“Interdependence of the banking system development and the economic growth in the context of digitalization: Case study of Azerbaijan and its key trading partners”

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INTERDEPENDENCE OF THE BANKING SYSTEM DEVELOPMENT AND THE ECONOMIC GROWTH IN THE CONTEXT OF DIGITALIZATION: CASE STUDY OF AZERBAIJAN AND ITS KEY TRADING PARTNERS

Abstract

When choosing a country as a trading partner, an important role is played by the speed, convenience, and reliability of banking services (this is primarily determined by the level of digitalization of banking activities), and the general level of economic growth of this country. The article analyzes the relationship between the efficiency of the banking system and the country's economic growth under digitalization using the example of Azerbaijan and its key trading partners. Calculations were made using data for 2010–2021 based on World Bank, IMF, and UN statistics. Principal component analysis was used to identify the most relevant indicators that describe the stability of the banking system, the level of economic development of the country, and the level of digitalization; the method of structural modeling was used to identify functional relationships between the constructed synthetic generalizing indicators. Calculations showed that the development of the banking system is much more (almost seven times) influenced by the level of digitalization in the country than the level of economic growth (coefficients for synthetic generalizing indicators formed in the process of structural modeling are 0.29 and 0.04). Modeling proved that the focus of reforms aimed at increasing the level of digitalization in the country should be an increase in the number of electronic accounts, electronic payments, the share of the population using the Internet, growth of R&D expenditures, and innovation index.

Keywords digitalization, banking, sustainability, development, economy, FinTech

JEL Classification C40, F63, G21

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INTRODUCTION

Today, the primary trend in the development of the world economy is its digitization; the introduction of digital tools in countries should be accompanied by both the legislative regulation of digital technologies and the search for new management models and business models using digital technologies of information storage, processing and transmission, which will lead to socio-economic, institutional and industrial transformations within the boundaries of individual states and the global macro-environment as a whole (Markevich, 2021).

At the current stage of development of the world economy, traditional banking activities in various countries are gradually adapting to global digital challenges. It is fashionable to consider the primary means

of digitalization of banking activities: digitization of traditional products and services (updating service channels through Internet Banking, chatbots, telebanking, mobile banking); adoption and launch of new processes (implementation of FinTech, Big data and dynamic financial data), etc.

The main advantages and opportunities of digitalization of banking activities are: higher availability of banking products and services; reduced total costs of banks due to the absence of the need to build a network of branches and offices; lower fees for servicing banking operations compared to traditional banking products etc. (Expatica, 2022; Geniusee, 2023). The main disadvantages and threats of digitization of banking activities include data security problems and privacy violations; deepening social alienation; high cost of digital transformation for banks; high level of activity dependence on technologies and energy resources etc. (Expatica, 2022; Geniusee, 2023).

Since banks are traditionally considered one of the main channels for moving financial resources in time, space and between different industries, a means of ensuring the accumulation and distribution of financial resources among various business entities (Maslenikov, 2010). That is why studying systemic convergent mutually determining relationships in the chain "digitalization – development of the banking system – economic growth" is of considerable scientific interest.

1. LITERATURE REVIEW

In the scientific literature, not only individual links of the chain "digitalization – development of the banking system – economic growth" are actively studied, but also their interrelationships, both in pairs and in a triangle.

Semenyuta and Shapiro (2023) investigated the pairwise relationships between digitalization and the development of banking systems – through the prism of the impact of economic digitalization on banking digitalization; Tyagi et al. (2022) – through the prism of research on the digitization effectiveness of banking products; Prokopenko et al. (2022) – through the prism of ways to improve customer relations in Ukraine's banking sector by developing priority digital banking products and services; Guliev et al. (2021) – through the prism of the features of the digitalization of China's banking system and the definition of the elements of this system; Dubina et al. (2020) – through the prism of determining the role of digitization in the use of services and when making strategic management decisions by banks; Kozmenko and Vasylyeva (2008) – through the prism of the conceptual foundations and organizational and economic mechanisms of the formation of the system of specialized innovation and investment banks in Ukraine; Leonov et al. (2012) – through the lens of innovation implementation by banks; Giebe et al. (2023), Baltgailis and Simakhova (2022) – through the prism of the introduction of digital innovations (big data, fintech) in banking. Digitization is seen as a way to improve the productivity of the banking system as a whole. Korneyev et al. (2022) consider digitalization in the context of an advanced approach that aims to enhance bank management at the micro-level and strengthen the efficiency of banking systems, considering the impact of digital challenges. Murshudli (2018), Murshudli and Loguinov (2019, 2020) determined that digitalization helps international banks achieve competitive advantages, creates favorable conditions for innovation, significantly increases the efficiency of international banking operations, and accelerates the growth of global financial capital flows. Boyarko and Samusevych (2011) in terms of the significant role of intangible assets in the process of transformation of the banking system; Ajibade and Mutula (2020) in the context of how big data, the fourth industrial revolution and the use of e-banking and banking systems in South Africa and Nigeria have become effective banking management solutions.

Pairwise relationships between digitalization and economic growth were investigated by Belhadi et al. (2023) through the prism of the impact of big data on the development of the country's insurance sector, Chen et al. (2023) – through the prism of the interaction between the digitalization process and economic growth in China; Bethlendi and Szőcs (2022) – in the context of studying the

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fintech ecosystem in the conditions of the activity of technological giants; Kuzior and Kwilinski (2022) explored cognitive technologies and artificial intelligence in social perceptions and their impact on the economic growth of the country; Melnyk et al. (2021a, 2021b, 2022) stated that digitalization, dematerialization of production and consumption, structural shifts in the direction of the formation of a service economy really contribute to the reduction of material use and sustainable development; Andrișan and Modreanu (2022) explored this relationship through the lens of digitization processes in the context of the fourth industrial revolution; H. Yoshimori and M. Yoshimori (2022) through the prism of the integration of cognitive and non-cognitive skills that will lead to economic growth at the digitalization stage; Fobel and Kuzior (2019) in terms of identifying the drivers of the transformation of the state economy during the transition to a digital socio-economic development model; Sadigov (2022) and Slavinskaite et al. (2022) considered it through the prism of the influence of digitalization on the principles of conducting business activities in the context of decentralization processes.

Pairwise relationships between economic growth and development of banking systems were studied by Kuznyetsova et al. (2022), Rushchyshyn et al. (2021), Grytten (2021), Vasilyeva et al. (2015), Kozmenko et al. (2014), Krykliy and Ryabichenko (2012), and Ramli et al. (2022) in the direction of finding tools to optimize the functioning of the banking sector as a key factor in economic growth. Vasilyeva et al. (2013) considered them through the prism of monitoring the development of the banking sector and identifying the causal relationship between it and economic growth, Kuznyetsova et al. (2017) in terms of developing an equilibrium model of supply and demand in the Ukrainian interbank market, which will affect the country's economic growth.

Complex relationships in the "digitalization – development of the banking system – economic growth" triangle were studied by Dluhopolskyi et al. (2023) through the prism of the impact of the COVID-19 pandemic, which caused the acceleration of digitalization and consideration of digital financial inclusion as a means of minimizing negative economic consequences and increasing the resilience of households and enterprises. Gurbanov et al. (2022) considered these relationships in the scope of studying the interaction between digitalization and COVID-19 in terms of achieving the country's financial stability; Njegovanović (2023) – through the prism of economic assessment between the sectoral exchange of the banking system and the digitization sector; Tsindeliani et al. (2023) – in terms of digitalization as an effective management solution in the field of banking operations, which contributes to the economic growth of the country.

Thus, studying the connections between digitalization, the development of the banking sector and economic growth is relevant since introducing digital products and services in banking guarantees the banking system's stability, which is strategically essential for ensuring economic growth.

2. METHODOLOGY AND METHODS

The paper aims to analyze the impact of digitalization and economic growth on the development of the banking system using structural modeling.

In the first stage, a set of indicators was formed, which to one degree or another, characterize the level of digitalization, development of the banking system, and economic growth (Table 1), the statistical data based on which will become the basis of structural modeling.

Input data were normalized in the second stage, considering stimulating and destimulating factors. Disincentives include the level of non-performing loans (NPL) in the block "Development of the banking system", the unemployment rate (UNEMPL) in the "Economic growth" block, and the poverty rate at the national border (POVERTY).

Statistically significant indicators of digitalization, development of the banking system and economic growth were selected using the method of principal components in the third stage, which uses the orthogonal transformation of a set of observations with possibly related variables into a set of variables without linear correlation, which is called principal components. The principal components

Table 1. Parameters characterizing the level of digitization, development of the banking system and economic growth (input parameters for calculations)

Sources: Bank of Israel (2022), Statista (2023), World Bank (2023).

Data block	Indicator	Designation	Units of measurement
Digitization (y1)	Retail cashless e-transactions per 1,000 adults	CASHLESS (x1)	Cond. units
	Having an e-account with a financial institution or mobile money service provider	EACCOUNT (x2)	%
	Digital payments made by the population during the past year	EPAY (x3)	%
	People who use the Internet (proportion of the population)	INTERNET (x4)	%
	Spending on research and development (share of GDP)	RESEARCH (x5)	%
	Innovation Index (0-100)	INNOVATION (x6)	Cond. units
	Import of ICT goods (share of total import of goods)	ICTIMPORT (x7)	%
Development of the banking system (y2)	Return on assets	ROA (x8)	%
	Return on equity	ROE (x9)	%
	Ratio of costs to income of banks (level of operating profitability)	CIR (x10)	%
	Share of non-performing loans	NPL (x11)	%
	Number of customer accounts per 1,000 adults	ACCOUNT (x12)	units
	The ratio of capital to bank assets	CAR (x13)	%
	Number of branches per 1,000 adult population	BRANCH (x14)	Cond. units
Economic growth (y3)	Annual GDP growth rate	GDP (x15)	%
	The annual growth rate of GNI	GNI (x16)	%
	Inflation rate (GDP deflator)	INFLATION (x17)	%
	Unemployment rate	UNEMPL (x18)	% from the total labor force
	Proportion of population living below the national poverty line	POVERTY (x19)	Cond. units
	Employment to population ratio	EMPL (x20)	%
	Gini index	GINI (x21)	Cond. units

method makes it possible to select principal components or generalized characteristics from the m-number of initial features. In this case, the initial features will be indicators characterizing each input data block. The number of factors that can be distinguished equals the number of variables when using this method. Each factor corresponds to the variance explained by this factor. These are eigenvalues.

The next step is to conduct structural modeling, which determines the structure of relationships between variables. It is worth noting that a system of joint, simultaneous equations usually contains endogenous and exogenous variables. Endogenous variables are dependent variables, which equal the number of equations in the system and are denoted by y. In this case, the endogenous variables in the first equation are synthetic parameters characterizing digitization, and in the second equation – parameters characterizing the development of the banking system. In the first equation, the exogenous variable is a synthetic parameter that denotes economic growth. In the second equation, the exogenous variables are synthetic parameters denoting economic growth and digitalization.

The structural form of the model in the right part contains coefficients bik for endogenous variables and coefficients aij for exogenous variables, which are called structural coefficients of the model. All variables in the model are expressed in deviations from the average level, i.e. x means $x - \underline{x}$, and y means, respectively, $y - \underline{y}$. Therefore, there is no free term in each equation of the system.

$$\begin{cases} y_1 = b_{12}y_2 + b_{13}y_3 + \ldots + b_{1m}y_m + a_{11}x_1 + a_{12}x_2 + \ldots + a_{1n}x_n + \varepsilon_1 \\ y_2 = b_{21}y_2 + b_{23}y_3 + \ldots + b_{2m}y_m + a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n + \varepsilon_2 . \\ y_3 = b_{31}y_1 + b_{32}y_2 + \ldots + b_{3m}y_m + a_{21}x_1 + a_{22}x_2 + \ldots + a_{2n}x_n + \varepsilon_2 \end{cases} \quad (1)$$

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The system of structural equations has the following generalized form (Shabashev et al., 2016):

Formalization of the model of structural analysis of the relationships of system-forming components involves the following sequence of stages:

1. Graphical interpretation of the model using the construction of a path diagram will provide an opportunity to visualize the structural and functional connections between digitalization, the development of the banking system and economic growth.

2. Identification of multifactorial regression dependencies: For the first equation, the role of the endogenous variable is digitalization, and the exogenous one is economic growth; for the second equation, the role of the endogenous variable is played by the banking system, and the exogenous variables are economic growth and digitalization. At this step, an iterative process is primarily conducted that characterizes the success or failure of identifying multifactor regression dependencies. In this case, Discrepancy characterizes the current value of the discrepancy function being minimized. RCos is the current value of the maximum cosine of residuals criterion, which should be close to 0. Lambda should equal 1.0, which characterizes the stepwise transition to the successive iterations. MAXCON, which characterizes the conduct of the unlimited evaluation. NRC is the number of excessive constraints, which should be close to 0. NAIC is the number of active limiting inequalities. Maximum Residual Cosine characterizes the success of the iteration process. ICSF Criterion and ICS Criterion are indicators of the stability of the obtained model to multiplication by a constant scale factor.

3. Checking the adequacy of the built model based on a set of the following parameters:

- compliance of the constructed model with the initial data;
- non-centrality indices (Stinger-Lind, MacDonald);
- correspondence of the covariance matrices of the initial data and those transformed due to the structural analysis.

The final stage of the calculations is the analysis of the identified connections between digitalization, the development of the banking system and economic growth. Accordingly, recommendations are being developed to overcome digital challenges. It will guarantee effective management of a bank to achieve the goal of economic growth.

A qualitative analysis of digitization of banking activities in Azerbaijan and its main trading partners was conducted. Azerbaijan and 13 countries, its main trading partners (Georgia, Italy, Israel, Germany, Portugal, Turkey, Russia, Ukraine, Croatia, Great Britain, USA, China and Japan), were selected for further analysis based on the volumes of exports and imports as of the end of 2021 (Table 2).

Table 2. Azerbaijan's trading partner countries by export and import volumes as of the end of 2021

Source: Own study based on data from the Tradeconomy (2021).

Country	Export		Import	
	million USD	%	billion dollars	%
Italy	9,240	41%	4,190	3.5%
Turkey	2,810	12.6%	1,840	15.7%
Russia	2,730	18.8%	975	2.55%
China	–	–	1,630	14%
Israel	898	4.0%	–	–
Croatia	751	3.4%	–	–
Georgia	661	3%	–	–
Germany	650	2.9%	632	5.4%
Portugal	587	2.7%	–	–
USA	–	–	442	3.8%
Great Britain	–	–	271	2.3%
Japan	–	–	259	2.2%
Ukraine	–	–	468	4%

Since 2013, the number of companies accepting payments for utility services through special bank terminals has increased in Azerbaijan, and a new version of the Internet Banking system has been introduced. Also, as of the end of 2020, more than 70% of bank cards were contactless, which indicates the possibility of linking them to Apple Pay and Google Pay and, accordingly, payment using a mobile phone and smart watch (Abbasov et al., 2019).

Azerbaijan's trading partners are also actively implementing digital technologies in banking activities.

A 2021 study by Accenture in the UK found that banks that only used digital technologies and adaptive models achieved 4% higher revenues than traditional banks. As of the end of 2021, 3 out of 5 customers were considering banking services at a bank without physical branches (Cooper, 2022). Georgia ranked first worldwide regarding the spread of contactless payments as of the end of 2022 (Thunes, 2023). Also, in 2021, a mobile business bank designed for instant business transactions was launched.

The main areas of banking digitization in Italy at the end of 2019 were the digitalization of traditional services, the adoption of new processes or delivery of innovative products (e.g., FinTech) and the use of big data (Strategy & PWC, 2023).

Israel has become one of the most innovative countries regarding the digitalization of the banking sector. At the beginning of 2022, the first digital bank was created, and electronic currency e-shekel began to be used (Bank of Israel, 2022).

The transformation of the state into a cashless society is expected in China to contribute to the growth of the digital services market in the period 2022–2027, with an average annual rate of 8.8% (Strategy & PWC, 2023).

At the end of 2020, 37% of personal consumer loans in Turkey were granted through digital channels. As of September 2021, 55% of bank customers did not visit bank branches (The Central Bank of the Republic of Turkey, 2022).

42 domestic and international payment systems were operating in Ukraine by the end of 2018, and by the end of 2021, every fifth active payment card was contactless (National Bank of Ukraine, 2021).

At the beginning of 2022, about 60% of the population in Germany used Internet banking (Deutsche Bundesbank, 2022); in Portugal about 40% of the population (Expatica, 2022); about 80% in the USA and Croatia.

Digitization of banking activity is also taking place through the creation of neo banks: the first such bank appeared in 2010 in Japan.

Also, popular methods of digitalization of the banking system are the use of cryptocurrency (USA), blockchain technologies (China), and the use of dynamic financial data and Big Data (Japan).

At the beginning of 2023, the following countries were the leaders in the volume of digital banking transactions: China, the United States, Great Britain, Japan, and Germany (Digital Payments, Statista, 2023). These countries are considered the world's main financial and trade centers and are also Azerbaijan's leading trading partners.

3. RESEARCH RESULTS

Study countries: Azerbaijan, Georgia, Italy, Israel, Germany, Portugal, Turkey, Russia, Ukraine, Croatia, Great Britain, USA, China and Japan.

Using the principal component analysis within each synthetic generalized indicator, digitalization (DIGITAL), development of the banking system (BANKING) and economic growth (ECONOMY), 2 main components were formed, which cumulatively explain respectively 81.1%, 69.9% and 68.8% of the variance of traits (Table 3).

According to Table 3, the cumulative percentage of the total variance explained by the main components of digitalization is 81.1%. At the same time, the first component explains 62.8% of the total variance, and the second – 18.3%. This indicates that the variables included in the first component exert a stronger influence on the level of digitization. The eigenvalues of these two components exceed unity. The cumulative percentage of the total variance for the components of the development of the banking system is 59.9%, and for the parameters of economic growth – 58.8%.

The next step of the research is the allocation of factor loadings in each studied block of parameters (Table 4).

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Table 3. Eigenvalues and the share of total variance for the components formed by synthetic generalized indicators of digitalization, development of the banking system and economic growth

Source: Authors' calculations.

Main components	Eigenvalues	Percentage of total variance	Cumulative percentage of total variance
DIGITAL			
Main component 1	4,398	62.8	62.8
Main component 2	1,280	18.3	81.1
BANKING			
Main component 1	2,329	33.2	33.2
Main component 2	1,867	26.7	59.9
ECONOMY			
Main component 1	2,340	33.4	33.4
Main component 2	1,780	25.4	58.8

Table 4. Factor loadings of the main parameters characterizing the level of digitization, economic growth and banking system development

Source: Authors' calculations.

Indicator	Main component 1	Main component 2
DIGITAL		
CASHLESS	0.618	0.609
EACCOUNT	0.916	0.062
EPAY	0.938	0.174
INTERNET	0.752	0.293
RESEARCH	0.795	–0.376
INNOVATION	0.931	–0.151
ICTIMPORT	0.479	–0.789
BANKING		
ROA	–0.809	–0.210
ROE	–0.898	–0.231
CIR	0.736	–0.036
NPL	–0.047	–0.814
ACCOUNT	0.006	0.740
CAR	–0.561	0.650
BRANCH	0.077	–0.364
ECONOMY		
INFLATION	–0.334	0.016
UNEMPL	0.755	–0.442
GNI	0.427	0.772
GDP	0.811	0.434
POVERTY	–0.637	0.448
EMPL	0.838	–0.212
GINI	0.420	0.289

Determination of factor loadings on all three links of the studied chain "digitalization – development of the banking system – economic growth" confirmed a more substantial influence of the parameters in the first component than those in the second component. Cells with statistically significant indicators are marked in grey. It is worth noting that all the listed parameters have values of factor loadings on the module more than 0.7. Thus, this study uses statistically significant parameters for structural modelling in the first component. Among the parameters of digitalization, electronic accounts (EACCOUNT); electronic payments (EPAY); share of the population using the Internet (INTERNET); research and development expenditures (RESEARCH) and innovation index (INNOVATION) are highlighted. The parameters of the development of the banking system return

Source: Authors' calculations.

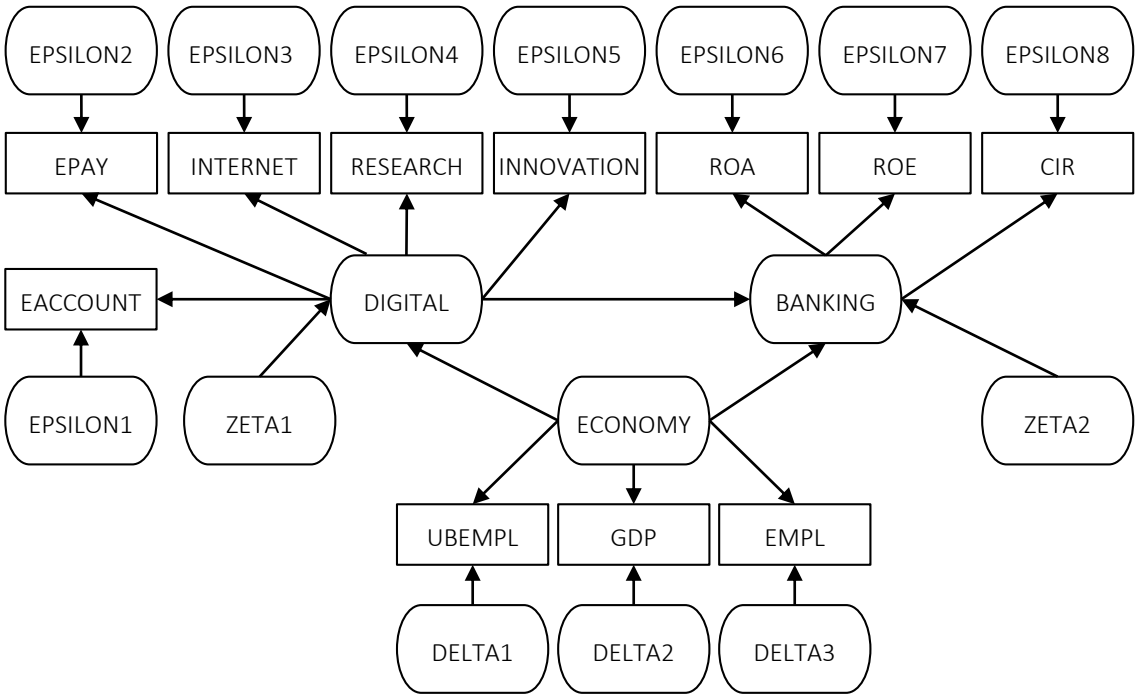

Figure 1. Covariance matrix of initial data

on assets (ROA), return on equity (ROE) and the ratio of income to expenses of the bank (CIR), and the parameters of economic growth are the unemployment rate (UNEMPL), the annual GDP growth rate (GDP) and the employment rate (EMPL).

The next step is to carry out basic structural modeling, which will help determine the structure of relationships between the specified synthetic generalizing indicators. Figure 1 shows the covariance matrix of the normalized initial data.

Table 5. Results of the created structural model

Source: Authors' calculations.

(ECONOMY)-1 → [UNEMPL]	(BANKING) → [ROA]
(ECONOMY)-2 → [GDP]	(BANKING)-11 → [ROE]
(ECONOMY)-3 → [EMPL]	(BANKING)-12 → [CIR]
(DELTA1) → [UNEMPL]	(EPSILON6) → [ROA]
(DELTA2) → [GDP]	(EPSILON7) → [ROE]
(DELTA3) → [EMPL]	(EPSILON8) → [CIR]
(DELTA1)-4-(DELTA1)	–
(DELTA2)-5-(DELTA2)	(EPSILON1)-13-(EPSILON1)
(DELTA3)-6-(DELTA3)	(EPSILON2)-14-(EPSILON2)
–	(EPSILON3)-15-(EPSILON3)
(DIGITAL) → [EACCOUNT]	(EPSILON4)-16-(EPSILON4)
(DIGITAL)-7 → [EPAY]	(EPSILON5)-17-(EPSILON5)
(DIGITAL)-8 → [INTERNET]	(EPSILON6)-18-(EPSILON6)
(DIGITAL)-9 → [RESEARCH]	(EPSILON7)-19-(EPSILON7)
–	(EPSILON8)-20-(EPSILON8)
(DIGITAL)-10 → [INNOVATI]	(ZETA1) → (DIGITAL)
(EPSILON1) → [EACCOUNT]	(ZETA2) → (BANKING)
(EPSILON2) → [EPAY]	(ZETA1)-21-(ZETA1)
(EPSILON3) → [INTERNET]	(ZETA2)-22-(ZETA2)
(EPSILON4) → [RESEARCH]	–
(EPSILON5) → [INNOVATI]	(ECONOMY)-23 → (DIGITAL)
–	(ECONOMY)-24 → (BANKING)
–	(DIGITAL)-25 → (BANKING)

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First, let us use the graphic capabilities of the Statistica program and build a path diagram that most adequately describes the system of interrelationships between digitalization, the development of the banking system, and economic growth. The results of the created model are shown in Table 5.

It is worth noting that the Statistica program independently determined which model (load) parameters are free and which are not. So, in the line (ECONOMY) > [UNEMPL] between the synthetic generalized ECONOMY indicator and the UNEMPL parameter, there is a number 1, which corresponds to the free value of a1, which is further evaluated by the program. In contrast, the line (DIGITAL) > [EACCOUNT] does not have a free value number; that is, the coefficient for DIGITAL equals one.

According to the obtained model, the regression equations are determined:

$$ECONOMY = a_1 \cdot UNEMPL + Delta_1, \quad (2)$$

$$ECONOMY = a_2 \cdot GDP + Delta_2, \quad (3)$$

$$ECONOMY = a_3 \cdot EMPL + Delta_3, \quad (4)$$

$$ECONOMY = EACCOUNT + EPSILON_1, \quad (5)$$

$$DIGITAL = a_7 \cdot EPAY + EPSILON_2, \quad (6)$$

$$DIGITAL = a_8 \cdot INTERNET + EPSILON_3, \quad (7)$$

$$DIGITAL = a_9 \cdot RESEARCH + EPSILON_4, \quad (8)$$

$$DIGITAL = a_{10} \cdot INNOVATION + EPSILON_5, \quad (9)$$

$$BANK = ROA + EPSILON_6, \quad (10)$$

$$BANK = a_{11} \cdot ROE + EPSILON_7, \quad (11)$$

$$BANK = a_{12} \cdot CIR + EPSILON_8, \quad (12)$$

$$DIGITAL = a_{23} \cdot ECONOMY + ZETA_1, \quad (13)$$

$$BANKING = a_{24} \cdot ECONOMY + a_{25} \cdot DIGITAL + ZETA_2. \quad (14)$$

A graphical interpretation of the model is shown in Figure 2.

After the model is written in the Path1 language and the analysis parameters are set, multivariate regression relationships between digitalization, the development of the banking system, and economic growth are identified. First, let us start the iterative procedure of estimating the unknown parameters. Figure 3 shows the table (Iteration Results) of the successfully completed iteration process results.

Discrepancy is 2.364. RCos is close to 0, indicating the model's high quality. Lambda 1.0 means that the first full step reduced the value of the disagreement function enough to proceed to the next iteration. MAXCON was 0, indicating unlimited evaluation. The NRC is 0, which means no excessive restrictions. NAIC was 0, meaning there are no active limiting inequalities.

Next, a detailed analysis of the results of structural modeling was conducted (Figure 4).

Maximum Residual Cosine is 0, which characterizes the success of the iteration process. ICSF

Source: Authors' calculations.

Covariances (Spreadsheet28)
Casewise deletion of MD
N=156

Variable	E-ACCOUNT	E-PAYMENT	INTERNET	RESEARCH	INNOVATION	ROA	ROE	CIR	UNEMPL	GDP	EMPL
E-ACCOUNT	0,05	0,06	0,03	0,04	0,03	-0,01	-0,01	0,01	0,01	-0,01	0,00
E-PAYMENT	0,06	0,09	0,04	0,04	0,04	-0,02	-0,01	0,02	0,02	-0,02	0,00
INTERNET	0,03	0,04	0,03	0,02	0,02	-0,01	-0,00	0,01	0,02	-0,01	0,00
RESEARCH	0,04	0,04	0,02	0,05	0,03	-0,00	-0,00	0,01	0,02	0,00	0,01
INNOVATION	0,03	0,04	0,02	0,03	0,03	-0,01	-0,00	0,01	0,02	-0,00	0,01
ROA	-0,01	-0,02	-0,01	-0,00	-0,01	0,18	0,07	-0,02	-0,00	0,05	0,00
ROE	-0,01	-0,01	-0,00	-0,00	-0,00	0,07	0,05	-0,02	0,00	0,03	0,00
CIR	0,01	0,02	0,01	0,01	0,01	-0,02	-0,02	0,02	0,00	-0,02	-0,00
UNEMPL	0,01	0,02	0,02	0,02	0,02	-0,00	0,00	0,00	0,04	-0,00	0,01
GDP	-0,01	-0,02	-0,01	0,00	-0,00	0,05	0,03	-0,02	-0,00	0,10	0,01
EMPL	0,00	0,00	0,00	0,01	0,01	0,00	0,00	-0,00	0,01	0,01	0,01

Figure 2. Graphical interpretation of the created model

Source: Authors' calculations.

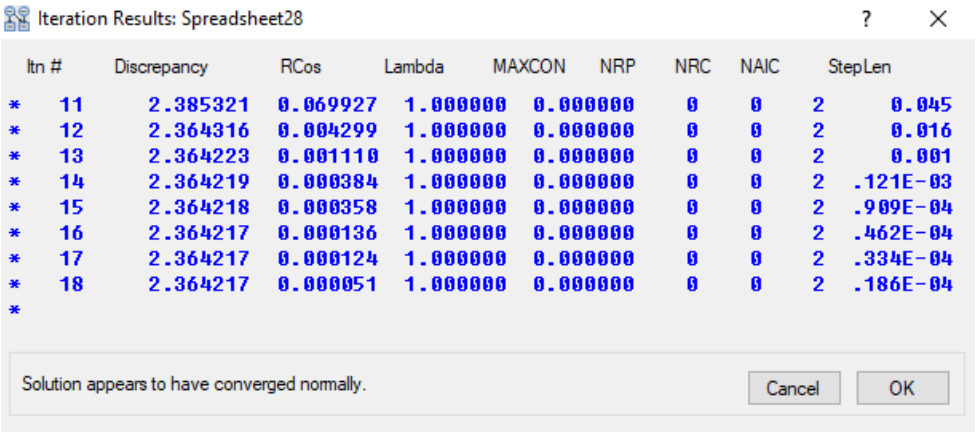

Figure 3. Output window of the iterative process and the results

Criterion and ICS Criterion are 0, confirming the obtained model's robustness to multiplication by a constant scale factor. The proposed model is invariant to scale change.

Chi-square Statistic contains information about the truth of the null hypothesis, that is, the exact correspondence of the constructed model to the initial data. The actual $\chi 2$ statistic is 366.4, which exceeds the tabulated value. Thus, the connection between digitization, the development of the banking system and economic growth is confirmed. p-level takes a value close to zero, indicating the model's adequacy.

Next, the obtained relations between the blocks of digitization – development of the banking system– economic growth will be analyzed (Table 6).

Table 6. Mathematical interpretation of the connections between digitization, development of the banking system and economic growth based on structural modeling

Source: Authors' calculations.

Block	Mathematical interpretation of connections
Economic growth (ECONOMY)	ECONOMY = –0.191 · UNEMPL
	ECONOMY = 0.004 · GDP
	ECONOMY = 0.063 · EMPL
Digitalization (DIGITAL)	DIGITAL = 1.361 · EPAY
	DIGITAL = 0.605 · INTERNET
	DIGITAL = 0.748 · RESEARCH
	DIGITAL = 0.650 · INNOVATION
Development of the banking system (BANKING)	BANKING = 0.713 · ROE
	BANKING = –0.240 · CIR
Connections between blocks	DIGITAL = 0.097 · ECONOMY
	BANKING = 0.036 · ECONOMY + 0.289 · DIGITAL

Source: Authors' calculations.

	Value
Discrepancy Function	2,364
Maximum Residual Cosine	0,000
Maximum Absolute Gradient	2,242
ICSF Criterion	-0,000
ICS Criterion	0,000
ML Chi-Square	366,454
Degrees of Freedom	41,000
p-value	0,000
RMS Standardized Residual	0,150

Figure 4. Structural modeling results

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Source: Authors' calculations.

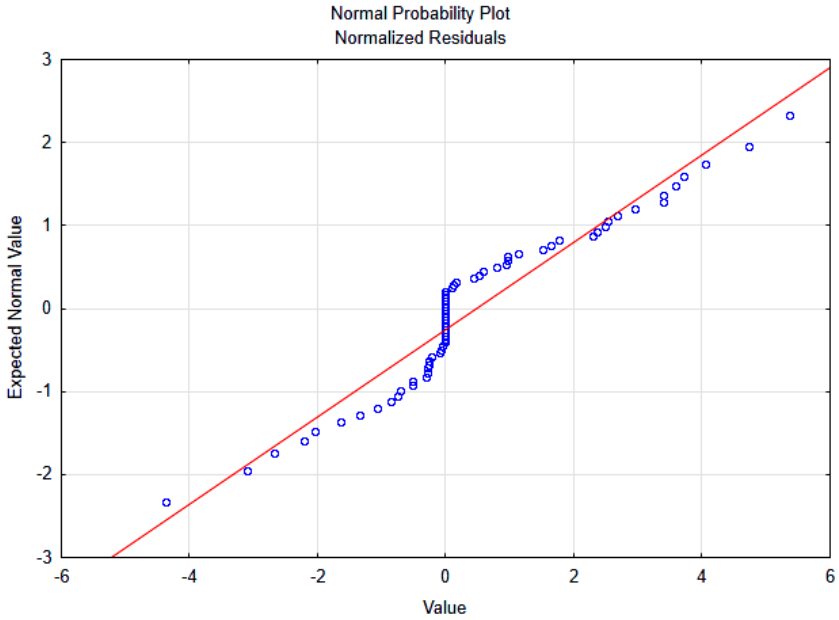

Figure 5. Normal probability plot

An important stage of structural modeling is checking the quality of the constructed model. The Stinger-Lind parameter (values less than 0.05 indicate a high model fit) and MacDonald's non-centrality (a value greater than 0.95 confirms a good model fit) are used.

To check the adequacy of the model, a normal probability plot is used, which corresponds to the distribution of residuals to the normal law (Figure 5).

The points are close to the line in the figure (Figure 5), meaning the distribution of residuals corresponds to the normal law. Thus, the built model is qualitative.

This study will use another tool to check the quality of the model: assessment of the correspondence of the covariance matrices of the initial data and those transformed as a result of the structural analysis. Figure 6 shows the Reproduced Matrix, which confirms the adequacy of the constructed model.

The final stage of structural modeling is the analysis of the identified relationships between digitalization, the development of the banking system and economic growth based on the results of structural modeling.

The following conclusions can be drawn from the equations given in Table 7:

- an increase in the unemployment rate by 1% reduces the level of the synthetic generalizing indicator ECONOMY by 0.191%;

Source: Authors' calculations.

	Reproduced Matrix (Spreadsheet28)										
	EACCOUNT	EPAY	INTERNET	RESEARCH	INNOVATI	ROA	ROE	CIR	UNEMPL	GDP	EMPL
EACCOUNT	0,054	0,064	0,028	0,035	0,031	-0,010	-0,007	0,002	0,019	-0,000	0,006
EPAY	0,064	0,094	0,039	0,048	0,042	-0,014	-0,010	0,003	0,025	-0,001	0,008
INTERNET	0,028	0,039	0,032	0,021	0,019	-0,006	-0,004	0,001	0,011	-0,000	0,004
RESEARCH	0,035	0,048	0,021	0,052	0,023	-0,008	-0,005	0,002	0,014	-0,000	0,005
INNOVATI	0,031	0,042	0,019	0,023	0,027	-0,007	-0,005	0,002	0,012	-0,000	0,004
ROA	-0,010	-0,014	-0,006	-0,008	-0,007	0,182	0,075	-0,025	0,002	-0,000	0,001
ROE	-0,007	-0,010	-0,004	-0,005	-0,005	0,075	0,053	-0,018	0,001	-0,000	0,000
CIR	0,002	0,003	0,001	0,002	0,002	-0,025	-0,018	0,020	-0,000	0,000	-0,000
UNEMPL	0,019	0,025	0,011	0,014	0,012	0,002	0,001	-0,000	0,037	-0,001	0,012
GDP	-0,000	-0,001	-0,000	-0,000	-0,000	-0,000	-0,000	0,000	-0,001	0,095	-0,000
EMPL	0,006	0,008	0,004	0,005	0,004	0,001	0,000	-0,000	0,012	-0,000	0,010

Figure 6. Reproduced matrix

- an increase in GDP by 1% increases the level of the synthetic generalizing indicator ECONOMY by 0.004%;
- an increase in the level of population employment by 1% increases the level of the synthetic generalizing indicator ECONOMY by 0.06%;
- an increase in digital payments made by the population by 1% increases the level of the synthetic generalizing indicator DIGITAL by 1.36%;
- an increase in the share of the population using the Internet by 1% increases the level of the synthetic generalizing indicator DIGITAL by 0.6%;
- an increase in research and development costs by 1% increases the level of the synthetic generalizing indicator DIGITAL by 0.75%;
- an increase in the Innovation Index by 1% increases the level of the synthetic generalizing indicator DIGITAL by 0.65%;
- an increase in the return on equity by 1% increases the level of the synthetic generalizing indicator BANKING by 0.71%;
- a 1% increase in the ratio of expenses to the bank's income reduces the level of the synthetic generalizing indicator BANKING by 0.24%;
- an increase in the synthetic generalizing indicator ECONOMY by 1% increases the level of the synthetic generalizing indicator DIGITAL by 0.1%;
- an increase in synthetic generalizing indicators ECONOMY and DIGITAL by 1% increases synthetic generalizing indicator BANKING by 0.04% and 0.289%, respectively.

Thus, the introduction of innovations, cashless payments, FinTech guarantees economic growth, which is confirmed by the results of the first equation. Implementing innovations in the banking system by a bank's management and considering the factors of economic growth of the country will contribute to the effective development of the banking system, which is confirmed by the data of the second structural equation.

4. DISCUSSION

Most authors evaluate the relationship between traditional and digital banking without considering the impact of economic growth. The approach presented in this paper has significant advantages over the approach of Metawa et al. (2023), who consider digitalization in the context of the banking system but do not consider the factors of the state's economic development. This paper examines the potential direct and indirect effects of the National Bank of Egypt's (NBE) digitalization and its financial inclusion on credit risk. The study results show that central bank digitization has direct and indirect effects through the mediating variable, financial accessibility. This study also provides insight into the relationship between digitization, credit, and financial inclusion.

Kolodiziev et al. (2021) studied the competitiveness of Ukrainian banks under the influence of the digitalization of the economy, the dynamic spread of electronic payments and electronic commerce, as well as innovative technologies aimed at providing digital services, but did not consider the impact of economic growth. It was determined that when switching to the Online Platform business model, the bank can expand the range of banking products, attract more customers, form a competitive policy, and gain competitive advantages. In contrast, the approach outlined in this study considers the influence of the country's economic growth indicators.

Dluhopolskyi et al. (2023) assessed the impact of the COVID-19 pandemic on digital financial accessibility by constructing and calculating an integrated index of digital financial accessibility. However, the approach outlined in this article differs in that it analyzes the impact of parameters of economic growth and the development of the banking system as a whole.

Ajibade and Mutula (2020) note that big data, the fourth industrial revolution and the use of e-banking and banking systems in South Africa and Nigeria have become effective management solutions for the banking system. The authors argue that the security, efficiency and inte-

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gration of banking systems are critical to the African continent's sustainable development but do not consider key parameters of countries' economic growth.

Thus, this study proposes an improved approach to assessing digitalization in determining its connection with the development of the banking sector and economic growth.

CONCLUSION

In the context of the research goal, an analysis of the impact of digitization of socio-economic relations and economic growth in the country on the development of the banking system was carried out using structural modeling tools. This analysis was conducted for Azerbaijan and its main trading partners (Italy, Israel, Georgia, Germany, China, Portugal, Turkey, Ukraine, Great Britain, USA, Croatia and Japan) during 2010–2021.

Four synthetic generalized indicators were introduced into the study, denoting the digitization of socio-economic relations (DIGITAL), economic growth in the country (ECONOMY), and development of the banking system (BANKING) to build structural equations. As a result of the factor analysis, the four most relevant parameters of digitalization were selected: the percentage of digital payments made by the population during the past year; the share of people who use the Internet; the share of research and development costs; innovativeness index. Similarly, indicators describing the development of the banking system and economic growth were selected. It was determined that in the structure of the block "Development of the banking system", the parameters return on assets (ROA), return on equity (ROE), and the ratio of income to expenses of a bank (CIR) exert the most significant influence. In the "Economic growth" block, the parameters unemployment rate (UNEMPL), annual GDP growth rate (GDP) and employment rate (EMPL) exert the most significant influence.

The structural modeling made it possible to formalize the functional relationships between synthetic generalized indicators of digitalization, banking system development, and economic growth. As a result, two main structural equations were obtained.

The first equation illustrates a positive statistically significant relationship between economic growth and digitalization, with an increase in the synthetic generalizing indicator ECONOMY by 1%, the level of the synthetic generalizing indicator DIGITAL increases by 0.1%.

The second equation shows that a 1% increase in the synthetic generalizing indicators of ECONOMY and DIGITAL increases the level of the synthetic generalizing indicator of BANKING by 0.04% and 0.289%, respectively.

Thus, the development of the modern banking system depends to a greater extent on digitalization processes and much less on economic growth. In other words, a country with a lower level of economic growth but with high rates of innovative development will have a more efficient banking system.

AUTHOR CONTRIBUTIONS

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