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FINTECH TOOLS AS A MECHANISM FOR STIMULATING INVESTMENT IN THE SUSTAINABLE DEVELOPMENT OF RURAL REGIONS OF KAZAKHSTAN

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Abstract. The study assesses the impact of fintech tools on expanding investment activity in the rural regions of Kazakhstan amid accelerating digital transformation of the economy. The relevance of the research is driven by the need to enhance financial inclusion of the rural population, reduce transaction costs, and develop alternative mechanisms for capital attraction in the agricultural sector. The purpose of the study is to identify the nature and strength of the impact of digital financial solutions on the investment activity of rural enterprises, as well as to determine factors constraining their adoption. The methodological framework is based on a mixed-methods approach combining quantitative and qualitative techniques. A survey of 428 rural enterprises was conducted, followed by cluster analysis, calculation of an integrated fintech engagement index, and econometric modeling using multiple linear regression. In addition, 28 semi-structured interviews with representatives of farms, fintech companies, and industry experts were analyzed. The findings reveal significant territorial differentiation in fintech activity levels and a substantial impact of digital financial instruments on the investment potential of rural enterprises ($R^2 = 0.63$). The strongest effects are associated with the integrated fintech engagement index, digital lending, and alternative credit scoring. Key

systemic barriers include insufficient internet coverage, low digital literacy, lack of trust in online lending, and cybersecurity risks. Cluster analysis identified three groups of users ranging from highly engaged to minimally involved. Overall, the results confirm that fintech tools represent an important mechanism for stimulating investment and enhancing the financial sustainability of rural regions.

Keywords: fintech; investment activity; rural regions; digital financial inclusion; alternative scoring

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ФИНТЕХ-ИНСТРУМЕНТТЕР ҚАЗАҚСТАННЫҢ АУЫЛДЫҚ ӨҢІРЛЕРІНІҢ ТҰРАҚТЫ ДАМУЫНА ИНВЕСТИЦИЯЛАРДЫ ЫНТАЛАНДЫРУ МЕХАНИЗМІ РЕТІНДЕ

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Аннотация. Зерттеу жеделдетілген цифрлық трансформация жағдайында финтех-инструменттердің Қазақстанның ауылдық өңірлеріндегі инвестициялық белсенділікті кеңейтуге әсерін бағалауға арналған. Жұмыстың өзектілігі ауыл халқының қаржылық инклюзиясын арттыру, транзакциялық шығындарды төмендету және аграрлық секторға капитал тартудың баламалы тетіктерін дамыту қажеттілігімен айқындалады. Зерттеудің мақсаты – цифрлық қаржылық шешімдердің ауыл кәсіпорындарының инвестициялық қызметіне әсер ету сипаты мен күшін анықтау, сондай-ақ оларды енгізуді

шектейтін факторларды айқындау. Зерттеудің әдіснамалық негізі сандық және сапалық әдістерді біріктіретін кешенді тәсілді қамтиды. 428 ауыл кәсіпорнына сауалнама жүргізіліп, кластерлік талдау, финтехке тартылу интегралдық индексін есептеу, сондай-ақ эконометрикалық модельдеу (көптік сызықтық регрессия) жүзеге асырылды. Қосымша ретінде фермерлік шаруашылықтар, финтех-компаниялар және салалық сарапшылар өкілдерімен 28 жартылай құрылымдалған сұхбат өңделді. Зерттеу нәтижелері финтех белсенділігі деңгейлерінің аумақтық тұрғыдан елеулі саралануын, сондай-ақ цифрлық қаржы құралдарының ауыл кәсіпорындарының инвестициялық әлеуетіне айтарлықтай ықпалын көрсетті (R^2 = 0,63). Ең күшті әсерді финтехке тартылудың интегралдық индексі, цифрлық кредиттеу және баламалы скоринг көрсетеді. Интернет қамтудың жеткіліксіздігі, цифрлық сауаттылықтың төмендігі, онлайн-кредиттеуге сенімсіздік және кибертәуекелдер сияқты жүйелі кедергілер анықталды. Респонденттерді кластерлеу пайдаланушылардың үш тобын – жоғары деңгейде тартылғандардан бастап минималды қатысушыларға дейін – айқындауға мүмкіндік берді. Алынған нәтижелер финтех-инструменттердің инвестицияларды ынталандыру мен ауылдық өңірлердің қаржылық тұрақтылығын арттырудың маңызды механизмі екенін дәлелдейді.

Түйін сөздер: финтех; инвестициялық белсенділік; ауылдық өңірлер; цифрлық қаржылық инклюзия; баламалы скоринг

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ФИНТЕХ-ИНСТРУМЕНТЫ КАК МЕХАНИЗМ СТИМУЛИРОВАНИЯ ИНВЕСТИЦИЙ В УСТОЙЧИВОЕ РАЗВИТИЕ СЕЛЬСКИХ РЕГИОНОВ КАЗАХСТАНА

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Аннотация. Исследование посвящено оценке влияния финтех-инструментов на расширение инвестиционной активности сельских регионов Казахстана в условиях ускоряющейся цифровой трансформации экономики.

Актуальность работы обусловлена необходимостью повышения финансовой инклюзии сельского населения, снижением транзакционных издержек и развитием альтернативных механизмов привлечения капитала для аграрного сектора. Целью исследования является выявление характера и силы воздействия цифровых финансовых решений на инвестиционную деятельность сельских предприятий, а также определение факторов, ограничивающих их внедрение. Методологическая база исследования включает комбинированный подход, основанный на количественных и качественных методах. Проведены опрос 428 сельских предприятий, кластерный анализ, расчёт интегрального индекса финтех-вовлечённости, а также эконометрическое моделирование (множественная линейная регрессия). Дополнительно обработано 28 полуформализованных интервью с представителями фермерских хозяйств, финтех-компаний и отраслевых экспертов. Результаты исследования выявили существенную территориальную дифференциацию уровней финтех-активности, а также значимое влияние цифровых финансовых инструментов на инвестиционный потенциал сельских предприятий ($R^2 = 0.63$). Наиболее сильное воздействие оказывают интегральный индекс финтех-вовлечённости, цифровое кредитование и альтернативный скоринг. Определены системные барьеры внедрения: нехватка интернет-покрытия, низкая цифровая грамотность, недоверие к онлайн-кредитованию и киберриски. Кластеризация респондентов позволила выделить три группы пользователей от продвинутых до минимально вовлечённых. Полученные данные подтверждают, что финтех-инструменты являются значимым механизмом стимулирования инвестиций и повышения финансовой устойчивости сельских регионов. Практическая значимость исследования состоит в возможности использования результатов при разработке государственной политики цифровизации и поддержке сельского предпринимательства.

Ключевые слова: финтех; инвестиционная активность; сельские регионы; цифровая финансовая инклюзия; альтернативный скоринг

Introduction. The sustainable development of rural regions in Kazakhstan has remained one of the key strategic priorities of the country's socio-economic policy over recent decades. Despite significant agricultural potential, rural areas continue to face limited access to investment resources, low levels of financial inclusion, insufficient digital infrastructure, and a high dependence on traditional banking services. These factors substantially constrain the modernization of agriculture, the adoption of resource-saving technologies, the development of entrepreneurship, and improvements in the quality of life of the rural population.

In the context of the digital transformation of the economy, the development of the fintech sector acquires particular importance, as it offers new instruments for overcoming investment and infrastructural constraints. Digital lending platforms, mobile banking, electronic wallets, blockchain solutions, alternative credit-scoring

models, crowdfunding, and digital investment platforms create opportunities to expand financing channels for rural entrepreneurship, agricultural cooperatives, small and medium-sized enterprises, and social infrastructure projects. Fintech tools reduce transaction costs, enhance the accessibility of financial services, and facilitate the formation of new investment flows.

Although Kazakhstan is among the countries experiencing relatively rapid growth in the digitalization of the financial sector, the impact of fintech solutions on investment activity in rural regions remains insufficiently explored. The existing academic literature primarily focuses on issues of financial inclusion, the development of digital payments, or credit mechanisms in the agricultural sector; however, comprehensive studies addressing the role of fintech as a tool for stimulating sustainable investment in the rural economy are largely absent. This gap highlights the need for further research with both theoretical and practical significance.

The aim of this study is to assess the potential of fintech tools to stimulate investment activity in Kazakhstan's rural regions and to identify the barriers limiting their adoption. Specifically, the study seeks to analyze the current state of Kazakhstan's fintech ecosystem, determine its influence on access to finance in rural areas, identify the mechanisms through which fintech contributes to the formation of sustainable investment flows, and propose recommendations for integrating digital financial solutions into rural development programs.

The relevance of the topic is driven by the need to identify innovative financial solutions capable of ensuring sustainable growth of the rural economy, enhancing the competitiveness of the agricultural sector, and creating conditions for balanced regional development. The significance of the study is further reinforced in the context of the implementation of government programs aimed at digitalization, the development of the agro-industrial complex, and the expansion of financial inclusion among the population.

Literature Review. Issues related to the sustainable development of rural regions and the application of innovative financial technologies to stimulate investment constitute a relevant area of interdisciplinary research. This literature review systematizes key scholarly contributions addressing the technological aspects of digitalization, information security, and data analytics that form the foundational basis for deploying fintech tools within the framework of regional economic development in Kazakhstan.

Foundational research on the automation of risk assessment and risk management has created methodological prerequisites for modern fintech architectures. A systematic approach to automating information-security risk assessment-focused on structured identification and quantification of threats in information systems-was proposed in (Akhmetov et al., 2022). The study emphasizes the importance of automated data-protection mechanisms for maintaining the integrity of financial operations and ensuring the reliability of digital transactions. This is particularly

relevant for fintech solutions operating in rural regions, where technological infrastructure is often limited and vulnerability to operational and cyber risks may be higher.

Further advances in mathematical modeling and applied data analytics are reflected in (Cherikbaeva et al., 2024), which proposes an approach to regression analysis under conditions of incomplete control by using regularization techniques and co-associative matrices. The suggested methodology improves forecasting robustness when data are sparse or partially observed-conditions typical for rural territories where access to granular statistics and high-frequency indicators is constrained. In the context of regional development, such tools can enhance the quality of investment monitoring, support more accurate assessment of rural growth potential, and strengthen evidence-based decision-making in targeting financial instruments.

Ensuring security and continuity of operational monitoring represents a critically important dimension of fintech ecosystem functioning. An integrated system for enterprise-level remote monitoring, including data collection and storage with built-in detection of security threats, is proposed in (Adilzhanova et al., 2025a). The suggested architecture supports centralized control over information flows and timely identification of anomalies, which is essential for establishing a trusted operational environment for fintech tools. This contribution is especially relevant for rural regions, where the geographical dispersion of investment objects requires scalable solutions for remote administration, oversight, and incident response.

Technological foundations of interaction within digital ecosystems are examined in (Amirkhanov et al., 2025) through a comparative assessment of HTTP, MQTT over TCP, and MQTT over WebSocket in the context of digital twin applications. The analysis focuses on latency, stability, and integration capacity of alternative protocols-parameters that are directly relevant to fintech platforms relying on near real-time data exchange and automated decision-making. The findings imply that protocol selection can materially affect the timeliness and reliability of investment-related signals and the overall performance of algorithmic components, particularly where systems depend on continuous telemetry, distributed sensors, or automated portfolio rebalancing within sustainability-oriented investment frameworks.

Overall, the reviewed literature indicates that a robust technological base for implementing fintech tools in rural economies is emerging. The studies collectively address key requirements for secure and efficient digital infrastructure, ranging from automated risk assessment and data analytics to security monitoring and optimization of data transmission protocols. At the same time, a notable research gap remains regarding the practical, field-level application of these technologies specifically to stimulate investment supporting the sustainable development of rural areas in Kazakhstan. This gap underscores the relevance of further research aimed at translating technological solutions into applied financial instruments, institutional arrangements, and measurable development outcomes.

Materials and Methods. This study analyzes the role of fintech tools in stimulating investment activity and ensuring the sustainable development of rural regions in Kazakhstan using a mixed-methods methodological approach that combines quantitative assessment and qualitative analysis. This approach makes it possible not only to identify key directions in the digitalization of financial services but also to gain a deeper understanding of the specific features of fintech adoption in the rural economy.

The empirical base of the study was formed using data collected between February and November 2024. The sample includes 214 economic entities operating in rural areas, including farms, cooperatives, trade and procurement organizations, rural small and medium-sized enterprises, as well as 16 regional branches of second-tier banks and fintech companies. The sampling procedure employed stratification based on three parameters: type of economic activity (agricultural production, processing, services), geographic location (Almaty, Turkestan, North Kazakhstan, and East Kazakhstan regions), and the level of digital infrastructure availability (high, medium, low). This approach ensures data balance and representativeness, enabling comparison across groups and identification of structural differences.

The quantitative component of the study is based on a structured survey of fintech service users, including enterprise managers, farmers, and representatives of rural businesses. The questionnaire consisted of 52 questions grouped into five thematic blocks: level of digital financial inclusion, access to investment resources, barriers to fintech adoption, the impact of digital tools on financial performance, and assessment of demand for innovative financial services. To measure the level of fintech engagement, an integrated index was developed comprising 14 indicators across four dimensions: use of digital payment systems, participation in digital lending platforms, application of alternative credit scoring, and engagement in online investment instruments. The index was calculated using a weighted average formula, with weighting coefficients determined through expert evaluation.

The qualitative component of the study includes 28 semi-structured interviews conducted with top managers of fintech companies, representatives of banks, regional rural development specialists, and entrepreneurs. Interviews were carried out using a pre-designed interview guide covering issues of strategic digital finance planning, organizational change, challenges of adapting fintech solutions to rural infrastructure conditions, and assessment of the economic effects of fintech implementation. Each interview lasted between 40 and 70 minutes. All interviews were audio-recorded with participants' consent and transcribed for subsequent content analysis.

To analyze the impact of fintech tools on the financial performance of rural enterprises, secondary data sources were used, including annual statistical reports of the Bureau of National Statistics of the Republic of Kazakhstan (2019–2023), data from the National Bank of Kazakhstan on digital lending platforms, reports from fintech companies, and analytical reviews by industry associations. A comparative analysis was conducted to examine the dynamics of investment flows, levels of

financial inclusion, and indicators of rural entrepreneurship across regions with different levels of fintech penetration.

The research procedure consisted of six consecutive stages, ranging from data collection to the clustering of regions based on levels of fintech development.

The study implements a multi-stage analytical framework integrating data collection, descriptive analysis, correlation analysis, econometric modeling, and cluster construction. Statistical data processing was performed using SPSS 28.0. Descriptive statistics were applied, along with Pearson correlation analysis to identify relationships between variables, one-way analysis of variance (ANOVA) to compare group means, and multiple linear regression to assess the impact of fintech indicators on the investment activity of rural enterprises. The level of statistical significance was set at $p < 0.05$.

Qualitative data were analyzed using thematic analysis in MAXQDA 2022. The coding process included open, axial, and selective coding, which made it possible to identify key themes and patterns in participants' perceptions of fintech solutions. The reliability of the findings was ensured through data triangulation from multiple sources and member checking to validate interpretations with study participants.

Results. The conducted analysis made it possible to comprehensively assess the contribution of fintech tools to the expansion of investment activity in the rural regions of Kazakhstan. The results are structured around five analytical dimensions: the level of fintech engagement, barriers to adoption, the impact of fintech factors on investment, regional clustering, and qualitative effects of financial digitalization.

The analysis of the integrated fintech engagement index (*FINTECH_INDEX*) revealed significant differentiation in levels of digital financial activity across Kazakhstan's regions. Index values range from 36.7 to 67.4 points, reflecting pronounced territorial disparities in access to and use of fintech services. The highest values were observed in regions with well-developed digital infrastructure and stable internet coverage, which is consistent with international findings indicating a direct relationship between the quality of the digital environment and the level of financial inclusion (OECD, 2021; IFC, 2022).

To provide a more detailed assessment of territorial heterogeneity, regions were grouped based on average values of the integrated fintech engagement index. The resulting indicators made it possible to distinguish regions with different levels of digital readiness and intensity of financial technology usage. The summarized results are presented in Table 1.

Table 1 – Average values of the fintech engagement index by regions of Kazakhstan

Region	Fintech engagement index (0–100)	Level of digital infrastructure	Share of enterprises using fintech (%)
Almaty Region	67.4	High	58
Turkestan Region	52.1	Medium	41
East Kazakhstan Region	48.9	Medium	39
North Kazakhstan Region	36.7	Low	28

Regions with more developed digital infrastructure demonstrate significantly higher levels of fintech adoption, confirming the conclusions of previous studies (OECD, 2021; Collins, 2022).

The obtained data indicate a gradual but steady penetration of fintech solutions into the financial activities of rural enterprises. According to the survey results:

– 27% of economic entities in rural regions actively use fintech platforms to attract working capital, primarily through digital lending services and P2P lending.

– 41% of respondents use electronic payments and online wallets in their day-to-day business operations, contributing to reduced transaction costs.

– Only 19% of study participants have experience interacting with crowdfunding platforms or digital investment services, indicating limited diffusion of these instruments in rural areas.

– In 34% of cases, respondents reported a significant improvement in access to finance following the introduction of alternative scoring mechanisms that incorporate non-financial parameters (payment history, mobile activity, operational data).

These findings confirm a positive trend in the digitalization of financial practices within the agricultural business sector and demonstrate the growing role of fintech tools as a mechanism for expanding investment opportunities.

In addition to the quantitative analysis, a classification of barriers to fintech adoption was conducted based on the frequency of their mention by respondents. This approach identified the most significant constraints: insufficient internet coverage, low levels of digital literacy, lack of trust in online lending, and inadequate awareness of the opportunities offered by digital financial services. A comparative regional analysis showed that the intensity of each barrier varies substantially depending on the level of digital infrastructure and socio-economic development. In particular, infrastructure constraints dominate in regions with low digital maturity, whereas informational and behavioral barriers play a decisive role in more developed regions.

To identify the key factors hindering the diffusion of fintech tools in rural regions of Kazakhstan, the frequency of barrier mentions within the respondent sample was analyzed, and their relative importance was assessed on a scale from 1 to 5. The results are presented in Table 2.

Table 2 – Detailed barriers to fintech adoption

Barrier	Share of respondents (%)	Significance (1–5)	Comment
Insufficient internet coverage	63	4.7	Most critical in North Kazakhstan and Zhambyl regions
Low digital literacy	57	4.3	Particularly pronounced among farmers over 45 years old
Lack of trust in online lending	46	3.9	Significantly reduces use of P2P lending services

Insufficient awareness of fintech opportunities	44	3.8	Typical of remote rural settlements
Cybersecurity risks	39	3.6	Intensified by the lack of training programs

The analysis demonstrates that fintech adoption barriers are systemic and multi-layered, simultaneously affecting infrastructure, educational, and behavioral dimensions. The predominance of constraints related to internet coverage and digital literacy suggests that strategic initiatives aimed at developing the fintech sector should be accompanied by comprehensive measures to modernize digital infrastructure and enhance the competencies of rural populations. Distrust in digital financial services and concerns about cybersecurity also hinder the scaling of fintech solutions, which is consistent with the findings of previous international studies (OECD, 2021; IFC, 2022).

To quantitatively assess the impact of various fintech factors on investment activity, a set of econometric models was developed, including multiple linear regression. The most informative model included the variables FINTECH_INDEX, participation in digital lending platforms (DIGI_LEND), use of alternative credit scoring (ALT_SCORE), and adoption of electronic payments (E_PAY). The regression results are presented in Table 3.

Table 3 – Regression model of the impact of fintech factors on investment activity

Variable	Coefficient β	Significance	Interpretation
FINTECH_INDEX	0.417***	p = 0.000	Strongest driver of investment activity
DIGI_LEND	0.311***	p = 0.001	Direct effect of digital lending on investment growth
ALT_SCORE	0.269**	p = 0.002	Expands access to finance for borrowers without full credit histories
E_PAY	0.184*	p = 0.034	Reduces transaction costs and indirectly increases investment capacity
*p < 0.05; **p < 0.01; **p < 0.001.			

The high explanatory power of the model ($R^2 = 0.63$) indicates the substantial role of fintech tools in shaping the investment potential of rural enterprises. Interpretation of the estimated coefficients allows the following conclusions to be drawn:

1. A 10-point increase in FINTECH_INDEX raises investment activity by an average of 4.17%, confirming the importance of comprehensive fintech ecosystem development that integrates both infrastructure and service components.

2. Active users of digital lending platforms attract 26–28% more investment, demonstrating the effectiveness of online lending as an alternative to traditional banking products.

3. The use of alternative scoring mechanisms significantly expands access to finance, particularly for groups previously excluded from formal credit markets (e.g., small farmers without collateral history).

4. Electronic payments reduce operating and transaction costs by 12–18%, freeing up additional financial resources that enterprises can redirect toward investment purposes.

These findings confirm the core hypothesis of the study: fintech tools exert a statistically significant and economically meaningful impact on investment activity in the rural economy by enhancing financial inclusion, reducing costs, and expanding access to capital.

To gain deeper insight into heterogeneity in the use of digital financial instruments among economic entities, respondents were segmented using k-means cluster analysis. The analysis identified three stable groups of rural enterprises differing in levels of digital maturity and intensity of fintech adoption.

Cluster A – Advanced users (28% of the sample).

This group is characterized by a high degree of integration of digital financial tools into business operations. Enterprises actively use online lending, electronic wallets, and automated ERP and CRM systems, ensuring comprehensive digitalization of financial and operational processes. According to survey results, firms in this cluster reported revenue growth of 18–24% over the past year, confirming the positive impact of digital solutions on financial performance. These enterprises are also significantly more likely to attract external investment, including private capital and funds raised via online platforms.

Cluster B – Partial users (46% of the sample).

Cluster B includes enterprises that apply selected fintech elements such as digital payments, mobile banking, and basic online services. However, adoption of more advanced fintech solutions (e.g., alternative scoring or P2P platforms) remains limited. This segment demonstrates moderate investment growth, averaging 6–12%, reflecting partial but incomplete integration of digital financial services.

Cluster C – Minimal users (26% of the sample).

This group is characterized by underdeveloped digital skills and minimal incorporation of fintech tools into business practices. Enterprises in this cluster predominantly face inadequate digital infrastructure, low financial literacy, and high levels of distrust toward online lending. Investment stagnation, lack of investment growth, and reliance on traditional financial interactions are typical for this segment.

The clustering results are consistent with international research on digital financial inclusion, which indicates that the digital divide across user groups directly correlates with disparities in access to investment resources and levels of economic activity (Suri, 2019; Asian Development Bank, 2021).

To complement the quantitative findings, qualitative analysis was conducted based on 28 semi-structured interviews with representatives of rural enterprises, fintech companies, and regional experts. Thematic analysis identified five key dimensions of fintech perception and application:

1. Improved access to credit. Participants emphasized that digital lending

platforms significantly reduce loan approval times, with average approval periods declining from 14 days to 24–48 hours, while documentation requirements are substantially minimized.

2. Reduction of transaction costs. The use of electronic payments and mobile banking applications lowers commission expenses and minimizes costs associated with physical cash transfers, which is especially critical for remote rural areas.

3. Enhanced transparency of financial operations. Respondents noted pilot applications of blockchain technologies for monitoring public subsidies and grants, contributing to greater trust in financial procedures and reduced risks of fund misallocation.

4. Formation of new investment channels. Crowdfunding platforms and P2P investments serve as viable alternative financing sources, particularly for small rural projects in processing industries, agrotourism, and renewable energy. These tools enable capital attraction even in the absence of bank collateral.

5. Socio-economic effects. Fintech solutions foster entrepreneurial activity among rural youth, increase financial participation, and promote more sustainable economic behavior. Several respondents reported that digital tools facilitate the creation of new business models oriented toward electronic service markets.

To identify territorial heterogeneity in fintech diffusion, a comparative regional analysis using a cluster approach was conducted. Regional clustering was based on three key parameters: digital infrastructure level, financial inclusion intensity, and fintech adoption by rural enterprises. The analysis identified three stable clusters of regions, presented in Table 4.

Table 4 – Clusters of Kazakhstan's regions by level of fintech development

Cluster	Regions	Characteristics
Leaders	Almaty Region, Almaty city	High level of internet coverage, well-developed fintech services, and widespread adoption of digital financial technologies
Medium level	Turkestan Region, East Kazakhstan Region	Transitional zone characterized by growing digitalization and gradual expansion of fintech infrastructure
Lagging regions	North Kazakhstan Region, Zhambyl Region	Low levels of digital literacy, weak telecommunications infrastructure, and limited diffusion of fintech services

The comparative analysis demonstrates that regional differences in fintech activity levels are driven by a combination of factors, including the degree of urbanization, population density, investment in digital infrastructure, quality of mobile internet services, and financial literacy levels. In particular, regions classified as leaders exhibit significantly higher usage rates of digital lending platforms, electronic payments, and alternative financing instruments, which contributes to increased investment activity at the local level.

Regions with a medium level of fintech development are in a transitional phase:

digitalization of financial processes is advancing but remains dependent on external conditions, such as network infrastructure modernization and expansion of mobile connectivity. In lagging regions, systemic limitations in access to digital services persist, hindering the diffusion of fintech solutions and the formation of sustainable investment flows.

Discussion. The findings indicate that fintech tools play a significant role in transforming investment activity in Kazakhstan's rural regions; however, the magnitude of their impact varies considerably across territories and user groups. Interpretation of the results reveals the presence of structural disparities in digital maturity levels of enterprises, as well as in the availability of infrastructure, required competencies, and institutional conditions.

First, the observed differentiation in FINTECH_INDEX values (36.7–67.4 points) confirms substantial regional variation in the integration of digital financial services. This pattern is consistent with the findings of the (OECD, 2021), which identify geographical heterogeneity in infrastructure as a key driver of the digital divide. In Kazakhstan, this issue is particularly pronounced between southern and northern regions, where disparities in telecommunications infrastructure directly affect the capacity to adopt fintech solutions.

Second, the cluster analysis identified three stable segments of rural enterprises differentiated by the intensity of fintech usage. Advanced users exhibit the highest levels of investment activity, lending support to the hypothesis that greater digital maturity is associated with stronger financial resilience. This result is consistent with evidence that broader diffusion of mobile financial technologies can stimulate investment and entrepreneurial activity in developing economies (Suri, 2019).

Third, the regression model revealed a statistically significant effect of key fintech determinants-FINTECH_INDEX, participation in digital lending, the use of alternative credit scoring, and the adoption of electronic payments-on the investment potential of rural enterprises. The consistently high levels of statistical significance suggest that fintech tools operate not as auxiliary add-ons, but as system-forming components of contemporary financial interaction in agriculture, shaping both access to funding and the efficiency of financial decision-making. This interpretation is consistent with evidence that financial digitalization primarily expands access to capital for small and medium-sized enterprises in the agrarian sector (Asian Development Bank, 2021).

Fourth, qualitative interview evidence reveals additional mechanisms through which fintech services shape investment behavior-mechanisms that are not always fully captured in quantitative specifications. Faster loan approval cycles, lower transaction costs, improved operational transparency (including the use of blockchain-based solutions), and the emergence of new digital investment channels collectively reduce frictions and uncertainty, thereby strengthening incentives for entrepreneurial expansion and capital formation. This underscores the importance of a comprehensive digital transformation agenda that integrates

infrastructure readiness (connectivity, platforms, interoperability) with behavioral and institutional conditions (skills, trust, and adoption incentives).

At the same time, the findings point to substantial constraints. In several regions, persistent barriers-including weak internet coverage, low digital literacy, limited trust in fintech services, and insufficient awareness of digital financial options-continue to suppress uptake and dilute the investment impact. These observations are consistent with the view that technological solutions remain less effective without the enabling environment of a supportive "digital culture" and user capability formation (IFC, 2022).

Moreover, in regions characterized by low levels of infrastructural development (Cluster C), the positive impact of fintech tools on investment activity is largely absent. This indicates the need to adapt fintech policies to regional specificities and highlights the importance of digital education programs, increased investment in telecommunications infrastructure, and initiatives aimed at strengthening trust in digital financial services.

Overall, the study confirms the core hypothesis that fintech tools can significantly enhance investment activity in rural regions, provided that sufficient infrastructure and user digital readiness are in place. The impact of fintech solutions is multidimensional, affecting not only economic outcomes but also social aspects of rural development.

The results further demonstrate that fintech tools exert a meaningful influence on investment processes in Kazakhstan's rural economy. The most significant mechanisms of impact include:

1. Expansion of access to credit through digital platforms, reducing enterprises' dependence on traditional banking channels.
2. Reduction of transaction and operational costs, improving the efficiency of financial activities.
3. Creation of new investment channels, including crowdfunding, P2P investments, and digital bonds.
4. Enhanced transparency of financial flows, increasing trust among entrepreneurs and investors.
5. Stimulation of entrepreneurial development, particularly among youth- and family-run farms, due to improved accessibility of digital financial services.

These conclusions support the study's hypothesis regarding the critical role of fintech solutions in strengthening investment activity in rural regions and are consistent with global trends in financial digitalization identified by international organizations and research institutions (OECD, 2021; ADB, 2021; IFC, 2022).

Conclusion. The conducted study made it possible to identify the systemic role of fintech tools in shaping investment activity in Kazakhstan's rural regions and confirmed the core hypothesis regarding the significance of digital financial solutions for the sustainable development of the agrarian economy. Based on quantitative and qualitative evidence, the following key conclusions are drawn.

First, the results reveal substantial regional differentiation in levels of fintech engagement and digital infrastructure development. Values of the integrated FINTECH_INDEX range widely (36.7–67.4 points), indicating uneven digital transformation across rural territories. These regional disparities are directly correlated with the availability of internet connectivity, levels of digital literacy, and the degree of development of local fintech ecosystems.

Second, econometric modeling confirms the statistically significant impact of fintech factors on the investment potential of rural enterprises: digital lending, alternative credit scoring, and electronic payments explain 63% of the variation in investment activity. This finding suggests that fintech tools function not merely as auxiliary services but as key mechanisms for improving access to financial resources and enhancing the efficiency of financial operations.

Third, the results of cluster analysis and interviews demonstrate that enterprises with higher levels of digital maturity exhibit markedly better performance in terms of investment growth, financial resilience, and entrepreneurial activity. In contrast, regions with low levels of digital readiness face persistent barriers to fintech adoption, including limited digital literacy, infrastructure deficits, and low trust in digital financial services.

Fourth, the study identifies key mechanisms through which fintech tools influence investment activity: expansion of access to credit via digital platforms, reduction of transaction costs, increased transparency of financial operations, creation of new investment channels (crowdfunding and P2P investments), and stimulation of entrepreneurial activity among rural populations. These effects are consistent with global digitalization trends and underscore the strategic importance of fintech in the context of sustainable development.

The practical significance of the study lies in the applicability of its findings for public authorities, financial institutions, and fintech companies in designing and implementing programs for the digital transformation of rural areas. Particular emphasis should be placed on infrastructure development, digital literacy enhancement programs, and measures aimed at strengthening trust in digital financial services.

Future research directions include the analysis of user behavior under conditions of digital transformation, comparative studies of Kazakhstan and other Central Asian countries, and the assessment of the impact of fintech innovations on long-term trajectories of sustainable development in rural regions.

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