

THE ROLE OF THE DIGITAL PLATFORM ECONOMY IN TRANSFORMING REGIONAL ENTREPRENEURSHIP AND EMPLOYMENT IN THE CONTEXT OF ACHIEVING SUSTAINABLE DEVELOPMENT GOALS



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ABSTRACT

The rapid expansion of digital platforms, financial technologies, mobile payments, and e-commerce has transformed entrepreneurship, employment, and regional economic development. As digitalization accelerates, understanding how platform economies contribute to sustainable development has become increasingly important, particularly in achieving the Sustainable Development Goals related to economic growth, innovation, and decent work. This study investigates the impact of digital platforms and digital financial technologies on regional entrepreneurship and employment in Kazakhstan and evaluates their contribution to sustainable development. The study employs annual time-series data for Kazakhstan covering the period 2014–2025, using indicators of internet penetration, digital literacy, cashless payments, mobile and QR payments, e-commerce, digital government services, and small and medium-sized enterprise (SME) activity. The methodological framework integrates economic-statistical analysis, comparative analysis, correlation and regression analysis, and the construction of an Integrated Digitalization Index (IDIG) to examine the relationships between digitalization and entrepreneurial development. The results reveal a strong positive association between digitalization and economic performance. The correlation coefficients between mobile payments and GDP, and between QR payments and GDP, were 0.954 and 0.936, respectively, while the regression model explained 91.9% of the variation in GDP ($R^2 = 0.919$). Mobile payment expansion showed a strong positive effect on GDP ($\beta = 161.453$), whereas the negative QR coefficient reflected statistical multicollinearity rather than an adverse economic effect. The IDIG increased from -1.56 in 2018 to 1.12 in 2025, while the number of active SMEs rose from 1.355 million to 2.176 million. These findings demonstrate that digital platforms and digital financial services are strongly associated with entrepreneurship growth, business digitalization, platform-based employment, and sustainable regional economic development in Kazakhstan.

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INTRODUCTION

The active spread of digital financial technologies, e-commerce, mobile and QR payments, marketplaces, online services, and digital government services accompanies the development of the platform economy. As a result, new models of interaction among the state, business, and the population are emerging; ways of doing business are changing; channels for selling goods and services are expanding; and new forms of employment are emerging.

For Kazakhstan, this topic is becoming particularly relevant due to the active digitalization of the economy, the development of fintech ecosystems, the growth of cashless payments, and the formation of a digital state. Digital platforms create additional opportunities for small and medium-sized businesses, especially in regions where traditional access to markets, financial services, and consumers remains limited.

At the same time, the development of the platform economy is accompanied by several unresolved issues. Despite the growth of digital services, the level of their impact on the sustainability of small and medium-sized businesses, the

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employment structure, and the development of regional entrepreneurship remains poorly understood. The problem of uneven digital development of regions, differences in access to digital infrastructure, the level of digital literacy of the population, and the willingness of entrepreneurs to use platform tools is particularly relevant. In these circumstances, digital platforms can simultaneously act as a factor in expanding economic opportunities and as a source of new imbalances between regions, sectors of the economy, and groups of the employed.

The scientific problem of the study is the need for a comprehensive understanding of the role of the digital platform economy in transforming regional entrepreneurship and employment in Kazakhstan. It is of particular importance to identify the extent to which the development of digital payments, e-commerce, platform services, and digital infrastructure is linked to the sustainability of small and medium-sized businesses, the expansion of platform employment, and the achievement of Sustainable Development Goals, primarily in terms of decent work, economic growth, innovation, and sustainable regional development.

Despite the significant digitalization of the economy and the active development of platform-based business models, the impact of digital platforms on the sustainability of small and medium-sized enterprises and on employment transformation remains the subject of scientific debate. Existing studies demonstrate the ambiguity of the results due to differences in countries' levels of digital development, institutional environments, digital infrastructure availability, and the degree of entrepreneurs' involvement in the platform economy. In this regard, the analysis of modern foreign and Kazakhstani studies on the impact of digitalization, platform technologies, and digital infrastructure on the development of small and medium-sized businesses, employment, and the achievement of sustainable development goals is of particular interest.

Contemporary international studies identify small and medium-sized enterprises (SMEs) as a key driver of sustainable economic growth, with their performance increasingly influenced by digital transformation. Mick et al. (2024) emphasize that SME digitalization requires an integrated approach combining technological adoption with sustainability principles. Empirical evidence confirms the generally positive impact of digitalization on business performance. Tripathi and Singh (2024) demonstrate that digital readiness and technological capabilities significantly improve SME outcomes. X. Chen et al. (2024) suggest that the performance effects of digitalization depend on how effectively firms integrate digital technologies into their organizational and managerial practices. Similarly, Bella et al. (2024) and da Silva et al. (2025) show that digital maturity enhances labor productivity, export performance, and long-term competitiveness.

For developing and transition economies, institutional quality and digital infrastructure play a critical role. Studies by Edeh et al. (2025) and Munir (2025) indicate that the combination of digitalization, innovation, and supportive institutions contributes to business creation, export growth, and sustainable economic development.

Kazakhstani research primarily focuses on the role of SMEs in the national economy and mechanisms for their support. Dosmambetova (2024) examines existing financial and non-financial support measures. Kazbekova et al. (2024) identify technological innovation, investment activity, and labor productivity as key determinants of SME growth. In addition, Tsakalerou et al. (2025) assess Kazakhstan's digital readiness using a customized DESI framework and conclude that progress in digital transformation remains uneven across regions. Fehlings et al. (2025) show that Kazakhstani SMEs successfully adapted to post-pandemic challenges through online sales channels, fintech services, and social commerce. Overall, the evidence suggests that digitalization has become not only a driver of business growth but also an important mechanism for enhancing SME resilience and sustainability.

The study aims to assess the impact of digital platforms on the development of small and medium-sized businesses and employment, and to develop measures to strengthen entrepreneurial resilience amid digital transformation.

The study utilizes comparative, correlation, and regression analysis, data standardization, and integrated indexing methods. An economic and mathematical model was created to analyze the relationships among the number of SMEs, internet penetration levels, the development of digital financial technologies, and the digitalization of public services. An integrated digitalization index (IDIG) was calculated to reflect the level of digital maturity of the entrepreneurial environment.

The scientific novelty of the study lies in a comprehensive assessment of the impact of the digital platform economy on the development of entrepreneurship and employment by combining indicators of digital payments, digital infrastructure, e-commerce, and digital public services within the framework of the integrated digitalization index (IDIG).

Thus, in this paper, the platform economy is considered an integrated system of factors that affect the sustainability of small and medium-sized businesses, in contrast to most existing studies that analyze specific aspects of digital transformation. The prospects for further research are related to the expansion of regional analysis, the inclusion of industry-specific indicators of the platform economy, the study of the impact of marketplaces and fintech ecosystems on enterprise productivity, as well as the construction of predictive models for the development of platform employment and digital entrepreneurship in the context of achieving Sustainable Development Goals. Digital platforms are becoming an integral part of the development strategy of small and medium-sized businesses, providing access to innovative tools and opportunities. Understanding the key factors influencing the implementation and use of these technologies will allow SMEs not only to improve their current performance, but also to respond effectively to changes in the external environment. Thus, successful digitalization will contribute not only to improving financial performance but also to sustainable growth amid globalization, laying the foundation for long-term prosperity.

The study aims to determine whether the empirical literature consistently supports the conclusion that digitalization affects the development of small and medium-sized businesses and their employment. Methodologically, the article employs systematic review, descriptive coding, and comparative synthesis of empirical results. The work is carried out as follows. The next section examines the theoretical and empirical literature and identifies unresolved issues. The section "Materials and methods" explains how the interrelationships between digitalization indicators and entrepreneurial development are

identified. The Results section summarizes the verified data using tables and figures. During the discussion, the main patterns are interpreted, and hypotheses are evaluated. The final section presents a description of the research contribution, its limitations, and directions for future research.

LITERATURE REVIEW

The theoretical framework of this study is based on the concept that digital platforms transform entrepreneurship, employment, and regional economic development by changing access to markets, finance, labor, and innovation. In the context of digital transformation, platform-based business models increasingly affect SMEs, employment structures, and the sustainability of regional economies.

Research on digital entrepreneurship in Kazakhstan shows that innovation, financing, and investment mechanisms are important conditions for the expansion of the entrepreneurial sector. Based on 140 commercialization projects, Yedgenov et al. (2025) demonstrate that financing, co-financing, and capital investment significantly influence the commercial success of scientific and innovative projects. This confirms the importance of an innovation-supporting environment for strengthening entrepreneurship.

A separate group of studies focuses on platform employment. Insebayeva and Beysembayev (2023) examine the expansion of digital platform employment in Kazakhstan, showing that platform-based work creates new employment opportunities while increasing labor market flexibility and posing important challenges for labor regulation and social protection. Kurmanov et al. (2023) also note that digital platforms support new forms of work, especially in the SME sector. Similarly, Kuttybayeva et al. (2024) consider platform employment an important trend in the reconstruction of Kazakhstan's labor market, emphasizing the growth of flexible employment, freelancing, and remote work.

The role of fintech in SME development is widely discussed in contemporary literature. Alongside the expansion of digital financial services, regulatory issues have also attracted growing attention. Kazbayeva and Ismagulov (2022) emphasize that the development of digital financial ecosystems should be supported by effective anti-money laundering legislation and financial monitoring mechanisms aligned with FATF standards. Abu et al. (2025) show that government support and financial technologies jointly improve SME access to finance and digital services. Dasaklis et al. (2025) examine how sustainable digital business models can address the resource and energy implications of blockchain-based platforms. Sharma et al. (2024) systematize the relationship between small businesses and fintech, while Manap et al. (2023) demonstrate that digital financial technologies improve access to credit, financial services, and e-commerce. Lasak (2022) argues that fintech platforms reduce dependence on traditional banking channels and expand alternative financing opportunities for SMEs. S. Chen and Guo (2023) show that fintech-related strategic incentives and investment in human capital support innovation in micro and small enterprises.

The transformation of entrepreneurship is also associated with the development of peer-to-peer and platform-based economic relations. Suieubayeva et al. (2023) emphasize that digital platforms create new forms of economic interaction, expand self-employment, and support digital entrepreneurship.

Recent research shows that digital transformation is becoming a key factor in the sustainable development of small and medium-sized enterprises. According to Bindeeba et al. (2025), the introduction of digital technologies improves business process efficiency, enhances customer interaction, and increases enterprise financial performance. Telukdarie et al. (2024) argue that SMEs achieve more successful digital transformation when organizational readiness is supported by structured risk management and adaptive leadership.

Research by Mick et al. (2024) focuses on developing integrated digital transformation strategies, noting that for SMEs, digitalization is no longer limited to introducing individual technologies but requires integrating digital solutions with the principles of sustainable development. The authors emphasize the need to develop long-term digital transformation roadmaps that account for the economic, social, and environmental aspects of enterprises' activities.

Special attention in modern literature is paid to the impact of digital maturity on business competitiveness. Lu and Shaharudin (2024) identify digital transformation as a key driver of sustainable competitive advantage for SMEs, while Kahveci (2025) and Soomro et al. (2024) provide evidence that the adoption of digital technologies enhances SMEs' productivity, managerial capabilities, and market opportunities, thereby supporting long-term sustainability and value creation.

Several studies consider digital marketing an important tool for increasing SME efficiency. Amin et al. (2025) and Sharabati et al. (2024) demonstrate that adopting digital marketing strategies positively affects SME performance by strengthening market presence, expanding customer engagement, and improving financial outcomes. The authors further emphasize the mediating role of digital transformation in this relationship. An important place in the scientific literature is occupied by analyses of the factors that enable successful digital transformation. Sagala and Öri (2024) emphasize that successful SME digital transformation requires an integrated digitalization strategy aligned with firms' capabilities, gradual implementation of digital technologies, and continuous organizational learning.

Hokmabadi et al. (2024) consider digitalization a tool for increasing business resilience to external shocks. The authors conclude that digital technologies enable enterprises to adapt more quickly to changes in the market environment, maintain business continuity, and reduce operational risks.

A separate area of research concerns the development of financial technologies and digital financial inclusion. Hasan et al. (2024) note that fintech contributes to achieving sustainable development goals by expanding access to financial services. A similar position is taken by Carè et al. (2025), who consider digital financial platforms a tool for increasing financial accessibility and the economic inclusion of the population.

The impact of fintech on the development of small and medium-sized enterprises is confirmed by Abu et al. (2025) and Elmi et al. (2025). These authors show that digital financial services help expand entrepreneurs' access to finance, reduce

transaction costs, and increase business sustainability. At the same time, government support enhances the positive effect of introducing financial technologies.

Studies by Lasak (2022) and Manap et al. (2023) demonstrate that fintech and alternative financing platforms can reduce financing constraints and expand SMEs' access to financial services and e-commerce channels. The development of digital payments, online commerce, and financial platforms helps SMEs enter new markets.

Of particular interest are studies on the long-term effects of digitalization on sustainable business development. Bella et al. (2024) and Yesuf and Fields (2026) consider SMEs as a central element of the processes of digital and sustainable transformation of the economy. The authors emphasize that enterprises' ability to integrate digital technologies into their business models is becoming a determining factor in their long-term sustainability, innovation, and competitiveness.

Thus, the analysis of modern literature shows that digital platforms, fintech technologies, digital financial inclusion, and e-commerce significantly impact the development of small and medium-sized businesses. At the same time, most studies examine individual aspects of digitalization, while the complex impact of the digital platform economy on entrepreneurship and employment in regional contexts remains insufficiently studied. This determines the need for further research on the role of the platform economy in the transformation of regional entrepreneurship and the labor market in Kazakhstan.

Overall, the analyzed studies confirm that digital platforms influence entrepreneurship through several interconnected channels: access to finance, market expansion, employment flexibility, innovation, and digital infrastructure. However, the relationship between the platform economy, regional entrepreneurship, and employment in Kazakhstan remains insufficiently studied from an integrated perspective.

This study aims to assess the role of the digital platform economy in transforming regional entrepreneurship and employment in Kazakhstan in the context of achieving the Sustainable Development Goals. To achieve this goal, we have developed the following research hypotheses:

H₁: The development of digital platforms has a positive impact on the growth of small and medium-sized entrepreneurship in Kazakhstan.

H₂: The expansion of digital financial technologies and cashless payments positively affects entrepreneurial activity.

H₃: The development of platform services contributes to the growth of platform employment and flexible forms of work.

H₄: Regional differences in digital infrastructure influence the uneven development of entrepreneurship and employment across Kazakhstan's regions.

H₅: The digital platform economy contributes to achieving sustainable development goals related to decent work, economic growth, innovation, and regional sustainability.

MATERIALS AND METHODS

This study assesses the impact of the digital platform economy on regional entrepreneurship and employment in the Republic of Kazakhstan. The empirical basis consisted of official statistical data covering eight annual observations obtained from the Bureau of National Statistics of the Republic of Kazakhstan, the National Bank of the Republic of Kazakhstan, the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan, as well as international statistical databases and official reports on the development of the digital economy.

The study uses a quantitative approach to identify the relationship between the development of digital platforms and indicators of entrepreneurial activity and employment. Indicators of the development of small and medium-sized enterprises (the number of operating SMEs) and of employment in the population are considered dependent variables. Independent variables characterize the level of development of the digital platform economy and include the share of Internet users, the level of digital literacy of the population, the volume of non-cash payments, the number of mobile and QR payments, the volume of e-commerce, and the level of development of digital public services.

To ensure comparability across indicators measured in different units, the indicators were standardized using the z-transformation. The integrated digitalization index (IDIG) was then calculated from the standardized data to reflect the development of the digital platform economy and the digital business environment.

The methodological basis of the research includes comparative and dynamic analysis, correlation analysis, regression modeling, integral indexing, and the economic interpretation of the results. Comparative and dynamic analyses were used to identify trends in the development of digitalization, entrepreneurship, and employment. The correlation analysis allowed us to determine the strength and direction of the relationship between digitalization indicators and the development of small and medium-sized businesses. To quantify the impact of digital economy factors on entrepreneurial activity, a multifactorial regression model was built, including the number of operating small and medium-sized enterprises (SMEs), the level of Internet penetration (INT), the volume of digital payments (PAY), the volume of electronic commerce (ECOM), and the integrated digitalization index (DIG).

The final stage of the study included an economic interpretation of the results to determine the contribution of digital platforms to the development of regional entrepreneurship, platform employment, e-commerce, and the achievement of sustainable development goals. The use of statistical and economic-mathematical methods ensured the reliability of the research results. It enabled a quantitative assessment of the impact of the digital platform economy on Kazakhstan's socio-economic development.

The integrated application of these research methods enabled an evaluation of digital transformation and government support for entrepreneurship while identifying areas for improvement. The findings also provide recommendations to strengthen digital infrastructure, expand access to digital financial services, improve digital government services, and promote platform employment and e-commerce.

RESULTS

During the observation period, the share of SME GVA increased from 30.8% in the baseline year to 39.7% in the latest year available. The Concept of SME Development in Kazakhstan set a target of 36%. State support for business—including tax benefits, a reduced regulatory burden, simplified registration for individual entrepreneurs, and access to credit—helped SMEs overcome the pandemic-related downturn and resume growth. Production output also benefited from the relocation of companies from Russia and from a temporary moratorium on SME inspections, which reduced the administrative burden on businesses (Figure 1).

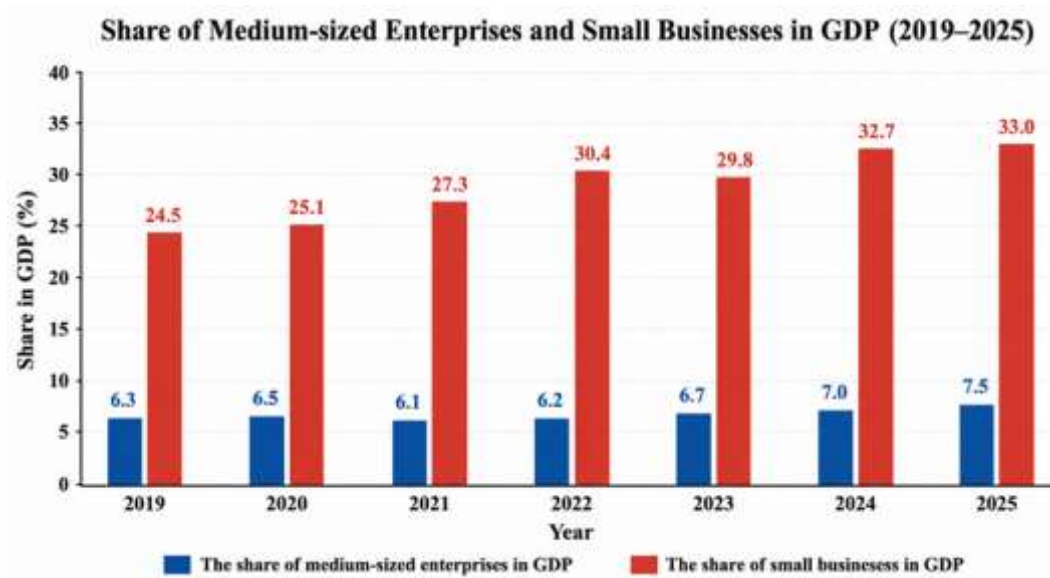


Figure 1. Growth of economic activity in the SME sector

In the structure of SMEs, the majority are individual entrepreneurs (69.7%) and small enterprises (17.5%), peasant farms make up 12.6%, and medium-sized legal entities make up 0.2% (Figure 2).

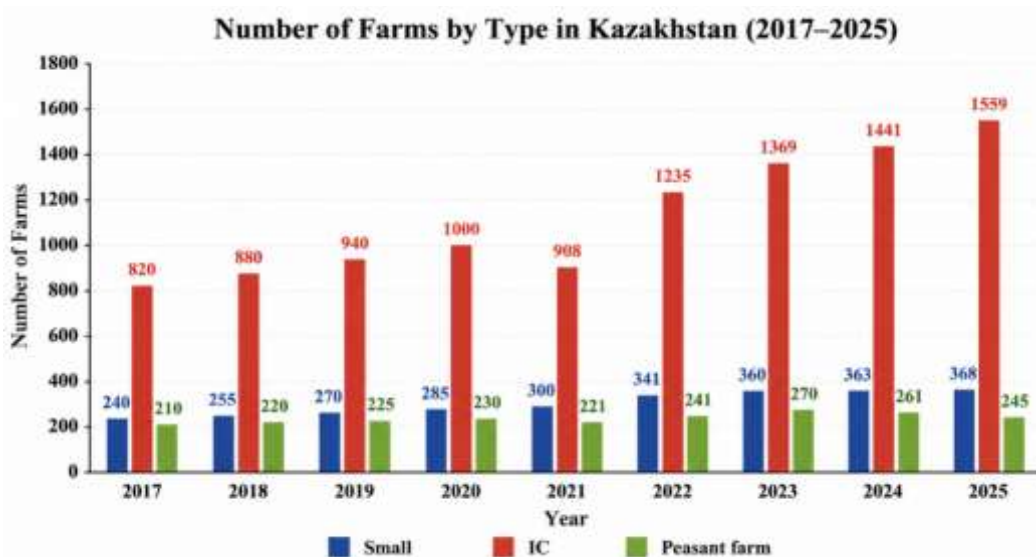


Figure 2. Dynamics of operating SMEs over the observation period, in thousands of units

The nine-observation time series reveals a steady growth trend in SMEs in Kazakhstan, particularly in the individual entrepreneur segment. Analysis of official data shows that the number of active businesses increased 1.7-fold, from 1.27 million to 2.17 million, over the observation period.

Over the analyzed period, the number of individual entrepreneurs more than doubled, indicating a structural shift toward flexible forms of employment and self-employment, whose share consistently exceeded 70%. Small businesses also demonstrated steady growth, whereas the peasant farm sector showed more moderate and unstable growth because of the agricultural sector's institutional and industry-specific characteristics.

Medium-sized businesses have higher growth potential than small businesses due to their larger scale, which enables more efficient use of resources, greater innovation, and easier production scaling.

During the period of active use of digital payment instruments, several countries, including Kazakhstan, recorded substantial growth in mobile and QR payments, contributing to the development of their digital economies (Table 1).

Table 1. Dynamics of digital payment and macroeconomic indicators of countries

Countries	Indicators	2020	2021	2022	2023	2024
Kazakhstan	Mobile transfers (USD billion)	2.5	2.8	3.0	3.2	3.8
	QR payments (USD billion)	1.2	1.5	2.0	2.5	3.5
	ATMs per 1000 people	85	87	88	90	92
	Number of banks	22	22	22	22	22
	GDP (USD billion)	171	225	225	261	288,9
USA	Population (million people)	19	19	19	20	20
	Mobile transfers (USD billion)	300	450	600	700	797
	QR payments (USD billion)	2	2.5	3	4	5
	ATMs per 1000 people	140	135	132	131	130
	Number of banks	4.700	4.500	4.300	4.100	3.928
Japan	GDP (USD billion)	20.893	23.315	25.439	26.949	28.781
	Population (million people)	331	332	333	336	341
	Mobile transfers (USD billion)	100	110	120	130	140
	QR payments (USD billion)	50	70	90	100	100
	ATMs per 1000 people	130	129	125	121	120
China	Number of banks	100	95	90	85	80
	GDP (USD billion)	5.055	5.005	4.256	4.211	4.110
	Population (million people)	126	125	124	123	122
	Mobile transfers (USD billion)	3.000	4.500	6.000	8.000	9.280
	QR payments (USD billion)	2.000	2.500	3.000	3.300	3.408
Germany	ATMs per 1000 people	70	75	77	80	72
	Number of banks	4.000	4.200	4.400	4.500	4.500
	GDP (USD billion)	14.723	17.820	17.963	17.795	18.533
	Population (million people)	1.439	1.412	1.412	1.411	1.425
	Mobile transfers (USD billion)	120	130	140	150	136
Russia	QR payments (USD billion)	10	12	15	18	20
	ATMs per 1000 people	90	88	86	85	84
	Number of banks	1.800	1.780	1.760	1.740	1.700
	GDP (USD billion)	3.885	4.258	4.072	4.456	4.591
	Population (million people)	83	83	83	84	84
Uzbekistan	Mobile transfers (USD billion)	20	50	100	150	235
	QR payments (USD billion)	5	6	7	8	10
	ATMs per 1000 people	165	162	160	158	155
	Number of banks	300	280	260	240	220
	GDP (USD billion)	1.484	1.837	2.240	2.012	2.056
Kazakhstan	Population (million people)	146	145	144	144	144
	Mobile transfers (USD billion)	1	1.5	2	3	5
	QR payments (USD billion)	0.1	0.3	0.5	1	2
	ATMs per 1000 people	40	50	60	80	105
	Number of banks	30	32	33	34	36
Uzbekistan	GDP (USD billion)	60	69	81	90	100
	Population (million people)	34	34	35	35	36

Based on the presented data, it can be concluded that the highest rates of development of digital payment technologies are observed in countries with developed platform economies and a high level of digitalization of financial services. Kazakhstan demonstrates stable positive dynamics in mobile and QR payments, indicating the formation of a digital ecosystem that facilitates the development of regional entrepreneurship and new forms of employment.

The modern platform economy creates a digital infrastructure for interaction among consumers, businesses, and financial institutions, in which mobile payments are a primary mechanism supporting e-commerce, digital marketplaces, and the service economy. The data demonstrate that, amid the active development of the platform economy, digital payment technologies are becoming a key factor in reshaping the business environment and employment. In Kazakhstan, QR payment volume nearly tripled, and mobile transfer volume increased by 52% over the study period (Table 2).

Table 2. Growth rates of mobile and QR payments

Country	The growth of Mobile Communications (%)	The Rise of the QR Code (%)
Kazakhstan	52	191.7
USA	165.7	150
Japan	40	100
China	209.3	70.4
Germany	13.3	100
Russia	1075	100
Uzbekistan	400	1900

Correlation analysis results indicate a strong positive relationship between digital payment volume and macroeconomic indicators. In Kazakhstan, the correlation coefficients between mobile payments and GDP were 0.954, and between QR payments and GDP were 0.936, indicating a strong link between economic growth and the development of digital financial infrastructure.

From the perspective of SME development, the expansion of digital platforms can contribute directly to entrepreneurial activity. Digital payment systems accelerate financial turnover, increase access to financial services, and reduce barriers to market entry for SMEs. Furthermore, the development of digital payments contributes to a unified digital space across regions, expanding opportunities for regional entrepreneurs to participate in e-commerce and the platform economy (Table 3).

Table 3. Correlation of digital payments and GDP

Country	The correlation coefficient between the volume of mobile transfers and a country's GDP	Correlation coefficient between the volume of QR payments and the country's GDP
Kazakhstan	0.954	0.936
USA	0.999	0.967
Japan	-0.918	-0.948
China	0.778	0.853
Germany	0.626	0.879
Russia	0.634	0.66
Uzbekistan	0.945	0.931

The results of the correlation analysis confirm that the development of digital payment platforms has a significant impact on economic growth and the development of small and medium-sized businesses. Digital financial technologies are becoming an important tool for stimulating regional entrepreneurship, increasing financial inclusion, and building a sustainable digital economy in Kazakhstan.

Regression analysis was used to assess the impact of mobile and QR payments on macroeconomic development. For Kazakhstan, the coefficient of determination was $R^2 = 0.919$, indicating that approximately 92% of the variation in GDP is explained by changes in digital-payment volumes. This result confirms the importance of digital payments within the current economic development model.

From the perspective of SMEs, this result indicates that digital platforms are becoming a key driver of entrepreneurial growth. The development of fintech services, digital marketplaces, and mobile payment systems can accelerate business digitalization, improve productivity, and expand entrepreneurs' access to new markets. Importantly, digital platforms create favorable conditions for regional SMEs by reducing operating costs and providing access to remote sales channels (Table 4).

Table 4. Regression analysis of the impact of digital payments on GDP

Country	β Mobile	β QR	Regression constant	R^2
Kazakhstan	161.453	-40.465	-173.271	0.919
USA	14.051	257.238	16225.78	0.999
Japan	-5.616	-16.326	6540.053	0.902
China	-0.548	4.492	7972.364	0.774
Germany	-2.432	65.654	3596.41	0.777
Russia	-19.689	967.949	-2857.98	0.578
Uzbekistan	86.35	-160	-11.075	0.993

The results of the regression analysis indicate that digital payment technologies have a significant impact on economic development and entrepreneurship in Kazakhstan. The high coefficient of determination confirms that mobile and QR payments are important elements of a cross-platform infrastructure that facilitates the development of SMEs, e-commerce, and digital employment.

The regression model is as follows:

$$Y = \beta_0 + \beta_1 \text{Mobile} + \beta_2 \text{QR} + \varepsilon, \quad (1)$$

where:

Y – GDP or the economic development indicator;

Mobile – mobile payments;

QR – QR payments;

β_0 – model constant;

β_1, β_2 – coefficients of influence of factors.

The positive value of the mobile β coefficient indicates that the expansion of mobile payments contributes significantly to economic activity by facilitating faster and more efficient financial transactions. It also accelerates business digitalization through the wider adoption of digital payment systems. It supports the growth of platform entrepreneurship across Kazakhstan's regions by improving access to digital markets and financial services.

For Kazakhstan, the estimated coefficient for Mobile ($\beta = 161.453$) indicates that, holding other factors constant, a US\$1 billion increase in mobile payments is associated with an average increase of approximately US\$161 billion in GDP. In contrast, the coefficient for QR payments ($\beta = -40.465$) indicates a negative statistical effect, likely attributable to limited observations, multicollinearity in the model, and the high correlation between mobile and QR payment variables, rather than a true negative economic impact.

Calculating the integrated platform digitalization index enabled a comparative assessment of the level of development of digital platform economies across countries. Due to the high level of development of mobile payments, digital ecosystems, and e-commerce, China and the United States occupy leading positions. Despite the relatively small size of its economy, Kazakhstan is demonstrating positive dynamics in the digitalization of its financial sector and the active development of platform services, creating conditions for the further growth of small and medium-sized businesses, particularly in e-commerce, digital services, and platform-based employment.

The development of digital platforms facilitates the integration of regional entrepreneurship into a single digital space, enhancing the competitiveness of small and medium-sized businesses and expanding their opportunities to enter foreign markets (Table 5).

Table 5. Integral index of platform digitalization

Country	Index	Interpretation
Kazakhstan	0.880896761	The emerging level of the platform economy
USA	0.362129984	High level of development of digital platforms
Japan	0.061089768	Intermediate level
China	0.058706938	Very high level of platform digitalization
Germany	0.031823751	Intermediate level
Russia	0.002342214	Moderate level
Uzbekistan	0.00004	The initial stage of digital platform transformation

To assess the impact of digitalization on entrepreneurial activity, an econometric model can be used in which the dependent variable is the number of active SMEs, and the factors are indicators of digital infrastructure, digital finance, and e-government:

X1 – share of internet users;

X2 – fintech development indicator, such as the share of cashless payments;

X3 – intensity of e-Government use, such as the number of electronic government services provided (Table 6).

Table 6. Indicators characterizing the sustainability of SMEs in the context of digitalization of the economy

Year	SMEs, thousands	Internet (%)	Digital literacy (%)	Non-cash payments (%)	eGov services, million tenge
2018	1355	81.3	79.6	48	12
2019	1435	82.5	80.3	60	15
2020	1515	85.0	82.0	67	20
2021	1357	92.9	87.3	75	24
2022	1760	93.5	88.0	82	28
2023	2042	94.2	89.5	86	30
2024	2029	95.0	90.0	89	32
2025	2176	96.0	91.0	92	34

$$MSP_t = \beta_0 + \beta_1 INT_t + \beta_2 FIN_t + \beta_3 EGOV_t + \varepsilon_t \quad (2)$$

where:

MSP_t – number of active entities;

INT_t – share of Internet users, %;

FIN_t – fintech indicator;

$EGOV_t$ – indicator of digitalization of public services.

Each indicator is standardized using a z-score:

$$z_i = \frac{x_i - \bar{x}}{\sigma} \quad (3)$$

where:

x_i – the value of the indicator in year i ;

$\bar{x}$ – the average value of the indicator for the entire period;

σ – standard deviation.

The final IDIG calculations are presented in Table 7.

Table 7. IDIG calculation summary table

Year	z(INT)	z(DIG)	z(FIN)	z (eGOV)	IDIG
2018	-1.50	-1.43	-1.76	-1.53	-1.56
2019	-1.30	-1.27	-0.98	-1.16	-1.18
2020	-0.87	-0.89	-0.52	-0.54	-0.71
2021	0.49	0.30	0.01	-0.05	0.19
2022	0.59	0.46	0.47	0.45	0.49
2023	0.71	0.80	0.73	0.69	0.73
2024	0.85	0.91	0.93	0.94	0.91
2025	1.02	1.13	1.12	1.19	1.12

The Integrated Digitalization Index is an effective tool for quantifying the impact of digital transformation on entrepreneurship development. The higher the level of digitalization of the economy, the greater the number of active SMEs, as each increase in the Integrated Digitalization Index by one unit increases the number of SMEs by approximately 455,000.

The results show that the development of the digital platform economy has a significant impact on entrepreneurial activity, employment, and regional economic development. Analysis of digital payment dynamics shows a steady increase in the use of mobile transfers and QR payments across all countries studied. In Kazakhstan, during the study period, mobile payments increased by 52% and QR payments by 191.7%, reflecting a high level of adaptation among the population and businesses to digital financial services. These trends indicate the formation of a stable digital financial infrastructure that supports e-commerce and platform entrepreneurship.

The correlation analysis confirmed a close relationship between the development of digital payments and macroeconomic indicators. For Kazakhstan, the correlation coefficients were 0.954 between mobile payments and gross domestic product, and 0.936 between QR payments and GDP. The values obtained indicate a strong positive relationship between the development of digital financial infrastructure and economic growth. Similar patterns are observed in the USA, China, and Uzbekistan. The exception is Japan, where a negative correlation has been identified, which may be explained by the high maturity of the financial system and the saturation of the digital market, in which the further growth of digital payments no longer has a significant impact on macroeconomic dynamics.

The results of the correlation analysis confirm H₂, which posits a positive impact of digital financial technologies and cashless payments on entrepreneurial activity and economic development. The development of digital payment platforms helps reduce transaction costs, expand access to financial services for small and medium-sized businesses, and create conditions for their involvement in e-commerce.

A regression model was built to quantify the impact of digital payments on economic development. For Kazakhstan, the coefficient of determination (R²) was 0.919, indicating that about 92% of the variation in GDP is explained by changes in the volume of mobile and QR payments. The high coefficient of determination confirms the significant role of digital financial services in the country's current economic development model.

The coefficient β for mobile payments in Kazakhstan was 161.453, indicating a positive impact of this factor on economic growth. At the same time, the negative coefficient for QR payments ($\beta = -40.465$) should not be interpreted as a negative impact of QR technologies on the economy. This result is due to the high correlation between mobile and QR payments and to the limited number of observations, which leads to multicollinearity. Therefore, the coefficient obtained reflects the model's statistical properties rather than the actual decrease in the economic efficiency of QR payments.

The integrated digitalization index of the platform economy (IDIG) provided additional results. The index demonstrates steady positive dynamics in Kazakhstan's digital transformation, increasing from -1.56 to 1.12 over the study period. This increase reflects the consistent development of digital infrastructure, higher digital literacy, and the expansion of non-cash payments and digital public services.

Analysis of the relationship between the digitalization index and the number of operating SMEs showed a pronounced positive association. During the study period, the number of active SMEs increased from 1.355 million to 2.176 million, an increase of more than 60%. The results confirm H₁, which posits a positive impact of digital platforms on SME development.

The data also confirm H₃ regarding the impact of platform services on new forms of employment. The expansion of e-commerce, digital marketplaces, delivery services, and fintech platforms contributes to the spread of platform employment, self-employment, and remote work. This is especially important in regions where digital platforms reduce territorial barriers to labor and business markets.

At the same time, the study's results confirm H₄, which posits regional differentiation in digital development. Despite nationwide digitalization, disparities in access to digital infrastructure, digital skills, and use of digital services can create different conditions for entrepreneurial development across regions.

Overall, the results confirm H₅: the digital platform economy contributes to achieving the Sustainable Development Goals by expanding entrepreneurial activity, increasing financial inclusion, creating new forms of employment, and developing digital infrastructure. Digital platforms are becoming a key factor in enhancing SME sustainability and shaping Kazakhstan's modern digital economy.

The analysis indicates that a stable digital financial infrastructure requires continued adaptation by both the population and businesses to digital financial services. The close relationship between digital payments and macroeconomic indicators supports this conclusion. However, entrepreneurial development in the context of digitalization varies across

regions due to differences in digital infrastructure, digital skills, and the use of digital services. Advancing sustainable economic development therefore requires broader entrepreneurial activity, improved access to financial services, new forms of employment, and continued investment in digital infrastructure.

DISCUSSIONS

The results generally confirm the study's hypotheses. The strongest support was found for H_1 and H_2 , which posit that digital platforms and digital financial technologies positively affect the growth of small and medium-sized businesses. The strong positive relationship among digitalization indicators, non-cash payment volumes, and the number of operating SMEs indicates that the digital environment is becoming a key factor in the sustainable development of entrepreneurship in Kazakhstan.

The results are consistent with previous studies showing that digital technologies, fintech, human capital investment, and online services can strengthen enterprise innovation, competitiveness, and market access (Abu et al., 2025; Amin et al., 2025; S. Chen & Guo, 2023; Lu & Shaharudin, 2024). Similarly, Tripathi and Singh (2024) show that businesses' digital readiness is an important factor in improving enterprise efficiency. The results of this study confirm these conclusions in the context of Kazakhstan, demonstrating the close relationship between digital payments and entrepreneurial activity.

The confirmation of the H_3 hypothesis on the impact of digital platforms on employment is also consistent with prior research on platform employment and digital entrepreneurship (Insebayeva & Beysembayev, 2023; Kuttybayeva et al., 2024; Suieubayeva et al., 2023). The expansion of e-commerce, marketplaces, and digital services creates additional opportunities for self-employment, remote work, and community engagement in the digital economy. Thus, digital platforms act not only as a business tool but also as a mechanism for transforming the labor market.

The confirmation of the H_4 hypothesis, concerning heterogeneity in the digital development of regions, warrants special attention. Despite the overall growth of digitalization, differences in infrastructure development, access to high-speed Internet, and the population's digital competencies persist. This conclusion aligns with Tsakalerou et al. (2025), who indicate that Kazakhstan's digital readiness exhibits significant regional differences. This finding suggests that the effect of digitalization on entrepreneurship depends not only on the availability of technologies but also on the institutional and infrastructural conditions of their use.

The results also confirm H_5 , which posits a link between the platform economy and the achievement of the Sustainable Development Goals. In particular, digital platforms contribute to SDG 8, "Decent Work and Economic Growth," by creating new jobs and expanding entrepreneurial activity; SDG 9, "Industry, Innovation and Infrastructure," by supporting digital infrastructure and innovation; and SDG 11, "Sustainable Cities and Communities," by increasing the availability of digital services and reducing territorial barriers to business.

At the same time, the study's results allow us to evaluate certain aspects of the analysis critically. The negative coefficient on QR payments in Kazakhstan's regression model is likely due to multicollinearity among the digital payment indicators and to the limited time series of observations. Therefore, this result does not indicate a negative impact of QR payments on the economy, but reflects the statistical limitations of the model. In addition, the study is based on macroeconomic indicators. It does not account for industry-specific characteristics of entrepreneurial activity, which may affect the accuracy of assessments of the individual effects of digitalization.

The findings indicate that the digital environment is becoming a key factor in the sustainable development of entrepreneurship in Kazakhstan. This conclusion is supported by both the present results and international studies showing that digital financial technologies, digital literacy, and online services enhance enterprise competitiveness and market access. These factors also create additional opportunities for self-employment, remote work, and participation in the digital economy. However, the effects vary across regions because of differences in institutional and infrastructural conditions. The findings therefore provide a basis for recommendations for further economic digitalization and the transformation of regional entrepreneurship and employment to support the Sustainable Development Goals.

CONCLUSIONS

The findings fulfill the study's main objective and indicate a stable relationship among the development of digital infrastructure, the spread of digital payments, the use of digital government services, and the dynamics of small and medium-sized businesses. The growth of the integrated digitalization index was accompanied by an increase in the number of operating SMEs, the expansion of e-commerce, and the development of new forms of economic activity.

The scientific contribution of the research is the development and testing of the Integrated Digitalization Index of the Platform Economy (IDIG), which enables a comprehensive assessment of the impact of digital transformation on entrepreneurial activity. Unlike existing approaches that focus on analyzing individual indicators of digitalization, the proposed toolkit integrates the characteristics of digital infrastructure, financial technologies, digital literacy, and government electronic services into a single assessment system.

The results indicate that digital platforms perform not only a technological function but also a socio-economic one by reducing transaction costs, expanding business access to financial services and sales markets, and creating new employment opportunities. The theoretical significance of the research lies in developing the concept of the platform economy as an independent factor in the sustainable development of entrepreneurship and regional socio-economic systems. Its practical significance lies in the potential use of the proposed approach to monitor digital transformation and evaluate the effectiveness of government support measures for entrepreneurship.

From a management perspective, the study's results confirm the need to develop digital infrastructure further, expand access to digital financial services for businesses, improve digital public services, and foster a favorable environment for platform employment and e-commerce.

The limitations of the study are related to the use of aggregated macroeconomic data, the limited length of the time series, and the lack of detailed regional statistics for individual segments of the platform economy. In addition, the study does not take into account the industry-specific features of how digital platforms operate and differences in the level of digital maturity among individual groups of enterprises.

The prospects for further research include conducting an interregional analysis of digital transformation, expanding the platform economy indicator system, studying the impact of digital ecosystems on enterprise productivity, and building predictive models for the development of entrepreneurship and employment in the context of further digitalization of Kazakhstan's economy.

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