faster internet access is associated with increased employment, which, in turn, leads to firm entry and productivity growth. Aker et al. (2015) used market-year data from Niger from 1999 to 2008 to show that the introduction of mobile phones reduced the spatial dispersion of prices for the semi-perishable crop cowpea, but the effects on millet and sorghum were statistically insignificant. All these studies suggest that increased digital connectivity can improve information efficiency and increase market integration, which in turn can affect resource allocation and agricultural labor productivity.

Bocean (2024) reviewed EU countries to show that the adoption of digital technology through ICT improves the productivity of agricultural labour but does not necessarily improve the productivity of agricultural land. The authors, Rajkhowa and Baumüller (2024), used panel data from 86 countries and found that ICT levels correlate with both agricultural labour and agricultural land productivity; however, labour productivity shows a stronger correlation. Bai et al. (2022) conducted research in the U.S. and indicated that areas with broadband coverage have experienced greater growth in farm sales. LoPiccalo (2021) indicates a statistically significant relationship between higher penetration rates of high-speed broadband access and improvements in crop yields and decreases in operating costs. Suroso et al. (2022) conducted a study using a panel dataset of 126 countries and identified statistically significant relationships between fixed broadband penetration, internet penetration, and farm value-added. Similarly, Oyelami et al. (2022) analysed data from sub-Saharan Africa and showed evidence of a long-run statistically significant relationship between mobile telecommunication utilisation, internet usage, and agricultural output. In general, the studies highlighted above show that digital infrastructure (i.e., fixed broadband networks, mobile telecommunication networks, and internet penetration) is consistently linked to agricultural labour productivity, agricultural land productivity, and farm value-added across multiple economic contexts.

Most research on the relationship between digital infrastructure and agricultural productivity in China has focused on how digital infrastructure can enhance productivity. Research by Rahman and Mamun (2017) has shown that there is a statistically significant positive relationship between telephone infrastructure and total agricultural output. Qiubo et al. (2020) found a statistically significant relationship between total factor productivity in agriculture and ICT indicators (internet and mobile network coverage). At the farm level, Li et al. (2024) found that internet use for agricultural production was associated with higher technical efficiency, whereas mere internet access was not an unequivocal indicator of technical efficiency. Additionally, Deng et al. (2024) identified a statistically significant relationship between internet usage and increased land productivity. Wang and Cai (2025) and Zhao et al. (2025) both found statistically significant relationships between levels of digital infrastructure and total agricultural productivity. Thus, the use of various digital infrastructure indicators shows statistically significant relationships with agricultural productivity in many instances.

In Kazakhstan, while relatively little first-hand empirical data exists regarding the impact that growth in digital infrastructure has on growth in agricultural productivity, Kushzhanov and Aliyev (2018) noted significant improvement in access to fixed broadband and mobile networks as a result of evaluating the implementation of the "Digital Kazakhstan" strategy; however, rural residents continue to have lower quality of access than urban residents. Gaysina et al. (2023) note that with the development of digitalization, the role of farms is changing: opportunities for online marketing of agricultural products through marketplaces and social media, as well as the use of digital agricultural advisory services, electronic government subsidies, and support programs are emerging. On a sector-by-sec-

tor basis, Aldashev and Batkeyev (2021) found that rural broadband expansion had a positive impact on sectors beyond agriculture, such as trade and retail, but no statistically significant impact on agricultural productivity. Similarly, Bekbossinova and Doszhan (2025) found no statistically significant relationship between growth in the level of internet penetration and growth in gross agricultural output when analyzing panel data for the period from 2010 through 2023. Overall, the existing body of evidence does not provide substantial support for establishing a systematic relationship between increasing levels of digital infrastructure and agricultural productivity. However, certain digital platforms, including Qoldau.kz and the e-APK ecosystem, are improving the efficiency with which farmers receive agricultural subsidies and integrating agricultural records, thereby contributing to the evolution of digital infrastructure for agriculture at the institutional level.

He et al. (2025) and several other studies examining country-specific contexts have also noted that, while the connection between digital infrastructure and agricultural performance has been an important topic of investigation, many structural limitations remain. First, most of the available literature focuses on a single country, particularly China, limiting the ability to conduct systematic comparative analyses across multiple economies at different levels of agricultural development. Second, while Patel et al. (2025) utilised cross-country data, their primary focus was on the digitisation of agriculture and sustainability rather than on agricultural productivity, and did not treat agricultural productivity as the primary outcome variable, nor did they systematically compare differences in development levels across countries. Lastly, while most studies have shown a statistically significant correlation between digital connectivity measures and agricultural productivity, there has been little explanation for why these relationships are stronger in some countries than in others or absent in many. This gap is particularly relevant in comparative studies between China and Kazakhstan. Therefore, there is a need to conduct cross-national, longitudinal studies to systematically analyse the impact of national digital infrastructure development on agricultural productivity growth across different structural and institutional environments.

RESEARCH METHODS

This study constructs a balanced panel dataset for China and Kazakhstan spanning 2011–2023. All data are primarily obtained from reputable international databases, such as the World Bank and the International Labour Organisation. Using international sources ensures comparability of statistical indicators and consistency in calculation methodologies. At the time of data collection (i.e., the 2025 World Development Indicators update), 2023 was the last period for which complete data were available for both countries.

Therefore, data for 2024 were excluded from the analysis to maintain a balanced panel structure. The dependent variable is agricultural productivity, measured as value added per worker in the agriculture, forestry, and fisheries sectors (in constant 2015 US dollars), reflecting the level of labor efficiency in the agricultural sector. This indicator is widely used in empirical studies to measure production intensity and technological development in agriculture. The main explanatory variable is internet penetration, which is used as a cross-country indicator of national digital infrastructure development. This indicator reflects the degree of digital connectivity of the economy, the availability of information and communications technologies, and the potential for the dissemination of digital services in rural areas.

The model includes three control variables:

(1) the share of employment in agriculture, reflecting the structure of labor force utilization;

(2) gross capital formation as a percentage of GDP, characterizing overall investment activity and the potential for upgrading production assets;

(3) the share of agricultural raw material exports in merchandise exports, reflecting the degree of openness of the agricultural sector and its orientation toward external demand. Including these variables reduces the problem of omitted variable bias and more accurately isolates the impact of digital infrastructure on productivity.

The natural logarithmic transformation of all variables produces stabilised data, which becomes easier to interpret in economic terms. To examine the effect of digital infrastructure on agricultural productivity, the following OLS baseline model is established (1):

$$\ln(agri\_it) = \alpha + \beta_1 \ln(digi\_it) + \beta_2 \ln(employ\_it) + \beta_3 \ln(capital\_it) + \beta_4 \ln(export\_it) + \varepsilon\_it \quad (1)$$

where:

ln(agri_it) – agricultural labour productivity;

ln(digi_it) – national digital infrastructure (internet penetration rate);

ln(employ_it) – agricultural employment share;

ln(capital_it) – gross capital formation (% of GDP);

ln(export_it) – agricultural raw materials exports (% of merchandise exports);

ε_it – the random error term.

Table 1 presents the descriptive statistics for the key variables over the period 2011-2023.

Table 1. Descriptive statistics of main variables

Variable	Mean	SD	Min	Max
ln_agri	8.6119	0.3340	8.0265	9.1372
ln_digi	4.1797	0.2553	3.6455	4.5313
ln_employ	3.0577	0.3287	2.4956	3.5496
ln_capital	3.5222	0.2609	3.1354	3.8345
ln_export	-1.2103	0.4269	-2.2046	-0.5975

Note: compiled by the authors

It can be seen that agricultural productivity (ln_agri) has a mean of 8.61 and a standard deviation of 0.33, indicating a relatively moderate level of variation in agricultural efficiency across these two countries, though some disparities remain. The mean of digitalisation (ln_digi) is 4.18, and a standard deviation of 0.26, this reflects the variation in the level of digitalisation over the sample period. China's penetration of the Internet has been rapidly expanding, whereas Kazakhstan's has been developing more slowly.

Agricultural employment (ln_employ) had a standard deviation of 0.33, indicating considerable variation in the structure of labour employed and the process of labour shifting from agriculture to non-agriculture during this period of modernisation. The capital formation (ln_capital) has a standard deviation of 0.26, indicating that the conditions of capital invested in agriculture are again rather stable. The agricultural exports (ln_export) had a standard deviation of 0.43, which is also the highest among the variables considered. This indicates that there is a significant difference in the openness and external orientation of the two countries as far as agriculture is concerned. These results are descriptive statistics that lead up to the regression analysis that follows.

RESULTS

This section presents the results of an empirical assessment of a baseline model designed to identify the impact of digital infrastructure on agricultural productivity in China and Kazakhstan over the period 2011–2023. The resulting estimates allow us to quantify the strength and direction of the relationship between the level of digitalization and agricultural sector performance, taking into account structural and macroeconomic factors. The analysis is based on panel data and ordinary least squares, ensuring comparability of the results across the two countries and forming the basis for further testing of the robustness and cross-country heterogeneity of the identified effects.

The model explains a significant share of the variation in agricultural productivity and is able to characterise the sampled series favourably: $R^2 = 0.946$ and F statistic = 121.01 ($p < 0.01$), indicating that the OLS regressions were statistically significant overall. Internet penetration is used as a proxy for digital infrastructure in this model to capture the broader digital landscape rather than directly measuring digital financial services.

As can be seen from the table, the digital infrastructure variable (ln_digi) shows a value of 0.7626 ($p = 0.000$). Since it is a positive figure with satisfactory statistical significance, this indicates that digital infrastructure is positively associated with agricultural productivity at the 1% level. Possible factors that may explain this relationship include better access to agricultural credit, lower information and transaction costs, and greater adoption of technology in agriculture.

Table 2 presents the OLS results for 2011-2023, using panel data from China and Kazakhstan to examine how digital infrastructure relates to agricultural productivity.

Table 2. Baseline regression results

Variable	Coefficient	Std. Error	t	P>|t|	95% Conf. Interval
ln_digi	0.7626	0.1389	5.49	0.000***	[0.4738, 1.0514]
ln_employ	-0.6640	0.1398	-4.75	0.000***	[-0.9548, -0.3733]
ln_capital	0.6751	0.1343	5.03	0.000***	[0.3958, 0.9545]
ln_export	-0.0438	0.1143	-0.38	0.705	[-0.2815, 0.1939]
cons	5.0238	0.6625	7.58	0.000***	[3.6460, 6.4017]
Obs = 26 R^2 = 0.946 F (4, 21) = 121.01 Prob > F = 0.000 Root MSE = 0.084 *** p < 0.01, ** p < 0.05, * p < 0.1.					

Note: compiled by the authors

The coefficient of agricultural employment share (ln_employ)is -0.6640 (p = 0.000) - negative and statistically significant at the 1% level - suggesting that the transfer of a share of labour out of agriculture into other branches is associated with agricultural labour productivity. The capital formation (ln_capital) estimate is 0.6751 (p = 0.000), implying a clear upward push at the 1% threshold and is positive and significant for agricultural productivity. The coefficient on agricultural export (ln_export) is -0.0438 (p = 0.705), statistically insignificant, suggesting that positive day-to-day export changes are not related to agricultural productivity.

From the VIF tests, it can be seen that multicollinearity among the main explanatory variables is acceptable. In the main, digital infrastructure shows a significant positive relationship with agricultural productivity, as theoretically expected and provides justification for the robustness and heterogeneity tests which follow. The limited observations cover two countries; thus, the high R^2s should be interpreted with caution, as they also reflect broad macroeconomic trends in the sample rather than the actual strong explanatory power.

As indicated in Table 3, to control for the possible influence of the COVID-19 pandemic, we exclude the years 2020-2021 from our estimation.

Table 3. Robust test results (excluding COVID-19 years)

Variable	Coefficient	Std. Error	t-Statistic	p-Value
ln_digi	0.744	0.156	4.76	0.000***
ln_employ	-0.674	0.156	-4.32	0.000***
ln_capital	0.642	0.160	4.00	0.001***
ln_export	-0.029	0.128	-0.23	0.820
_cons	5.267	0.842	6.26	0.000***
*** p < 0.01, ** p < 0.05, * p < 0.1. R^2 = 0.937, F(4, 17) = 82.16, Prob > F = 0.000, Obs = 22.				

Note: compiled by the authors

The results show that the coefficient on digital infrastructure (ln_digi) is 0.7436 (p = 0.000), still positive and at the 1% level, and almost the same as the baseline value of 0.7626 (p = 0.000), indicating the stability of the positive association between digital infrastructure and agricultural productivity. The coefficient on the agricultural employment share (ln_employ) is -0.6737 (p = 0.000), significantly negative at the 1% level, suggesting that labour movement from agriculture to the non-agricultural sectors is associated with agricultural productivity. The coefficient on capital formation (ln_capital) is 0.6415 (p = 0.001), indicating a significant positive relationship, suggesting that capital investment is positively related to agricultural productivity. In contrast, the coefficient of agricultural exports (ln_export) is -0.0295 (p = 0.820) and still insignificant, implying that temporary fluctuations in agricultural

exports have a limited impact on agricultural productivity. In general, the model still has very high explanatory power ($R^2 = 0.937$), which is very close to that of the baseline regression ($R^2 = 0.946$), thereby reiterating the stability of the empirical results.

Table 4 presents the results from the regression after standardising the variables using the z-score transformation to further strengthen the regression's robustness.

Table 4. Robust test results (standardised variables)

Variable	Coefficient	Std. Error	t-Statistic	p-Value
z_ln_digi	0.583	0.106	5.49	0.000***
z_ln_employ	-0.654	0.138	-4.75	0.000***
z_ln_capital	0.528	0.105	5.03	0.000***
z_ln_export	-0.056	0.146	-0.38	0.705
_cons	0.000	0.050	0.00	1.000
*** p < 0.01, ** p < 0.05, * p < 0.1. $R^2 = 0.946$, F(4, 21) = 121.01, Prob > F = 0.000, Obs = 26.				

Note: compiled by the authors

The differences in measurement scales have been eliminated by standardising all variables using mean-centring and normalisation by the standard deviation. The coefficient of digital infrastructure (z_ln_digi) is 0.583 (p = 0.000). This figure is statistically significant at the 1% level in both the current model and in the base regression and the regression excluding the effects of the COVID variables, suggesting that the positive association between digital infrastructure and agricultural productivity remains stable.

The coefficient of the employment share of agriculture (z_ln_employ) is -0.654 (p = 0.000). This figure is also significant at the 1% level, implying that the transfer of labour from agriculture to non-agriculture is associated with higher productivity. The coefficient of capital formation (z_ln_capital) remains significantly above zero, at 0.528 (p = 0.000), implying a positive association. The coefficient on agriculture's exports (z_ln_export) remains -0.056 (p = 0.705), as in previous models, and is statistically insignificant. In general, the regression reveals strong explanatory power ($R^2 = 0.946$). The direction and significance of the coefficients are exactly the same as in the base regression, thus showing the strong robustness of the findings.

Table 5 displays the results.

Table 5. Cross-country heterogeneity analysis results

Variable	C Coef	C SE	C p	KZ Coef	KZ SE	KZ p
ln_digi	0.4211	0.077	0.001***	-0.4826	0.252	0.092*
ln_employ	-1.4761	0.235	0.000***	-1.6000	0.176	0.000***
ln_capital	0.2038	0.298	0.514	-0.4142	0.204	0.077*
ln_export	0.1096	0.100	0.305	-0.0354	0.038	0.377
_cons	11.0035	0.868	0.000***	16.6035	1.784	0.000***
R^2	0.9975	—	—	0.9907	—	—
*** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors reported, Obs = 13.						

Note: compiled by the authors

To investigate the different influences of digital infrastructure on agricultural productivity across countries, we employed Ordinary Least Squares (OLS) estimation on the samples from China and Kazakhstan separately. For China, the estimate of digital infrastructure (ln_digi) is 0.421 (p = 0.001), which holds at the 1% mark and suggests that digital infrastructure is positively related to agricultural productivity. This may be explained by the increased accessibility of agricultural finance and the efficiency of information, which, in turn, enhances productivity in the agricultural sector.

In the case of Kazakhstan, the coefficient on digital infrastructure is -0.483 (p = 0.092), significant only at the 10% level and indicating that it is not yet a sufficiently strong and stable influence on ag-

ricultural productivity. This implies that the foundation of digital infrastructure in Kazakhstan remains weak, while the relatively low level of informatisation of agriculture has not been sufficient to translate digital infrastructure into a factor tending to increase productivity.

The results here indicate that the role of digital infrastructure in agricultural productivity shows a clear cross-country heterogeneity. China's more developed digital infrastructure system is associated with higher agricultural efficiency, while Kazakhstan is still in the early stages of digital transformation. These results indicate cross-country differences in the relationship between digital infrastructure and agricultural productivity and provide a basis for further discussion. However, given the small subsample size for each country, the country-specific estimates should be interpreted cautiously, particularly in the case of Kazakhstan, where the statistical significance is weak.

This chapter examines the impact of digital infrastructure on agricultural productivity in China and Kazakhstan, using balanced panel data from 2011 to 2023. The results of the main regression analysis show that digital infrastructure has a positive relationship with agricultural productivity and highlights its important role in improving the efficiency of the agricultural sector. Data reliability checks, variable normalisation, and the exclusion of pandemic years support the reliability and consistency of these results. The heterogeneity test reveals that while digital infrastructure is positively related to agricultural productivity in China, the effect in Kazakhstan is insignificant or slightly negative. This may be related to differences in development stages between the two countries in terms of digital infrastructure, financial inclusion and agricultural informatisation. In conclusion, the results suggest a positive relationship between digital infrastructure and agricultural productivity, while also indicating cross-country differences in digital development patterns. These empirical results provide a basis for further discussion of policy implications and development recommendations in the following chapter.

DISCUSSION

The empirical results suggest that improvements in digital infrastructure are positively related to agricultural productivity. The regression coefficient for the digital infrastructure variable in the benchmark regression model is 0.7626, statistically significant at the 1% level ($p = 0.000$). This indicates a positive association between digital infrastructure development and agricultural production efficiency. The robustness tests also support this pattern. The regression excluding the pandemic years of 2020 and 2021 (coefficient = 0.7436, $p = 0.000$) produces results similar to the benchmark model. The regression using standardised variables (coefficient = 0.583, $p = 0.000$) also yields comparable coefficient signs and significance levels. These findings support the robustness of the positive relationship between digital infrastructure and agricultural productivity across different model specifications. In general, digital infrastructure is consistently associated with agricultural productivity in the estimated models, providing a basis for further comparative analysis of cross-national differences.

Beyond digital infrastructure, other variables are also statistically significant in relation to agricultural productivity. The agricultural employment variable exhibits a significant negative coefficient in the overall models ($p = 0.000$), suggesting that a lower share of agricultural employment is associated with higher agricultural labour productivity. This pattern is consistent with structural transformation, where labour reallocation may coincide with improvements in average labour efficiency. The capital formation variable is significantly positive in all models ($p \leq 0.001$), indicating a positive association between capital accumulation and agricultural productivity. This may reflect the role of investment in mechanisation and agricultural infrastructure. In contrast, the coefficient of agricultural exports is negative and statistically insignificant ($p \geq 0.70$), suggesting that short-term fluctuations in agricultural exports are not systematically related to agricultural productivity in the sample. Overall, labour structure and capital accumulation appear more closely associated with agricultural productivity than with export performance.

The heterogeneous regression results indicate cross-country differences in the relationship between digital infrastructure and agricultural productivity. In the Chinese sample, the coefficient of digital infrastructure is 0.4211 and statistically significant at the 1% level ($p = 0.001$), suggesting a positive association between digital infrastructure and agricultural productivity. In contrast, for Kazakhstan, the coefficient of digital infrastructure is

-0.4826 and weakly significant at the 10% level ($p = 0.092$). Given the small subsample size, this estimate should be interpreted with caution. The results do not provide robust evidence of a positive relationship between digital infrastructure and agricultural productivity in Kazakhstan during the sample period.

The coefficients of agricultural employment, capital formation, and agricultural exports display broadly similar patterns across the two countries. In both samples, labour structure and capital accumulation are more consistently associated with agricultural productivity than export performance. However, given the limited sample size, these associations should be interpreted cautiously. Overall, digital infrastructure development appears more advanced in China and is positively associated with agricultural productivity in the Chinese sample.

CONCLUSION

This study conducts a systematic empirical analysis of the relationship between digital infrastructure and agricultural productivity using balanced panel data from China and Kazakhstan during 2011–2023. The empirical results indicate that the main research objectives have been addressed. Digital infrastructure is positively and statistically significantly associated with agricultural productivity in the pooled sample (coefficient = 0.76, $p < 0.01$). This association remains statistically significant after excluding the pandemic years (coefficient = 0.74, $p < 0.01$), suggesting that the results are robust across model specifications. The heterogeneity analysis indicates cross-country differences. In the Chinese sample, digital infrastructure is positively and significantly associated with agricultural productivity (coefficient = 0.42, $p < 0.01$). In contrast, the estimate for Kazakhstan is negative and weakly significant (coefficient = -0.48, $p = 0.09$). Given the limited subsample size, this result should be interpreted cautiously and does not provide robust evidence of a positive relationship in Kazakhstan during the sample period. Overall, the findings suggest a positive association between digital infrastructure and agricultural productivity in the pooled analysis, while also indicating cross-country differences in the estimated relationships.

At the policy level, the findings suggest that continued improvement in rural digital infrastructure may be associated with higher agricultural productivity. For China, this implies the importance of further enhancing digital connectivity in rural areas, strengthening broadband coverage, and improving the integration between digital platforms and agricultural information systems. Ensuring stable and secure digital networks may help sustain the observed positive association within the current institutional framework. For Kazakhstan and other Central Asian countries, the results indicate that strengthening basic digital infrastructure—such as expanding internet access and improving digital connectivity in rural regions—may be a prerequisite for realizing potential productivity gains. Given the limited empirical evidence in the Kazakh sample, policy measures should proceed cautiously and focus on foundational digital development before expecting measurable productivity improvements. More broadly, cross-country cooperation in digital infrastructure standards, data governance, and connectivity frameworks may facilitate knowledge exchange and gradual digital integration in the agricultural sector.

Future research could proceed in at least two directions. First, microdata from agricultural surveys or firm-level panel datasets can be integrated to explore potential mechanisms in the relationship between digital infrastructure and agricultural productivity. This will allow us to more closely examine potential transmission channels. Second, nonlinear specifications and spatial econometric models can be used to examine whether the relationship between digital infrastructure and agricultural productivity varies across regions and levels of development. These methods can help to better understand the heterogeneity and contextual variation in digital development and agricultural outcomes.

AUTHOR CONTRIBUTIONS

Conceptualization and theory: YS, DR and ZC; research design: ZC and NZ; data collection: YS, DR, ZC and NZ; analysis and interpretation: YS, DR, ZC and NZ; writing draft preparation: YS, DR and NZ; supervision: NZ; correction of article: YS, DR and ZC; proofread and final approval of article: YS, ZC and NZ. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Aker, J. C., & Fafchamps, M. (2015). Mobile phone coverage and producer markets: Evidence from West

Africa. *World Bank Economic Review, 29*(2), 262–292. https://doi.org/10.1596/1813-9450-6986

Aldashev, A., & Batkeyev, B. (2021). Broadband infrastructure and economic growth in rural areas. *Information Economics and Policy, 57,* 100936. https://doi.org/10.1016/J.INFOECOPOL.2021.100936

Bai, Y., Wang, R. Y., & Jayakar, K. (2022). What $2.5 billion can buy: The effect of the Broadband Initiatives Program on farm productivity. *Telecommunications Policy*, *46*(7), 102404. https://doi.org/10.1016/j.telpol.2022.102404

Bekbossinova, A., & Doszhan, R. (2025). The impact of digitalization and investment on agricultural development in Kazakhstan. Eurasian Journal of Economic and Business Studies, 69(1), 81–96. https://doi.org/10.47703/ejebs.v69i1.474

Bocean, C. G. (2024). A cross-sectional analysis of the relationship between digital technology use and agricultural productivity in EU countries. Agriculture, 14(4), 519. https://doi.org/10.3390/agriculture14040519

Deng, X., Peng, J., & Wan, C. (2024). The impact of internet use on land productivity: Evidence from China land economy survey. *Land, 13*(2), 262. https://doi.org/10.3390/land13020262

Gaysina, S.N., Chulanova, Z.K., & Dzhumashev, N.M. (2023). Socio-Economic Risks of Internal Migration Processes and Their Impact on the Socio-Territorial Mobility of the Population of Kazakhstan. *Economy: strategy and practice, 18*(3), 174-188, https://doi.org/10.51176/1997-9967-2023-3-174-188

Gollin, D. (2023). Agricultural productivity and structural transformation: Evidence and questions for African development. *Oxford Development Studies, 51*(4), 375–396. https://doi.org/10.1080/13600818.2023.2280638

Greenstein, S. (2021). *Digital infrastructure.* In E. L. Glaeser & J. M. Poterba (Eds.), Economic analysis and infrastructure investment (pp. 409–447). University of Chicago Press.

He, X., Liu, Y., Wang, H., & Zhou, L. (2025). Digital inclusive finance and agricultural green efficiency: Evidence from provincial panel data in China. Frontiers in Sustainable Food Systems, 9, 1448550. https://doi.org/10.3389/fsufs.2025.1695589

Hjort, J., & Poulsen, J. (2019). The arrival of fast internet and employment in Africa. American Economic Review, 109(3), 1032–1079. *https://doi.org/10.1257/aer.20161385*

International Telecommunication Union. (2022). Measuring digital development: Facts and figures 2022. ITU Publications.

Kushzhanov, N. V., & Aliyev, U. Z. (2018). Digital transformation of Kazakhstan: To what extent is the country ready to embrace it? News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Social and Human Sciences, 11, 11–18.

Li, X., Xiong, H., Hao, J., & Li, G. (2024). Impacts of internet access and use on grain productivity: Evidence from Central China. Humanities and Social Sciences Communications, 11, 1–9.

LoPiccalo, K. (2021). Impact of broadband penetration on U.S. farm productivity. SSRN Electronic Journal.

Macours, K. (2019). Farmers' demand and the traits and diffusion of agricultural innovations in developing countries. Annual Review of Resource Economics, 11, 483–499. https://doi.org/10.1146/annurev-resource-100518-094045

Qiubo, Z., Junfei, B., Chao, P., & Chen, Z. (2020). Do ICTs boost agricultural productivity? *China Economist, 15*(6), 9–26.

Organisation for Economic Co-operation and Development. (2019). Digital infrastructureand financial system risks. OECD.

Oyelami, L. O., Sofoluwe, N. A., & Ajeigbe, O. M. (2022). ICT and agricultural sector performance: Empirical evidence from sub-Saharan Africa. *Future Business Journal, 8*(1), 18.

Patel, R., Kumar, S., & Adams, K. (2025). Digitalisation and agricultural sustainability: A cross-country perspective. Sustainability, 17(9), 9676. https://doi.org/10.3389/fenvs.2024.1375193

Rahman, M. M., & Mamun, S. A. K. (2017). The effects of telephone infrastructure on farmers' agricultural outputs in China. *Information Economics and Policy, 41*, 88–95. https://doi.org/10.3390/foods11101389

Rajkhowa, P., & Baumüller, H. (2024). Assessing the potential of ICT to increase land and labour productivity in agriculture: Global and regional perspectives. *Journal of Agricultural Economics, 75*(2), 477–503. https://doi.org/10.1111/1477-9552.12566

Suroso, A. I., Fahmi, I., & Tandra, H. (2022). The role of internet on agricultural sector performance in global world. *Sustainability, 14*(19), 12266. https://doi.org/10.3390/su141912266

Wang, L., & Cai, Y. (2025). The impact of digital economy on agricultural green total factor productivity: Evidence from the quasi-natural experiment of the "Broadband China" strategy. *Frontiers in Sustainable Food Systems, 9*, 1607567. https://doi.org/10.3389/fsufs.2025.1607567

Zhao, Y., Yang, C., & Khan, S. (2025). The impact of new digital infrastructure on agricultural green development: Evidence from China. *Frontiers in Environmental Economics, 4*, 1525531. https://doi.org/10.3389/frevc.2025.1525531

Information about the authors

Yawen Sun – PhD Student, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: sunyawen2024@gmail.com, ORCID ID: https://orcid.org/0009-0002-1544-7529

Nursaule Zh. Brimbetova – Cand. Sc. (Econ.), Leading Researcher, Institute of Economics CS MSHE RK, Almaty, Kazakhstan, email: nbrimbetova@mail.ru, ORCID ID: https://orcid.org/0000-0001-5009-8534

***Zaure K. Chulanova** – Cand. Sc. (Econ.), Leading Researcher, Institute of Economics CS MSHE RK, Almaty, Kazakhstan, email: chulanova.zaure@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-9333-7582

Dinara Zh. Rakhmatullayeva – PhD, Lund University, Department of Sociology of Law, Lund, Sweden, Al-Farabi Kazakh National University, Almaty, Kazakhstan, email: dinara.rakhmatullayeva@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-6532-1652

Авторлар туралы мәліметтер

Сунь Я. – PhD докторанты, Әл-Фараби атындағы Қазақ ұлттық университеті, Экономика және бизнес жоғары мектебі, email: sunyawen2024@gmail.com, ORCID ID: https://orcid.org/0009-0002-1544-7529

Бримбетова Н.Ж. – э.ғ.к., жетекші ғылыми қызметкер, ҚР ҒЖБМ ҒК Экономика институты, Алматы, Қазақстан, email: nbrimbetova@mail.ru, ORCID ID: https://orcid.org/0000-0001-5009-8534

***Чуланова З.К.** – э.ғ.к., жетекші ғылыми қызметкер, ҚР ҒЖБМ ҒК Экономика институты, Алматы, Қазақстан, email: chulanova.zaure@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-9333-7582

Рахматуллаева Д.Ж. – PhD, Лунд университеті, Құқық әлеуметтануы кафедрасы, Лунд, Швеция; Әл-Фараби атындағы Қазақ ұлттық университеті, Экономика және бизнес жоғары мектебі, Алматы, Қазақстан, email: dinara.rakhmatullayeva@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-6532-1652

Сведения об авторах

Сунь Я. – PhD докторант, Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан, email: sunyawen2024@gmail.com, ORCID ID: https://orcid.org/0009-0002-1544-7529

Бримбетова Н.Ж. – к.э.н., ведущий научный сотрудник, Институт экономики КН МНВО РК, Алматы, Казахстан, email: nbrimbetova@mail.ru, ORCID ID: https://orcid.org/0000-0001-5009-8534

***Чуланова З.К.** – к.э.н., ведущий научный сотрудник, Институт экономики КН МНВО РК, Алматы, Казахстан, email: chulanova.zaure@ieconom.kz, ORCID ID: https://orcid.org/0000-0001-9333-7582

Рахматуллаева Д.Ж. – PhD, Лундский университет, кафедра социологии права, Лунд, Швеция, Казахский национальный университет им. Аль-Фараби, Алматы, Казахстан, email: dinara.rakhmatullayeva@kaznu.kz, ORCID ID: https://orcid.org/0000-0002-6532-1652

Rules for authors

All manuscripts are accepted on-line through the personal account of the author on the website of the journal https://esp.ieconom.kz.

Manuscript submission rules:

Research paper should contain 3000 - 5000 words, review papers - 5000 - 7000 words, including figures and tables and excluding abstract and references.

Title page is being generated when user/author is registering and submitting a manuscript through the web-site. The title page contains: UDC and JEL codes, heading, abstract, keywords, authors details, source of research funding, acknowledgement.

Main body of a manuscript is uploaded as a separate file through the web-site. The main body should include: Heading, Introduction (with the relevance and purpose of the study), Literature review (in some cases, may be in the Introduction), Methodology (for empirical research), Results and discussion, Conclusions. If necessary, additional special sections as well as subsections are allowed.

References. At least 10 relevant references. DOI of the cited source is preferable. Each source should be referenced in the manuscript. Anonymous sources (decrees, laws, etc.) should not be included in references, but should be indicated in the text or in-line footnotes.

IMPORTANT: Reference is an indicator of the author's scientific horizons. Quality of citations indicates awareness of scientific achievements in the world, as well as deep knowledge of a topic. Sources published over the last 5-10 years are preferable.

Авторларға арналған ақпарат

Барлық мақалалар автордың жеке кабинеті арқылы https://esp.ieconom.kz журналдың сайтында қабылданады.

Мақала туралы мәлімет:

Зерттеу мақалалары - 3000 - 5000 сөз, Шолу мақалалары – 5000 - 7000 сөз, суреттер мен кестелердің мазмұнымен қоса (түйін және дереккөздер тізімін қоспағанда)

Т*итул парағы* автор тіркеліп, мақала сайт арқылы жіберілген кезде жасалады. Титул парағы енетін: ӘОЖ және JEL кодтары, тақырып, түйін, түйін сөздер, авторлар туралы ақпарат, зерттеуді қаржыландыру көзі, алғыс сөз қамтылады.

Мақаланың негізгі мәтіні сайт арқылы жеке файл ретінде жүктеледі.

Негізгі мәтінде: Мақаланың атауы, Кіріспе (зерттеудің өзектілігі мен мақсатын сипаттай отырып), әдеби шолу (кейбір жағдайларда Кіріспеде көрсетілуі мүмкін), Әдіснама (эмпирикалық зерттеу жағдайында), Нәтижелер мен талқылау, Қорытындылар болуы тиіс.

Дереккөздер тізімі. Кем дегенде 20 өзекті дереккөз, келтірілген дереккөздің DOI көрсету қажет. Мақала мәтінінде әр дереккөзге сілтеме жасалуы керек. Анонимді дереккөздер (жарлықтар, заңдар) сілтемелер тізіміне енгізілмеуі керек, бірақ олар мәтінде немесе парқшаның астында келтірілетін ескертуде келтірілуі қажет.

МАҢЫЗДЫ: Дереккөздер тізімі - автордың ғылыми ой-өрісінің көрсеткіші. Әдебиеттер тізіміндегі шетелдік дереккөздердің саны ғылымның жетістіктерінен хабардар болуды, сонымен қатар тақырып бойынша біліктілігін көрсетеді. Соңғы 5-10 жыл ішінде жарияланған дереккөздер болуы қажет.

Информация для авторов

Все статьи принимаются on-line на сайте журнала https://esp.ieconom.kz через личный кабинет автора.

Требования к статье:

Исследовательская статья – 3000 - 5000 слов, Обзорная статья - 5000 - 7000 слов, включая содержание рисунков и таблиц (без учета абстракта и списка источников)

Титульная страница генерируется при регистрации автора и подаче статьи через сайт. Титульный лист содержит: коды УДК и JEL, заголовок, абстракт, ключевые слова, сведения об авторах, источник финансирования исследования, благодарность

Основной текст статьи загружается отдельным файлом через сайт.

*Основной текст статьи д*олжен содержать: Название статьи, Введение (с описанием актуальности и цели исследования), Литературный обзор (в некоторых случаях может быть отражен во Введении), Методология (в случае эмпирического исследования), Результаты и обсуждение, Выводы, Список источников (на языке оригинала и латинице).

Список источников. Не менее 20 актуальных источников, требуется приводить DOI цитируемого источника. На каждый источник должна быть ссылка в тексте статьи. Анонимные источники (ссылки на постановления, законы и т.д.) не включать в списки литературы, а ссылаться на них в тексте, либо делать внутритекстовые сноски.

ВАЖНО: Список источников – это индикатор научного кругозора автора. Количество иностранных источников в списке литературы свидетельствует об осведомленности о достижениях науки, а также владении темой. Рекомендуется использовать источники, изданные в течение последних 5-10 лет

Оформление и верстка *Г.Д. Жадыранова*

Подписано в печать 30.03.2026 г.
Формат 60x84 1/8
усл. п.л. 8,0
Тираж 500 экз.
Цена договорная

Издано КИЦ Института экономики
Комитета науки
Министерства науки и высшего образования
Республики Казахстан

050010, г. Алматы, ул. Курмангазы, 29
тел. 8(727)261-01-78