“Relationship between banking infrastructure, innovation and economic growth in Kazakhstan”

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RELATIONSHIP BETWEEN BANKING INFRASTRUCTURE, INNOVATION AND ECONOMIC GROWTH IN KAZAKHSTAN

Abstract

Today, the development of financial technologies and their application in the banking sector have changed the processes of economic growth in general and commercial banks in particular, giving them an innovative orientation. The aim of this study is to investigate the relationship between the banking infrastructure, innovation, and economic growth in Kazakhstan based on panel data. The study relies on information extracted from annual publications issued by the National Bank of Kazakhstan, the World Bank Database, and the Bureau of the National Statistics of Kazakhstan from 2004 to 2022, and also uses a regression model. Within this framework, variables used in the study, the number of ATMs, the number of bank branches, and the share of innovative products, are explanatory variables, and the gross domestic product per capita is the dependent variable. The study showed that both business innovations and the prevalence of ATMs have a significant and noticeable impact on the economic landscape of Kazakhstan, as evidenced by the impressive value of the R-square of 0.890. Moreover, the regression model demonstrates reliable stability and reliability, which is confirmed by the p-value of 0.001. In light of these findings, it is important to contribute valuable insights and evidence-based recommendations to enhance Kazakhstan's economic growth strategy by leveraging the synergistic potential of its banking infrastructure and innovation ecosystem.

Keywords financial development, bank, banking infrastructure, bank branches, innovation, economic growth, Kazakhstan

JEL Classification G21, O31, O33

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INTRODUCTION

The development of financial technology (fintech) has significantly affected the global financial sector, especially in investments and automated teller machines (ATMs). Studying innovation and ATMs is crucial for several reasons. First, ATMs represent one of the most widespread and accessible contact points between consumers and the financial system. As such, they substantially impact the consumer's perception of banking and financial services. Understanding how innovation can improve ATMs' functionality, security, and user experience can significantly impact the overall quality of financial services. Second, ATMs are an essential site for the implementation of new technologies. Innovations such as biometric authentication, contactless transactions, and AI-driven customer service can all be integrated into ATMs. Studying these innovations can provide insights into the practical challenges and benefits of implementing new technologies in real-world settings.

Moreover, fintech has also changed the investment landscape. This has democratized access to investment opportunities, allowing people to quickly and cost-effectively invest in various financial instruments.

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Fintech platforms leverage cutting-edge technologies like artificial intelligence and machine learning to offer personalized investment advice, and through the introduction of advisors and online trading platforms, investors can make informed decisions (Kabulova & Stankevičienė, 2020). However, these advances have also increased investment risk and market volatility (Edward & Kuznetsov, 2023).

The connection between ATMs, innovation, and fintech is strong. Fintech, or financial technology, applies the latest technological innovations to financial services. This includes everything from mobile banking apps to blockchain and cryptocurrency. As an essential part of the financial services infrastructure, ATMs allow users to perform various banking operations. In addition, modern ATMs are equipped with multiple security technologies, such as data encryption and multi-factor authentication, to ensure the security of transactions and personal data protection. Contactless technology can make transactions faster and easier, improving the user experience. By integrating ATMs with other fintech services, it's possible to offer consumers a more comprehensive range of services at ATMs, from mobile top-ups to bill payments.

Prior studies concerning the influence of banking infrastructure on economic growth have primarily focused on traditional metrics of financial access and efficiency, such as the number of bank branches, ATMs per capita, and the depth and breadth of financial services. However, a limited number of studies have examined the links between innovation – measured through metrics such as the number of patent applications, R&D expenditures, and the volume of production of new technologies and its synergistic effect with banking infrastructure on economic growth. This oversight represents a significant gap in the literature, as innovation plays a crucial role in driving productivity gains, industrial competitiveness, and the overall dynamism of an economy. Moreover, this paper can provide a more nuanced understanding of how banking infrastructure and innovation collectively influence economic growth, offering valuable insights for policymakers, financial institutions, and business leaders aiming to foster an environment conducive to innovation-led economic expansion.

1. LITERATURE REVIEW

With the advent of the digital age, fundamental changes are taking place in the global economy, with the emergence of numerous technological innovations. Technological innovations and their impact on the financial industry are constantly evolving. Only a few operations left in the banking sector would have been performed using fintech. In addition, in recent years, financial technologies have become one of the most essential strategies for developing the banking sector in many countries. Scientific research in financial technologies should be considered through macroeconomic and microeconomic factors.

Fintech startups are often created in countries with the latest technologies, supporting infrastructure, benevolent regulation, and a large labor market (Haddad & Hornuf, 2019). Investments in feints and the relationship of GDP are considered by Fidan and Güz (2023). The study discusses the dynamic effect between investments in fintech and GDP in different countries. Since developed countries have relatively flexible financial systems, there are more stable conditions for investment in fintech and GDP growth.

The fintech banking industry showed the connection between financial technologies and innovation management (Wonglimpiyarat, 2017). Musabegovic et al. (2019) proved a statistically significant positive relationship between GDP per capita and the use of new technologies and smartphones in financial transactions. The relationship between GDP per capita, the payment of utilities, and the wages received through a mobile phone was proved. Another work shows that without the introduction of fintech, the rate of income and the money multiplier would not change (Mumtaz & Smith, 2020; Fidan & Güz, 2023). The works provided an empirical analysis to study the relationship between the critical components of fintech, including mobile and Internet technologies, as well as digital currencies, and the demand for money. The research is based on statistical analysis and data modeling to determine how fintech transforms traditional understandings of monetary economics.

The importance of fintech for small and medium enterprises (SMEs) cannot be overstated. Through this method, fintech has contributed to the growth and development of SMEs by providing easy access to financial services. However, rapid fintech innovation has also increased investment risk and created serious monopolies (Zhou et al., 2018). Moreover, the advent of fintech has led to new lending models that make it easy for people to borrow money. Furthermore, fintech development has led to the emergence of novel lending models that simplify borrowing money. However, this has also led to an uptick in fraudulent activities, with some individuals defaulting on loan repayments (Sheng, 2021). In addition, fintech has also led to the emergence of digital finance companies, which, while beneficial, also pose regulatory and security challenges (Lee & Shin, 2018; Wang et al., 2021).

Interesting is the research on deposits in Islamic banks (Zucchelli, 2022; Long et al., 2023). The studies showed that the use of fintech channels via mobile phones could make a significant contribution to expanding access to financial services. There is a proven high demand for products that meet the requirements of Sharia and ESG products. Financial innovation and increasing access to financial services help explore issues related to access to economic benefits from the digital age perspective. Yoon et al. (2023) considered macroeconomic factors devoted to the impact of financial technologies on banking activities. The primary attention is paid to the authors' argument that simple correlation coefficients can distort the real impact of fintech on the banking sector since GDP per capita is not considered.

Some studies examine the impact of consumer behavior and product quality on consumers' decision-making process when choosing mobile payment applications in the field of financial technology in Indonesia (Raya & Kartawinata, 2022; Courbe & Lyons, 2016). Digital fintech solutions, such as "DANA" and "Aulia", emphasize the importance and relevance of the development and implementation of innovative products in the financial market of Indonesia. Such products not only meet the needs of consumers but also contribute to the overall development and modernization of the country's economic infrastructure.

Special attention is paid to the work that covers the regions of Kosovo, Ukraine, and Africa. Dermaku et al. (2023) analyze how fintech affects banks in Kosovo. Empirical data demonstrate the dynamics and specifics of changes in financial indicators under the influence of technological innovations. Dubin et al. (2020) focused on Ukraine and examined security issues related to implementing and using fintech solutions in the banking payment environment. Okoli and Tewari (2020) analyzed fintech in the heterogeneous economies of Africa, identifying the determinants of growth and the depth of technology penetration in various countries of the continent.

Financial innovations include financial technologies, so the study of research in this aspect of research is important. Alvarez and Lippi (2009) presented a dynamic inventory model of the demand for money, integrating the impact of financial innovations on management. The authors used the results of their assessments to revise and update the understanding of classical issues related to the demand for money in the context of modern financial innovations. Furthermore, studies were conducted on the impact of financial innovations on economic growth in the example of Africa (Yinusa et al., 2021; Osei et al., 2023).

The role of money transfers as a fintech service in the Pacific region is based on data from a study by Hahm et al. (2021). Particular attention is paid to the potential of expanding access to financial services for non-banking groups of the population and the subsequent stimulation of economic and social development. The history of fintech development in banks in the example of Indonesia is presented in the study by Legowo et al. (2021). The research puts forward the information generation hypothesis, which negatively impacts competition on the efficiency of banking activities (Le et al., 2021). Increased competition may reduce the ability of banks to collect information and increase the likelihood of an unfavorable choice for the borrower. A decrease in the efficiency of banking activities in these conditions is inevitable. Kanga

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et al. (2022) showed positive changes caused by introducing and spreading fintech technologies in the banking sector. Based on empirical data, the study focused on the diffusion of ATMs and living standards (GDP per capita) that have a long-term impact on economic growth.

Specific works demonstrate that the impact of financial development on economic growth can be twofold (Ductor & Grechyna, 2015; Kim, 2017). With a moderate increase in private lending and a corresponding increase in actual output, financial development contributes to economic growth. Furthermore, Domeher et al. (2022) analyzed the dynamics of economic growth in the context of financial innovation in 26 African countries to assess how innovations in the banking sector affect the availability of financial services and economic growth. The main conclusion was that investments in innovations in the banking sector contribute to expanding access to financial services. Based on the results of numerous empirical studies, it is safe to say that financial innovations play a crucial role in stimulating the economic growth of individual countries (Shirazi et al., 2022). Studies that have sought to investigate this linkage in sub-Saharan Africa have produced mixed results (Domeher et al., 2022). Secondary data from 26 selected SSA countries from 2004 to 2017 were used. The data were analyzed using the GMM estimation technique. It was found, amongst other things, that investments in innovations in the banking sector promote financial inclusion. In addition, financial inclusion fully mediates the relationship between innovation and economic growth.

The economic feasibility of sustainable innovations is considered in the studies of Kazakhstani authors (Aubakirova, 2019; Sambetbayeva et al., 2020). The model proposed by the authors builds the logic and structure of research on innovation management focused on sustainable development in innovative companies in Kazakhstan. Omarov and Kobadilov (2020) focused on the role of fintech as a driver stimulating the growth and development of the Kazakh financial market. The authors also consider the fintech ecosystem of Kazakhstan in the context of its interaction with commercial banks, regulatory authorities, and other financial market participants. The research results inform companies about how to further develop sustainable innovation management systems in their regions of presence (Sadyrova et al., 2021; Dutta et al., 2023). Further, Sadyrova et al. (2021) examined innovation processes in Kazakhstan, identifying critical problems in forming and implementing innovation policy. The authors applied a comprehensive analytical approach combining quantitative and qualitative analysis to study innovative development's dynamics and structure thoroughly. One of the papers examined the correlation between economic growth, the number of ATMs, Internet access, and the number of users and gender indicators (Kireyeva et al., 2022).

However, no definitive directional causal relationship has yet been established while analyzing the causality between banking infrastructure and economic growth. From the literature review, it was found that most of the research on the banking sector was focused on financial development. In addition, studies have yet to investigate the impact of banking infrastructure on economic growth, especially considering the impact of innovation. Macro and micro factors can influence the development of financial technologies that correlate with GDP growth rates. ATMs, services, and applications play a huge role in the bank's profit and economic stability in general. Thus, existing literature does not provide any conclusive evidence of empirical studies focusing on investigating the nexus between banking infrastructure, innovation, and economic growth. However, the current study tries to capitalize on the existing research gap and explore their relationship with Kazakhstan's economy.

The purpose of this study is to investigate the relationship between the banking infrastructure, innovation, and economic growth in Kazakhstan based on panel data. The following hypotheses were put forward:

H_1: *There is a significant relationship between the number of ATMs and GDP per capita.*

H_2: *There is a significant relationship between the share of innovative products in GDP and GDP per capita.*

H_3: *There is a significant relationship between the share of bank branches and GDP per capita.*

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2. RESEARCH METHODS

Methods range from data coverage analysis and structural equation modeling to descriptive statistics and regression models.

The articles used were based on literature review, bibliometric and network analysis, structural analysis, and systematic literature review (SLR) (Musabegovic et al., 2019; Suryono et al., 2020). Data collection methods were based on primary or secondary data (interview or observation) (Raya & Kartawinata, 2022). Then, descriptive statistics were applied using the method of data analysis with a qualitative approach or diagnostic tests (Yoon et al., 2023). Regression models are also found in the study in various variants: the OLS method (the Usual Least Squares Method). This study is carried out in several critical stages, which are presented in Figure 1.

The equation is a simple linear regression model with three independent variables ATM (automated teller machines, per 100,000 adults), Innov (share of innovative products) in relation to GDP, and Branch (bank branches, per 100,000 adults), and one dependent variable Y (GDP); *B*1, *B*2, and *B*3 – coefficients for independent variables (ATM, Innov, Branch), calculated by the formula (1):

$$Y = B0 + B1 \cdot ATM + B2 \cdot Innov + B3 \cdot Branch + B0, \quad (1)$$

where *Y* – GDP per capita, which is the exogenous variable; *B*0 – the constant, represents the *Y* value when ATM, Innov, and Branch are zero. In other words, this is the expected value of *Y* in the absence of exogenous variables; *B*1 – the coefficient for the exogenous variable ATM. This represents the change in *Y* (GDP per capita) as the ATM variable increases by one unit, while the Innov variable remains unchanged; *B*2 – the coefficient for the exogenous variable Innov. This represents the change in *Y* (GDP per capita) as the Innov variable increases by one unit, while the Innov variable remains unchanged; *B*3 – the coefficient for the exogenous variable Branch. This represents the change in *Y* (GDP per capita) as the Branch variable increases by one unit while the Branch variable remains unchanged.

The equation states that GDP per capita (*Y*) is a linear combination of a constant term (B0), the product of the coefficient (*B*1-*B*3), and the outcome of the coefficients (*ATM, Innov, Branch*), again a constant term (*B*0). The indicators used in the research are shown in Table 1.

To use this model, the values of B0, B1, B2, and B3 need to be estimated using statistical methods such as Least Squares regression (OLS). After calculating the coefficients, the equation predicts GDP per capita (*Y*) for ATM (X1), Innov (X2), and Branch (X3) variables. In addition, statistical analysis can help determine the significance and strength of the relationships

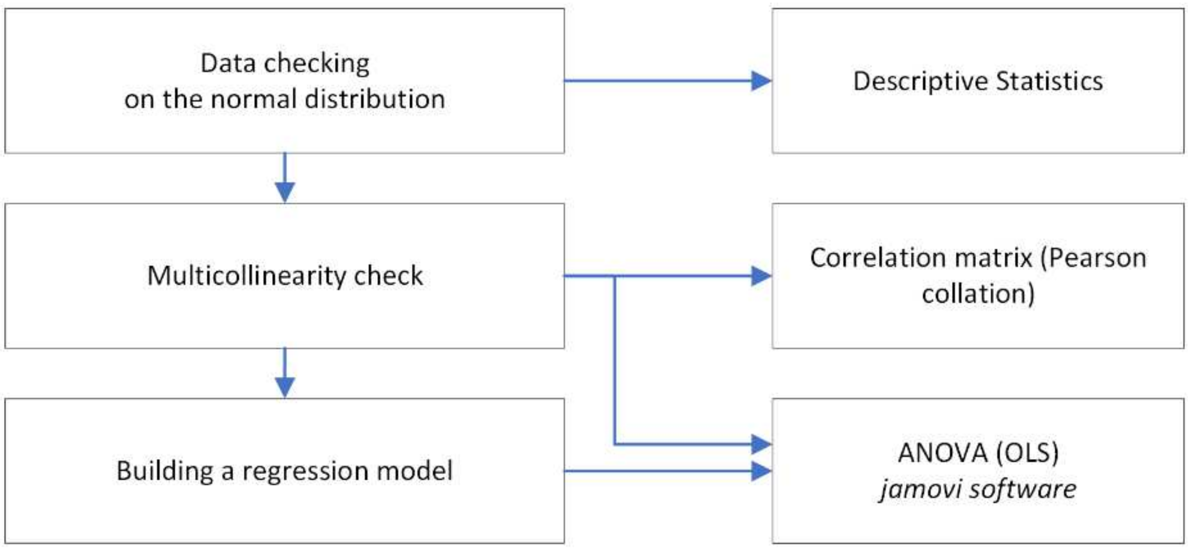

Figure 1. Stages of the study

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Table 1. Variables presented in the study

Source: Authors compilation.

No.	Variable	Code	Definition	Data source
1	Gross domestic product per capita	GDPper (Y)	The gross domestic product per capita (used as an indicator of economic growth)	National Bank of Kazakhstan
2	Automated teller machines	ATMs (X1)	The number of ATMs available for use per 100,000 adults (used as an indicator of banking infrastructure)	World Bank Database
3	Share of innovative products	Innov (X2)	The percentage change in the quantity of patent applications, R&D costs, and the volume of production of new technologies (used as an indicator of innovation)	Bureau of the National Statistics of Kazakhstan
4	Bank branches	Branch (X3)	The number of bank branches available for use per 100,000 adults (used as an indicator of banking infrastructure)	World Bank Database

between the exogenous variable (ATM, Innov & Branch) and the endogenous variable (GDP per capita).

3. RESULTS

3.1. Analysis of GDP development dynamics

Gross domestic product is one of the most well-known indicators of the economic development of countries. The size of Kazakhstan's GDP was USD 185 billion, which confirms that the level of this indicator is inferior to developed countries. Below is the data, which reflects the indicator that reflects the economic growth of Kazakhstan over the past 18 years – GDP per capita (Figure 2).

According to the data presented, the volume of GDP per capita has been constantly growing since 2004. Nevertheless, the GDP per capita growth rate demonstrates the cyclical economy. Periods of recession coincide with a drop in demand, prices on world energy markets, and a pandemic (2008–2009, 2015, 2020). Thus, during the period 2008–2009, the reason for the instability of the growth of Kazakhstan's economy was the fall in global demand for goods and raw materials, which led to a decrease in exports of Kazakhstani goods, such as oil, gas, and metals. The fall in prices for these goods caused significant financial losses for the country. Further, in 2015, the decline was associated with a decrease in oil prices – this year, oil prices fell by more than half, which greatly affected the economy of Kazakhstan since oil is one of the country's main exports. The decline in oil prices caused a significant decrease in export revenue and the weakness of the national currency. Finally, the 2020 downturn is associated with the COVID-19 pandemic – stemming from the COVID-19 pandemic, restrictive measures such as lockdowns and border crossing restrictions were introduced. These measures have seriously affect-

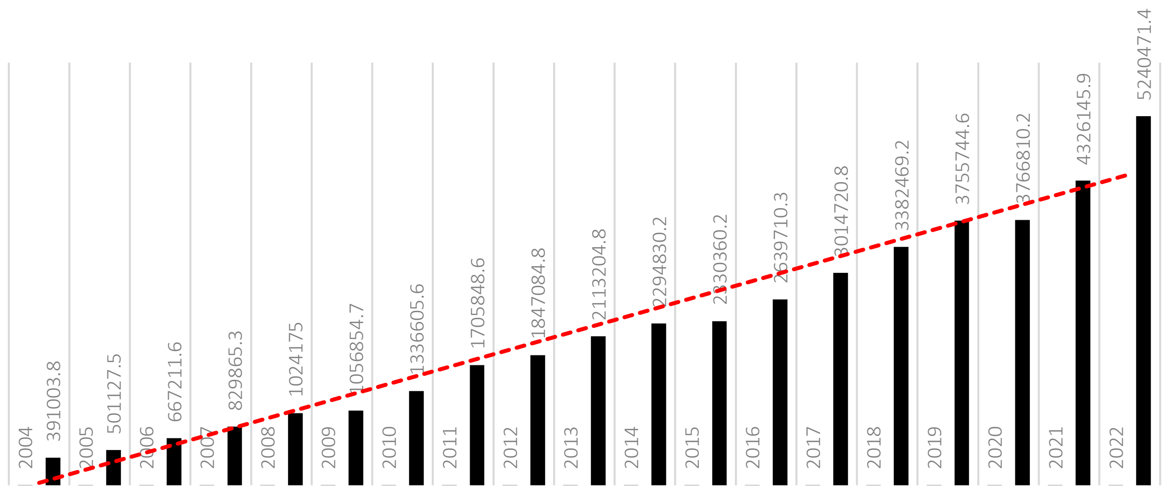

Figure 2. GDP per capita in Kazakhstan for 2004–2022, in KZT

ed various sectors of the economy, such as tourism, retail trade, and services. In addition, the decline in global demand and falling prices for raw materials also affected the economy of Kazakhstan. As a result, there was a significant reduction in GDP, problems in the country's economy, and increased unemployment.

Figure 3 shows the growth rate results of GDP growth per capita, automated teller machines, and the share of innovative products and bank branches for 2004-2022.

Three-time ranges were taken to construct the results presented in Figure 3: 2004–2009, 2010–2015, and 2016–2022. The economic situation in the country was studied in increments of 5-7 years. As can be seen in the figure, in the range of 2004–2009, there was a very high increase (five times) in the number of ATMs in the country. According to the data presented, during the analyzed period from 2004 to 2022, there has been a significant increase in the number of bank branches, especially since 2018. At the same time, there is an increase in the number of ATMs, which is associated with the amount of demand for banking infrastructure. A decrease in the number of ATMs was observed in 2010–2015 (0.2%). At that time, the general economic downturn led to a reduction in money turnover and using non-cash payment instruments more often. The recovery and subsequent increase in the number of ATMs in Kazakhstan from 2016 to 2022, associated with GDP per capita growth, indicates the relationship between the economic development of the country and the development of banking infrastructure. In addition, the chaotic development of innovation indicators between 2004 and 2022 may also significantly impact the banking infrastructure. Interestingly, from 2016 to 2022, for the purposes of this study, there was a link between the growth of the number of ATMs and innovation. The development of new technologies also contributes to the emergence of new models of banking services, including remote ATM management.

3.2. Results of correlation analysis

The first step in the study is to perform descriptive statistics. This nonparametric statistical test is used to determine whether a data set matches a particular distribution. It compares a data set's cumulative distribution function (CDF) with the expected theoretical distribution in Table 2 (for example, with a normal distribution).

Table 2. Descriptive statistics

Indicator	GDPper	ATM	Innov	Branch
Mean	2.22e+6	8,078	132	6.15
Mode	2113205	8,965	1.46	3.37
Std. Deviation	1.40e+6	3,562	0.48	4.93
Minimum	391,004	1,124	0.49	2.81
Maximum	5,240,471	12,728	2.43	15.20

As can be seen from Table 2, all variables have 18 observations. The description of the test results will be carried out for each indicator separately. The minimum GDPper value is 391,004, the maximum value is 5,240,471, the mode is 2113205, and the standard deviation is 1.40e+6. The standard deviation is quite significant, indicating a widespread in GDP per capita values around the mean.

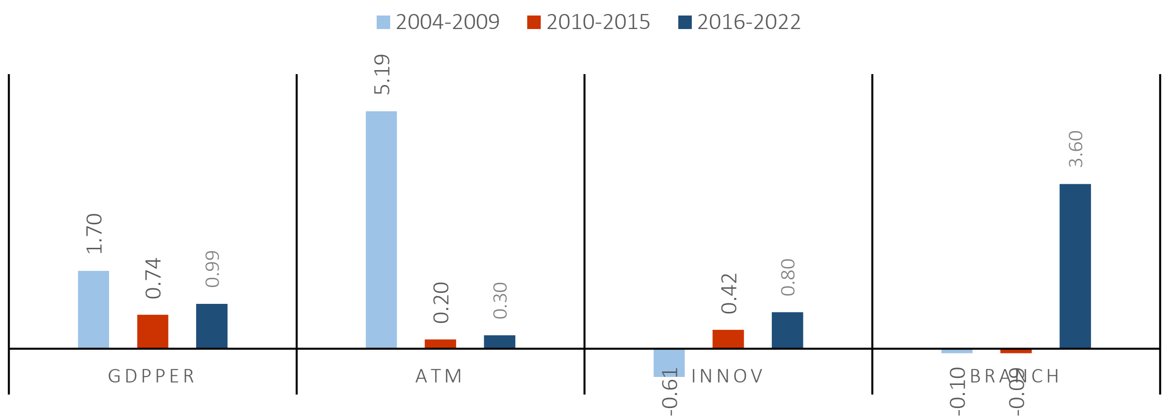

Figure 3. Growth rate results of GDP per capita, automated teller machines, and the share of innovative products and bank branches in Kazakhstan, in %

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The maximum ATM is 12728, the minimum value is 1,124, the average is 8965, and the standard deviation is 3,562. The standard deviation is relatively lower than GDPper, indicating that the values of this variable are closer to the mean. The minimum Innov value is 0.49, the maximum value is 2.43, the mean is 1.46, and the standard deviation is 0.48. The standard deviation is the lowest among the three variables, indicating that the values of this variable are closest to the mean. The maximum Branch value is 15.20, the minimum value is 2.81, the mean is 6.15, and the standard deviation is 3.37.

Before building a linear regression, some scientists use Generalized Methods of Moments (GMM) (Blundell & Bond, 2000), which do not require checking for multicollinearity and heteroscedasticity of the data. Pearson's coefficient evaluates the linear connection between two data collections. Values range from (–1) to (1), where 1 indicates complete positive correlation, –1 indicates absolute negative correlation, and 0 ranges from –0.5 to 0.5 with no correlation. Table 3 shows the Pearson correlation coefficients between three variables: GDPper, ATM, and Innov for 2004–2022.

The data shows (see Table 3) that all coefficients associated with GDP per are above 0.5, which means the exogenous relationship with the endogenous variables is positive. At the same time, the correlation between independent factors is 0.349 and 0.637**, which indicates the absence of multicorrelation between bank branches and automated teller machines (637**). In addition, it was the multicorrelation between bank branches and the share of innovative products (637**). Therefore, from the regression model, bank branches were excluded. Furthermore, coefficients for each indicator will be described in more detail.

GDPper and *ATM*: The correlation coefficient is 0.909***, which is relatively high, indicating a significant direct link between these two factors. This correlation is significant at the 0.001 level (p-value), meaning there is less than 1% chance that this correlation arose by chance if there was no actual correlation in the population.

GDPper and *Innov*: The correlation value of 0.553* suggests a slight direct association. This relationship is notable with a 0.143 threshold (two-sided), signifying there is less than 5% chance that this correlation arose by chance if there was no actual correlation in the population.

GDPper and *Branch:* The correlation value of 0.785*** suggests a slight direct association. This relationship is notable with a 0.001 threshold (p-value), signifying there is less than 1% chance that this correlation arose by chance if there was no actual correlation in the population.

ATM and *Innov*: The correlation coefficient is 0.349, indicating a weak positive relationship. The p-value is 0.143, which is greater than 0.05. This implies that the relationship is not statistically meaningful at the 0.05 threshold. This suggests that there is no multicollinearity, and the factors can be used to build by linear regression.

Table 3. Pearson correlation

Variable	Indicator	GDPper	ATM	Innov	Branch
GDPper	Pearson r	–	–	–	–
	df (degrees of freedom)	–	–	–	–
	p-value	–	–	–	–
ATM	Pearson r	0.909***	–	–	–
	df (degrees of freedom)	18	–	–	–
	p-value	< .001	–	–	–
Innov	Pearson r	0.553*	0.349	–	–
	df (degrees of freedom)	18	18	–	–
	p-value	0.014	0.143	–	–
Branch	Pearson r	0.785***	0.637**	0.653**	–
	df (degrees of freedom)	18	18	18	–
	p-value	< .001	0.003	0.002	–

Note: * p < .05, ** p < .01, *** p < .001.

Table 3 and Table 4 show the leading indicators of statistical compliance (R, R^2, F) obtained by a linear regression model.

Table 4. Model validity indicators

Model compliance indicators			Comprehensive model test			
Model	R	R²	F	df1	df2	*p*
1	0.943	0.890	64.7	2	16	<.001

To enter variables, the "Input" method is used, which means that all variables were entered into the model in one step and not stepwise or by another method. R (multiple correlation coefficient) shows an R-value of 0.943, which is the correlation between observed and predicted GDP per value. This value is very close to 1, indicating a strong relationship. The coefficient of determination (R-square) is 0.890. This is a very high value, suggesting that the model accounts for a substantial portion of the GDP per capita fluctuations. This value indicates the proportion of GDP per variance that can be explained by predictors, but this is a more unbiased estimate, especially when the number of predictors is large.

F (F-statistic) is 64.7. It is a measure of how much the predictors improve the dependent variable prediction compared to no predictors at all. A larger F-statistic indicates a more helpful model. Whitefish (p-value) has a p-value of 0.001, which is less than 0.05. This means that the predictors in the model (Innov and ATM) significantly improve the model's ability to predict GDP per compared to a model without predictors. The ANOVA analysis assesses if the model's independent factors notably influence the outcome variable. Table 5 presents the regression model coefficients that indicate GDP per capita using the independent factors Innov and ATM.

Table 5. Model coefficients – GDPper

Predictor	Weight	Std. Error	t	Sig.
Constant	–1.40e-6	375223.4	–3.72	0.002
ATM	320	34.7	9.21	< .001
Innov	4434	2578.8	3.04	0.008

The constant (or intercept) is –1.40e-6. This is the GDP per value when all explanatory variables are 0. The Std. error of model is 375223.4. The t-value for the constant stands at –3.72, with a corresponding p-value of 0.002. Given that this is below 0.05, it suggests the constant holds statistical relevance.

The unstandardized coefficient (B1) for ATM is 320, which means that for every unit increase in ATM, we expect GDP to increase by 320 units, assuming all other variables remain constant. The Std. error is 34.7 and represents the number of standard deviations by which GDP per will change due to one change in the standard deviation in ATM. The t-statistic for ATM is 9.21, and the p-value is 0.001, indicating that ATM is a statistically significant predictor of GDP per.

The unstandardized factor (B2) for Innov is 4,434, which means that for every unit increase in Innov, we expect GDP to increase by 4,434 units, assuming all other variables remain constant. The Std. error is 34.7. The t-value for Innov is 3.04, with a p-value of 0.008. This implies that Innov significantly influences the prediction of GDP per.

The regression equation based on these coefficients will be:

$$GDP\ per\ capita = 320(ATM) + 4,434(Innov) - 1.40e^{-}6. \quad (2)$$

Furthermore, the tolerance values for ATM and Innov are 320 and 4,434, respectively, emphasizing the absence of multicollinearity issues in the analysis. These values indicate minimal overlap in information between ATM and Innov when predicting GDP per capita. Thus, each of these factors contributes uniquely to the predictive model. When conducting an analysis, it's essential to consistently consider collinearity data, as the presence of multicollinearity can distort results. Based on the current analysis, the model appears robust, with two primary predictors influencing GDP per capita. Future research might benefit from considering the inclusion of additional variables or employing alternative analysis methods for further examination of the obtained outcomes.

From the computed outcomes, it is possible to pinpoint specific hypotheses that were confirmed and reject those that were not:

H_1: *There is a significant relationship between the number of ATMs and GDP per capita* – accepted.

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H_2: *There is a significant relationship between the share of innovative products in GDP and GDP per capita* – accepted.

H_3: *There is a significant relationship between the share of bank branches and GDP per capita* – accepted.

4. DISCUSSION

Despite the in-depth analysis of fintech's impact on economic indicators and quality of life, there is a need to place greater emphasis on integrating research data into practical applications. The research results highlight potential areas for infrastructure and education improvement in the fintech sector. It is recommended to conduct further studies to determine the optimal strategies for introducing innovations in the banking sector and expanding access to financial services. Based on these data, governmental bodies and private companies can develop strategies aimed at enhancing fintech's positive impact on the economy and ensuring broader access to financial services for the population.

The research results indicate that the proliferation of financial technologies positively affects GDP per capita and financial accessibility, with an intertwined relationship. These results highlight the need for governments to broaden their policy considerations to enhance the effectiveness of the monetary domain through measures such as standard-setting, infrastructure development, and financial technology education. The available results showed similarity with the studies given earlier.

Thus, Kanga et al. (2022) found that the standard of living for various states is an important indicator of economic development (in particular GDP). Advancements in financial technologies (Fintech) and the growth of the banking industry positively influence the quality of life for the populace (Dermaku et al., 2023). Accordingly, increasing the accessibility of monetary services and the evolution of cashless transactions, working on the financial literacy of the population in the future, will positively impact economic growth. In addition, it is also necessary to develop the ICT sector both in the online sphere through the development of data security systems and the material component – the quality of mobile communications and the laying of fiber-optic cable to remote regions (Zhang-Zhang et al., 2021; Legowo et al., 2021; Doszhan et al., 2022). A relatively simple way to expand access to financial technologies for the population is to increase the number of ATMs, leading to participation in remote regions' economic life (Wonglimpiyarat, 2017; Long et al., 2023).

Also, a method to enhance the efficiency of financial services is to encourage innovation, especially in the banking sector (Dermaku et al., 2023). Understanding how banks' innovative practices align with long-term development goals is important to ensure positive economic results. Banks contribute to increasing the proportion of novel products compared to GDP by developing the interface, developing mobile fintech applications, and changing the ways of customer service (Fidan & Güz, 2023). Access to technological infrastructure, such as mobile phones and the Internet, holds a crucial position in promoting the adoption of FinTech and economic growth (Yoon et al., 2023).

Thus, numerous studies have collectively emphasized fintech's evolutionary impact on multiple economic sectors, from banking to economic growth, access to financial services, innovation management, and policy development. The study highlights the importance of understanding this dynamic for both scientific research and practical decision-making in the rapidly developing digital economy.

CONCLUSIONS

This study aimed to investigate the impact of financial technologies on the country's economy and the relationship between financial technology, innovation, and economic growth in Kazakhstan. During the data analysis and trend study, it was revealed that financial technologies have a significant impact on economic development. The study identified the key indicators determining the relationship between financial technologies, innovation, and economic growth.

In general, the study showed that financial technologies through innovations in business and the number of ATMs in the country affect the economy (R-squared = 0.890). The regression model is accurate, stable, and has a sufficient degree of reliability (whitefish (p-value) has a p-value of 0.001). Of course, fintech has spurred the emergence of digital financial companies that offer many benefits. At the same time, however, these same companies pose serious regulatory and security problems. Therefore, while fintech provides many opportunities to improve and bolster the effectiveness and inclusivity of financial services, addressing its related challenges is paramount for the enduring growth of the economic domain. Future research should focus on developing robust strategies and regulatory frameworks to mitigate the risks associated with Fintech and maximize its potential benefits.

As recommendations, the monetary and financial strategy should target disseminating financial technologies and the development of the business environment through innovation. However, there are risks in any area, so government decision-makers need to be careful. In conclusion, studying innovation and ATMs and understanding their connection to fintech can provide valuable insights into how technology can be used to improve financial services. It can also identify potential issues and risks, helping to guide the development of more efficient, secure, and user-friendly financial technologies.

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