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Foreign Experience in Building an Algorithmic Model for the Formation of Banking Ecosystems

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ABSTRACT

The article is devoted to the study of foreign experience in creating algorithmic models for the formation of banking ecosystems. The conceptual approaches and practical implementations used by the world's leading banks to integrate financial and non-financial services into a single digital platform are considered. Special attention is paid to the principles of ecosystem building, including the use of artificial intelligence, machine learning, and cloud technologies to improve customer engagement. The key advantages and challenges associated with the digital transformation of the banking sector, including data management, cybersecurity, and regulatory constraints, are discussed. The results of the study emphasize that algorithmic models of the formation of banking ecosystems contribute to increasing the competitiveness and sustainability of financial institutions, opening up new opportunities for business development and improving customer service. Reducing the share of factors such as payment calculations in explaining changes in equity allows us to consider them as auxiliary to forecasting operating expenses. The findings confirm the possibility of creating an adaptive model that redistributes priorities depending on changes in the external and internal conditions of banking activity. The recommendations are aimed at adapting best international practices in the context of national markets.

INTRODUCTION

In modern conditions of global digitalization, the banking sector is faced with the need to transform traditional business models. One of the key directions of such transformation is the creation of banking ecosystems — integrated platforms combining financial and non-financial services using modern technologies (Al-Omoush & Gomez-Olmedo, 2024). The ecosystem approach allows banks not only to strengthen their market positions, but also to expand the range of services offered, improving customer experience and generating new sources of income (Vinuela & Sapena, 2024).

The world's leading banks, such as JPMorgan Chase, HSBC, and DBS, are actively developing ecosystem models by implementing artificial intelligence, machine learning, and blockchain technologies to automate processes, improve decision-making accuracy, and provide personalized service. This approach allows not only to adapt to changes in the market environment, but also to set new standards in the financial sector.

The purpose of this study is to study foreign experience in building algorithmic models of banking ecosystems, to identify key factors of their success, as well as the possibilities of adapting these approaches in national conditions. The research focuses on the consideration of structural and technological solutions, as well as the analysis of the economic efficiency of the implementation of the ecosystem approach.

The relevance of the topic is due to the growing competition in the banking sector, where success is determined not only by the quality of services provided, but also by the ability to innovate, be flexible, and have a strategic vision. Consideration of foreign experience will allow us to identify best practices and develop recommendations for optimizing the processes of digital transformation of the banking sector.

The hypothesis of the study is that effective management of banking ecosystems directly depends on key drivers influencing changes in equity, such as fee income, corporate loans, interbank loans and settlements. Commission income and corporate loans have the most significant impact, which implies their priority use in algorithmic models to optimize resource allocation and increase the sustainability of banking ecosystems.

1. MATERIALS AND RESEARCH METHODS

The following methods were used to conduct this study:

- statistical analysis - conducting statistical tests and analyzing data to confirm the hypothesis of the study;

- correlation and regression analysis, used to assess the degree of influence of each variable on the change in equity. The calculation of regression coefficients (bi) allowed us to determine the directions and strength of the influence of factors.;
- a comparative analysis method that allowed us to evaluate the results of the study in the context of international experience and identify the features of the banking ecosystem of Kazakhstan;
- the method of standardized coefficients - the calculation of standardized coefficients (Ii) allowed us to determine the share of each factor in explaining changes in equity, which is critically important for the formation of an algorithmic model;
- economic and mathematical modeling - a linear regression model has been developed to build an algorithmic model of the formation of banking ecosystems. Standard formulas were used to assess the impact of factors on the key indicators of the banking system.;
- a systematic approach is a comprehensive consideration of all factors, their interrelationships and integration into an algorithmic model of the formation of banking ecosystems.

These methods ensure the reliability of the research results and make it possible to substantiate recommendations for improving the structure and management of banking ecosystems in the face of changes in the external and internal environment.

2. LITERATURE REVIEW

The financial ecosystem is developing in the context of digital transformation and integration of global trends, contributing to the creation of new opportunities for the banking sector, businesses and consumers. Considering the foreign experience of ecosystems created by large banks, it is necessary to note their features and key elements (Table 1).

Table 1. Comparison of ecosystems created by large banks

№	*Bank*	*Feature*	*Key elements of the ecosystem*	*Ecosystem features*

1	JPMorgan Chase (USA) [1]	JPMorgan Chase uses an ecosystem approach to integrate its financial products with various digital services. The focus is on platforms that provide convenience for private and corporate clients.	- payment platforms: Zelle (real-time transfers); - investment services: You Invest (online investment platform); - partner programs with technology companies such as Amazon.	- integration of artificial intelligence-based solutions to personalize recommendations; - great emphasis on cybersecurity and customer data protection.
2	DBS Bank (Singapore) [2]	DBS Bank has been recognized as one of the world's leading digital banks due to its strategy of building a fully integrated ecosystem.	- financial management platforms for business (DBS BusinessClass); - virtual banks and mobile applications such as Digibank; - integration with non-banking services, including platforms for travel and e-commerce	- using machine learning to analyze customer behavior; - emphasis on minimizing human interaction through full digitalization.
3	Santander (Spain) [3]	Santander has successfully integrated banking services with various technology platforms, focusing on the development of small and medium-sized businesses.	Openbank: one of the largest digital platforms in Europe; - Small business lending platforms (Santander InnoVentures); - integration with blockchain systems such as Ripple for cross-border payments.	- support for startups and fintech companies through the venture division; - innovative platforms for servicing small and medium-sized enterprises.
4	HSBC (United Kingdom	HSBC is focused on creating a global ecosystem that supports operations in different regions and sectors of the economy.	- platforms for international business: HSBCnet; - integration of asset management and insurance services; - innovations in the field of green finance and sustainable development	- using cloud technologies to unify services; - support for ESG (environmental, social and corporate governance) within the ecosystem
5	of Great Britain) [4]	ICICI Bank actively uses fintech solutions to build an ecosystem focused on digital transformation.	- mobile applications for retail customers such as iMobile; - digital business lending platform – InstaBIZ; - partnerships with Indian startups and fintech companies	- localization of products to meet the specific needs of regional markets; - fast scaling through digital solutions
6	ICICI Bank (India) [5]	BBVA integrates cutting-edge technologies, focusing on financial inclusion and digital platforms	- Open Banking platform for developers; - digital solutions for lending to small businesses and individuals; - focus on mobile payments through the BBVA Wallet app	- active use of the API to connect external developers; - participation in startup incubators and accelerators

Source: Compiled by the author based on the sources

Large banks such as JPMorgan Chase, DBS Bank, and Santander use different approaches to build ecosystems. The main differences are in the level of digitalization, integration with non-banking services, and targeting specific customer segments. The experience of these banks shows that an ecosystem approach helps to increase competitiveness and customer retention.

Each of the major banks demonstrates a unique approach to building an ecosystem. JPMorgan Chase and Santander are focused on corporate clients, DBS Bank and BBVA focus on digital platforms and mobile solutions, and HSBC and ICICI Bank focus on globalization and localization of their ecosystems, respectively. Such diverse experiences can serve as a basis for developing an optimal ecosystem model that takes into account the specific needs of the region or the target audience.

The role of the digital economy in economic transformation is becoming more and more noticeable (Chen, W. et al., 2023) [7], (Tian et al., 2021) [8]. Financial products combining online standardization and regional customization can provide a more convenient payment method, a more efficient workflow, and

lower-cost credit products for consumers and service providers in the industry chain (Huang and Hao, 2021) [9]. Modern financial institutions and Internet companies are actively implementing advanced technologies such as big data, IoT, cloud computing, blockchain, and artificial intelligence into their operations. These innovative technologies are used to create new financial business models that include finance, payments, and investments. This combination of finance and digital technologies is called digital finance (Huang and Huang, 2018). It contributes to the improvement of risk management through the use of technological innovations [10]. Foreign authors Shen G., Lin G., Ouyang A. The influence of various factors on the credit policy of commercial banks is considered, and country differences in banking activities are identified [11]. The issues of credit policy transformation in the context of digital transformation have been studied in the work of Azzawi A., Fouad J. [12].

The integration of online standardization with regional customization of financial products helps create more convenient payment methods, improve workflows, and reduce the cost of credit products for consumers and service providers in various industries. Modern financial institutions and Internet companies are actively implementing advanced technologies that contribute to the creation of new financial business models covering finance, payments and investments. The combination of finance and digital technologies, known as digital finance, significantly improves risk management through the application of technological innovations. The digital transformation of the financial sector not only increases the efficiency and competitiveness of banking institutions, but also opens up new opportunities for the development and optimization of credit policy and digital business models, being an important factor for sustainable economic growth in the digital economy.

Over the past few years, the volume of data has grown exponentially, and it has attracted a lot of attention due to its impact on society (Barrett and Greene, 2023) [13], (Muniswamaiah et al., 2023) [14]. The ability to collect and store ever-growing amounts of data, made possible by technological progress and lower computing and storage costs, has opened up new business opportunities and changed the way companies operate (Chen et al., 2012) [15], (Mamonov and Triantoro, 2018) [16]. The targeted integration of new technologies requires the provision of opportunities for academia and industry to explore and experiment with such technologies. The banking sector is increasingly aware of the need to introduce robotic consulting. The introduction of this service can lead to an increase in the efficiency of banks, improve the quality of customer service, and strengthen the image of banks as innovative institutions. Robo-advisory uses data about customers, their behavior and preferences obtained by banks from various communication channels (Ozheshko., Piotrovsky D., 2024) [17].

Algorithmic trading supported by computer algorithms has become widespread (A. Azzutti, 2022) [18]. It is especially common in high-frequency trading (V. Manakhov, 2015) [19]. Artificial intelligence and machine learning play a crucial role in the development of complex algorithms capable of analyzing large datasets and identifying patterns beyond human capabilities. This achievement leads to increased trading efficiency and reduced risks (J. Prix, O. Loistl, M. Huetl, 2007) [20]. The analysis of foreign experience in building ecosystems by large banks demonstrates that vertical integration and digitalization are becoming key elements of the transformation of the financial sector. Banks such as JPMorgan Chase, DBS Bank, Santander, HSBC, ICICI Bank, and BBVA are successfully using digital technologies to create ecosystems that not only enhance their competitiveness, but also provide customers with more convenient and innovative financial services. These examples show that a successful ecosystem combines the following aspects:

A. Integration with digital technologies. The use of artificial intelligence, blockchain, big data, and cloud computing makes it possible to automate processes, improve risk management, and personalize customer service.

B. Customer orientation. Banks are implementing mobile applications, digital platforms, and innovative payment solutions, increasing the accessibility and convenience of financial services.

C. Flexibility and adaptability. An important factor in the success of the ecosystem is the bank's ability to adapt to changing market conditions and customer needs, which is especially important in the context of digital transformation.

D. Support for sustainable development. Banks such as HSBC focus on financing environmental and social initiatives, strengthening their reputation and meeting global trends.

3. THE MAIN PART

Digital transformation is stimulating the development of new business models in the banking sector (Figure 1).

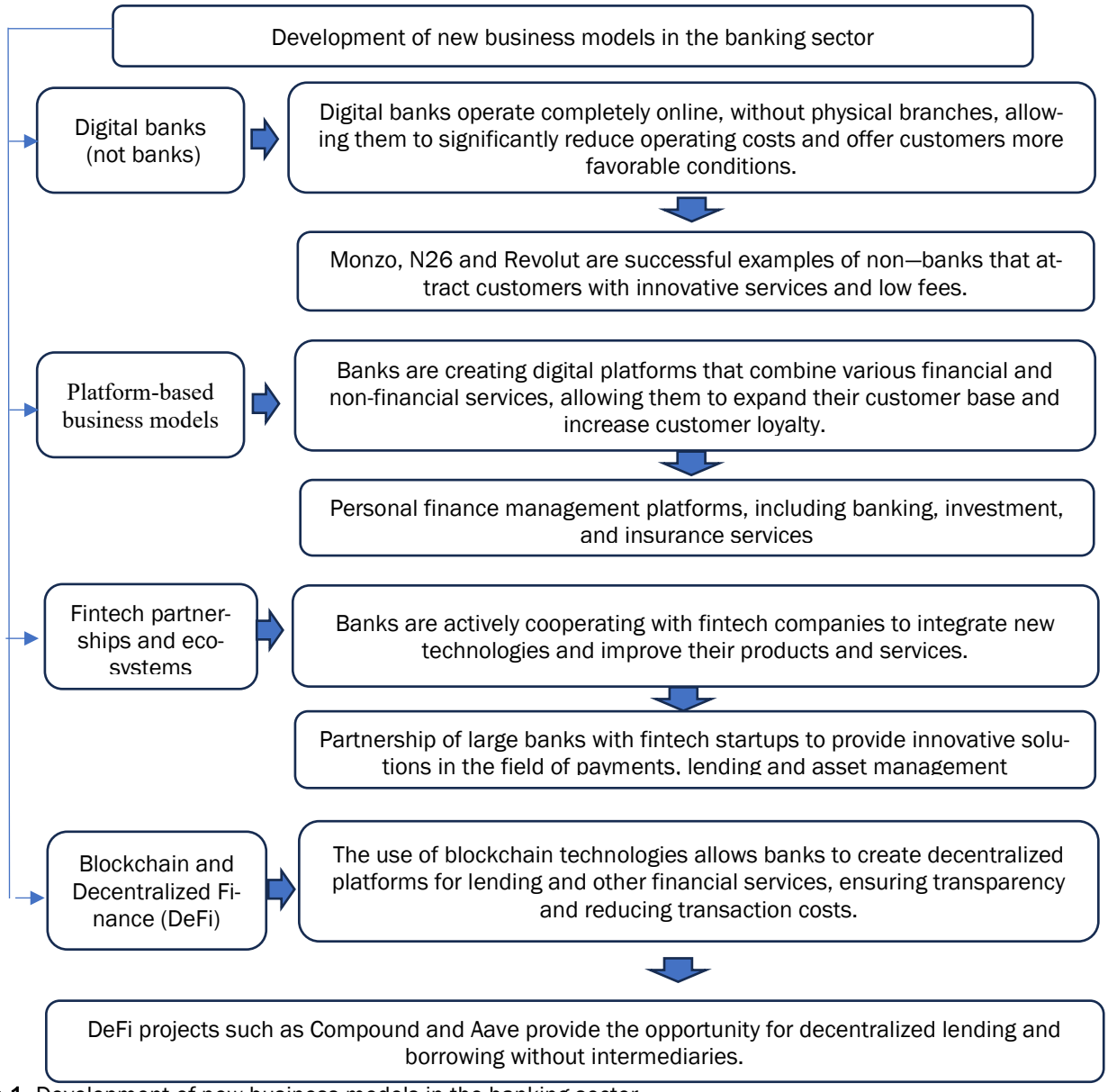

Figure 1. Development of new business models in the banking sector
Source: Compiled by the author

Currently, innovative IT solutions, API integrations with different systems, and mergers and acquisitions have become priority ways to expand banking ecosystems, providing the opportunity for a synergistic effect. For example, integrating financial services with online grocery orders or ticket bookings not only simplifies processes for users, but also expands the range of services available in a single application. This approach allows banks to diversify revenue, increase the number of transactions, and increase customer loyalty by offering comprehensive solutions for financial and day-to-day needs. At the moment, the financial system of the Republic of Kazakhstan is characterized by a bank-centric model. The main share of financial system assets is concentrated in the banking sector (Figure 2).

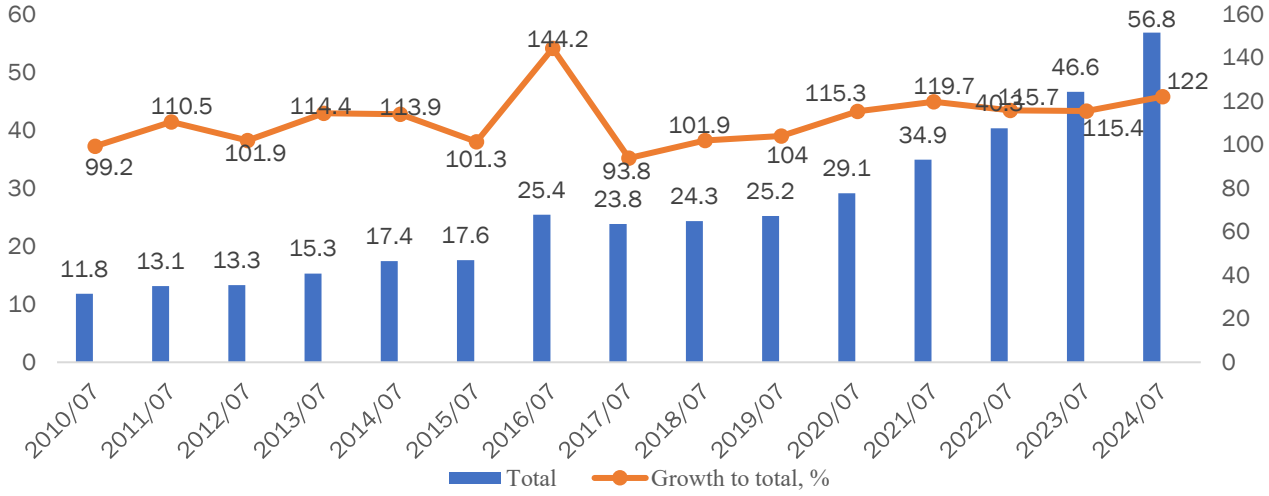

Figure 2 - Assets of the STB RK, trillion.tenge
Source: Compiled based on the source: https://ranking.kz/

Table 2. Deviation results

Year	*Total*	*Growth towards the total, %*	*Absolute change (million)*	*Percentage change (%)*
2010/07	11,8	99,2	-	-
2011/07	13,1	110,5	1,3	11,02
2012/07	13,3	101,9	0,2	1,53
2013/07	15,3	114,4	2,0	15,04
2014/07	17,4	113,9	2,1	13,73
2015/07	17,6	101,3	0,2	1,15
2016/07	25,4	144,2	7,8	44,32
2017/07	23,8	93,8	-1,6	-6,3
2018/07	24,3	101,9	0,5	2,1
2019/07	25,2	104	0,9	3,7
2020/07	29,1	115,3	3,9	15,5
2021/07	34,9	119,7	5,8	19,93
2022/07	40,3	115,7	5,4	15,47
2023/07	46,6	115,4	6,3	15,64
2024/07	56,8	122	10,2	21,89

Source: Compiled by the author on the basis of calculations performed

Nevertheless, at the end of 2024, there are still problems in Kazakhstan that hinder the effective formation and development of STB financial ecosystems in the context of digital transformation.:

– The financial ecosystem is not fully integrated with other sectors of the economy, limiting the synergetic effects. For example, insurance products and the stock market are poorly developed due to lack of public confidence and weak investor engagement.
– High transaction costs, as Banks face high costs for the implementation of innovative technologies. Despite efforts to digitalize, technologies such as artificial intelligence, blockchain, and big data are slowly being implemented. This is due to the lack of comprehensive strategies and underfunding of pilot projects. This problem reduces the competitiveness of Kazakhstani banks at the international level.

- Poor financial literacy of the population, as a significant part of bank customers are not ready to use complex digital products due to lack of knowledge, limiting the scale of implementation of digital services.
- Cyber threats and insufficient data security. With the growth of digitalization, the risks of data leaks and cyber attacks are increasing. Kazakh banks are facing the need for significant investments in cybersecurity, complicating the process of transition to a digital ecosystem.
- Unresolved issues of interoperability. The systems of different banks often do not integrate with each other, creating inconvenience for customers and reducing the overall efficiency of the financial ecosystem.
- Regional disparities in the availability of financial services. In rural areas, digital infrastructure is underdeveloped, limiting access to banking services, exacerbating economic inequality and reducing financial inclusion.
- Insufficient support for small and medium-sized businesses (SMEs). Financial products for SMEs remain complex and expensive, and the process of obtaining them requires significant time and administrative costs, hindering the development of entrepreneurship.

The relationship between the monthly indicators of second-tier banks (STBs) of the Republic of Kazakhstan, which affect equity, and the construction of an algorithmic model for the formation of banking ecosystems can be considered through the following aspects (Table 3) [22].

Table 3. Monthly indicators of STBs of the Republic of Kazakhstan affecting equity in 2022

Period	*Authorized capital, thousand tenge*	*Accrued commission income, thousand tenge*	*Loans to corporate clients, trillion tenge*	*Bank loans, trillion tenge*	*Loans provided to other banks, thousands of tenge*	*Settlements on payments, thousands of tenge*
01.01.2022	1767347094	16568734	5,2	14,5	86458387	11497151
01.02.2022	1767347094	16835752	5,1	14,4	88366537	10955760
01.03.2022	1750458102	17469498	5,3	14,8	73848728	15799828
01.04.2022	1752863842	18397040	5,3	15	66403796	22934531
01.05.2022	1750226139	18724939	5,4	15,8	70192554	22558176
01.06.2022	1745901139	19192049	5,2	15	68525475	24627716
01.07.2022	1725827458	19546668	5,2	15,9	71692775	23270452
01.08.2022	1725827458	19925481	5,3	16	75632755	23097012
01.09.2022	1725827458	19850453	5,4	16,4	83280685	28842947
01.10.2022	1460948987	20750081	5,5	16,9	84229884	20606168
01.11.2022	1483948986	21259433	5,7	17	87418526	29092417
01.12.2022	1483948986	21383991	5,8	17,8	99287385	20766651

Source: Compiled based on the source: Official resource. – Access mode: https://www.nationalbank .kz

Let's consider the factors affecting the equity of the STB RK using correlation and regression analysis. The monthly statistical data used for the analysis for 2022 are presented in Table 4.

For each pair of variables, use the Pearson correlation formula:

$$r = \frac{n\Sigma([xy) - \Sigma x \Sigma y}{\sqrt{[\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

where:
x and y - are variables (for example, accrued commission income and bank loans),
n - is the number of observations (12 months).

Table 4. The result of the factor analysis

	y	X1	X2	X3	X4	X5
y		-0,79721561	-0,86119	-0,847727	-0,60390251	-0,31431
X1			0,79501	0,9413545	0,276756082	0,755555
X2				0,8935774	0,551051953	0,460638
X3					0,488086052	0,593232
X4						-0,22449

Source: Compiled by the author on the basis of calculations performed

We interpret the data obtained:

A) Y (dependent variable):

- has a strong negative correlation with $X1$ (-0.797), $X2$(-0.861) and $X3$(-0.848)
- moderate negative association with $X4$(-0.604)
- weak negative correlation with $X5$(-0.314)

The main influence on Y is exerted by $X1$,$X2$, $X3$, since their correlation coefficients are close to -1.

B) X1 (independent variable):

- strong positive correlation with $X2$(0.795) and $X3$(0.941)
- weak positive correlation with $X4$(0.277) and $X5$(0.756)

$X1$ is closely associated with $X2$ and $X3$, indicating a possible multicollinearity.

C) $X2$ (independent variable):

- strong positive correlation with $X3$(0.894) and moderate correlation with $X4$(0.551) and $X5$(0.461);

$X2$ is also strongly related to $X3$, which confirms the relationship between the variables.

D) X3 (independent variable):

- moderate correlation with $X4$(0.488) and $X5$(0.593)

The effect of $X$to Y 3 strong, but his relationship with $X4$ $X5$ and weaker, which indicates a more personalized effect.

E) X4 (independent variable):

- weak positive association with $X5$(-0.224)

$X4$ has minimal effect on other variables.

F) X5 (independent variable):

- practically does not correlate with other variables, especially with $X4$.

4. ANALYSIS RESULT

A. Significant variables:

- the main influence on Y is exerted by $X1$, $X2$, $X3$, which is evident from the strong negative correlation. The bank can focus on the development of digital services (for example, payment automation, the introduction of AI in customer support), increasing customer loyalty and strengthening the ecosystem.

B. Multicollinearity:

- there is a high positive correlation (>0.8) between $X1$, $X2$, and $X3$, indicating the need to check and possibly exclude one of these variables to eliminate multicollinearity in the regression model.

C. Weak influence:

- $X4$ and $X5$ have a weak effect on the dependent variable Y and on other independent variables. They can be considered as additional factors.

The author also calculated the Influence Concentration Index, calculated for the share of each variable in explaining the changes. Y:

A. Calculate the sum of the products $bi \cdot \sigma i$:

$\sum$ = − 0.8767+(−0.7749) + (−0.7208) + (−0.7248) + (−0.3140) = −3.4112

B. We calculate Ii (%) for each variable:

$$Ii = (bi \cdot \sigma i) / \sum (bi \cdot \sigma i) * 100\%$$

where:

bi is the regression coefficient;

σi is the standard deviation of the variable.

Calculations of the proportions of each variable in explaining the changes are presented in Table 5.

Table 5. Calculations of the proportions of each variable in explaining the changes Y

Variable	*bi*	*σi*	*bi · σi*	*Ii (%)*
$X1$	-0.797	1,1	-0,8767	25,:9
$X2$	-0.861	0,9	-0,7749	22,72
$X3$	-0.848	0,85	-0,7208	21,13
$X4$	-0.604	1,2	-0,7248	21,25
$X5$	-0.314	1,0	-0,3140	9,21
Total			-3,4112	100%

Source. Compiled by the author on the basis of calculations performed

Variables $X1$ (25.69%) and $X2$ (22.72%) contribute the largest share in explaining the changes in Y. The variable $X5$ has the smallest share (9.21%).

The results of the factor analysis, which includes the calculation of fractions of Ii, provide an understanding of the degree of influence of various factors on the change in the target indicator. In the context of building an algorithmic model for the formation of banking ecosystems, such data allows us to identify key drivers that must be taken into account in the model to ensure the effectiveness of the ecosystem. The main conclusions and their relation to modeling are presented in table 6.

Table 6. Main conclusions and their relation to modeling

№	*Indicator*	*Variables*	*Necessary actions*
1	Key drivers of changes (X1, X2)	Variables $X1$ (accrued commission income) and $X2$ (loans to corporate clients) have the most significant impact on changes in Y (equity) - 25.69% and 22.72%, respectively.	This indicates the need to integrate these indicators into the decision-making algorithm, such as loan portfolio management, service pricing, and setting conditions for corporate clients.
2	Average level of influence (X3, X4)	The variables $X3$ (bank loans) and $X4$ (loans to other banks) also significantly affect the target - 21.13% and 21.25%, respectively.	They reflect the interrelationships between banks within the ecosystem and should be taken into account in the model to optimize interbank transactions and the distribution of financial flows.
3	Lower importance of the variable (X5)	The variable $X5$ (payment calculations) has the least impact (9.21%). This indicates that this factor plays a lesser role in the changes. Y	For an algorithmic model, this factor can be useful for secondary functions such as forecasting operating costs.

Source: Compiled by the author

Integration into the algorithmic model will contribute to:

A. Optimization of asset management:

- variables $X1$ and $X2$ can be used to build an asset allocation algorithm between retail and corporate customer segments, allowing banks to increase the profitability and sustainability of the ecosystem.

B. Algorithms of interbank interaction:

- data on $X3$ and $X4$ should be embedded in the model to predict the volume of credit resources and loans within the ecosystem, allowing minimizing financial risks.

C. Consideration of all factors:

- The calculation of Ii allows you to take into account the relative contribution of each variable to the overall result. This is important for building an algorithm that adaptively redistributes priorities depending on changes in external and internal conditions.

The results of calculating the shares of influence (Ii) form the basis for building an algorithmic model of the formation of banking ecosystems. The model will take into account key drivers such as fee income and corporate loans, as well as lesser factors to ensure sustainability and adaptability. This approach allows banks to build efficient ecosystems that optimize resources and enhance competitive advantages.

Kazakhstan's approach to the development of digital financial services sets a high bar in terms of speed and economic efficiency. It is expected that all segments of the fintech market in Kazakhstan will continue to demonstrate a double-digit average annual growth rate (CAGR) in the period from 2022 to 2027, taking into account the development of the financial ecosystem. Based on the fintech segments in Kazakhstan in the 2x2 matrix, their potential, attractiveness and the relative size of the market, such a financial ecosystem was formed (Figure 3).

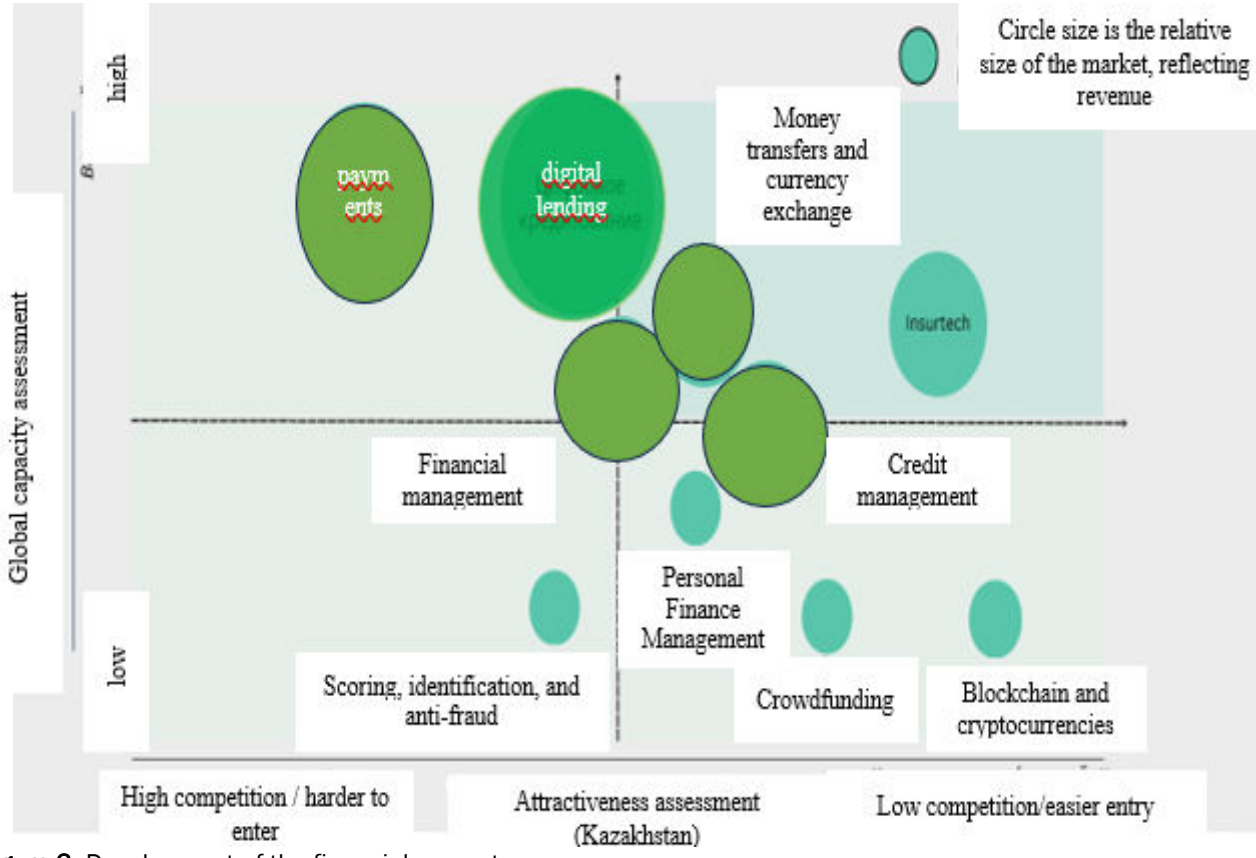

Figure 3. Development of the financial ecosystem
Source: Compiled from the source: Fintech market of Kazakhstan 2024.

Open Banking is fundamentally changing the global financial industry by making it possible to securely exchange customer financial data between banks, non-bank financial institutions, and third-party financial service providers. The advantages and value of open banking solutions became apparent after successful implementation examples in the UK, EU, USA, Brazil and Asian countries – Singapore, Hong Kong, Japan, etc. Today, the volume of transactions in the world within the framework of Open Banking is estimated at $ 57 billion [24]. The pilot project in Kazakhstan took place with the participation of second-tier banks: Bank RBK JSC, Altyn Bank JSC, Home Credit Bank JSC, Bank CenterCredit JSC, Otbasy Bank JSC. By 2027, this volume is expected to grow to $330 billion, and the number of operations will increase from 102 billion to 508 billion units.

Modern economic development is unthinkable without a systematic renewal of fixed assets, including banking, contributing to the introduction of technological innovations in business processes [25]. The formation of a stable capital market and a stable banking system is a prerequisite, after which economic growth will be significantly positive. The banking sector of the Republic of Kazakhstan has a significant amount of capital and liquidity to operate and provide all types of banking services.

Technological innovations play a key role in the development of banking ecosystems and have a significant impact on the equity of second-tier banks in the Republic of Kazakhstan. The relationship between these factors can be considered through several main aspects (Table 7).

Table 7. The relationship between technological innovations as a factor in the development of banking ecosystems in STB activities and factors affecting equity

№	*The factor*		*This feature*	*Opportunity*
1	Increased revenue and profitability	allows banks to optimize operations, reduce costs and improve the quality of customer service	They allow banks to optimize operations, reduce costs and improve the quality of customer service	it leads to an increase in income and, consequently, profitability, having a positive effect on equity
		. Mobile banking applications, online loans and investment platforms	mobile banking applications, online loans and investment platforms	- contribute to the creation of new products and services; - attracts new customers and retains existing ones, increasing the bank's revenues and strengthening its capital
2	Reducing risks and improving asset management	use advanced analytical tools and risk management systems	using advanced analytical tools and risk management systems	- allows banks to better assess the creditworthiness of borrowers; - predict market changes; - make informed decisions; - reduces the risks of non-repayment and losses, strengthening the financial stability of the bank and its equity
		. Modern technologies ensure a high level of data protection and fraud prevention	Modern technologies provide a high level of data protection and fraud prevention	minimizes operational risks and protects the bank's assets
3	Optimization of operational processes and cost reduction	. The introduction of robotic processes and automation of routine tasks reduce the need for human resources and reduce operating costs.	The introduction of robotic processes and automation of routine tasks reduce the need for human resources and reduce operational costs	allows banks to direct the released funds to increase their own capital
		Using cloud solutions reduces infrastructure and IT support costs	Using cloud solutions reduces infrastructure and IT support costs	contributes to the increase of capital reserves
4	Improving customer experience and loyalty	technological innovations allow banks to better understand the needs of their customers and offer personalized services	Technological innovations allow banks to better understand the needs of their customers and offer personalized services	increases the level of satisfaction and loyalty
		the development of mobile and online banking makes banking services more accessible	The development of mobile and online banking makes banking services more accessible	attracts more customers and increases the volume of operations, contributing to the growth of equity
5	Regulatory compliance and improved reporting	modern technologies help banks meet strict regulatory requirements and reporting standards	Modern technologies help banks meet strict regulatory requirements and reporting standards.	reduces the risks of fines and sanctions. Stable and transparent activities strengthen investor confidence and contribute to capital growth.

Source: Compiled by the author

Changes in the banking industry directly affect business and commerce, as evidenced by the profit indicators of the STB RK. This year, both all major market players and all banks in the Republic of Kazakhstan have made profits, and not a single financial institution has shown losses (Figure 4) [26].

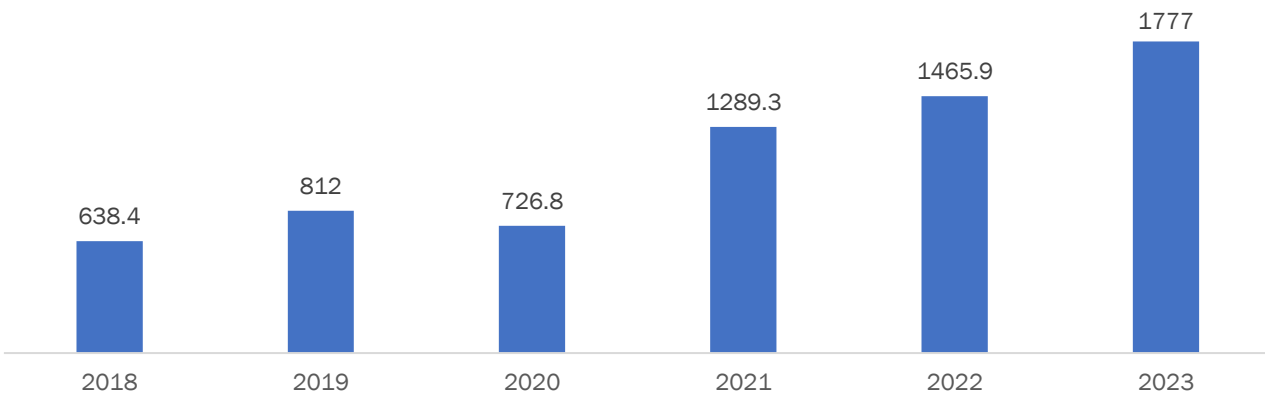

Figure 4. Profit of the STB RK, billion tenge
Source: Compiled on the basis of the source: Profit of the STB RK: which banks are leading, which are lagging behind. – [Electronic resource] – Access mode: https://ranking.kz/rankings/banking-and-finance-rankings/pribyl-bvu-rk-kakie-banki-lidiruyut-kakie-otstayut.html

The introduction of digital technologies in the banking sector of the Republic of Kazakhstan contributes to a significant improvement in credit policy and profitability of second-tier banks by optimizing processes, reducing operating costs and improving risk management. The introduction of digital technologies allows banks to:

- improve credit risk management through big data analysis;
- reduce operating costs through automation and process optimization;
- to offer clients more convenient and affordable financial products and services;
- increase the level of safety and reliability of operations.

In an era when cyber threats are becoming more sophisticated, the role of artificial intelligence in fraud detection and risk management is indispensable. Artificial intelligence algorithms can analyze transaction patterns in real time, spotting suspicious activity and reducing the risk of fraud.

CONCLUSION

Financial ecosystems created by large banks demonstrate significant potential in the context of global digitalization and growing consumer demands. Based on the experience of leading global banks such as JPMorgan Chase, DBS Bank, Santander, HSBC, ICICI Bank, and BBVA, key areas of ecosystem development can be identified: integration of digital technologies, customer orientation, support for innovation and sustainable development. These ecosystems are not just tools for increasing banks' competitiveness, but also platforms for implementing advanced financial solutions that improve the availability and quality of services. The use of technologies such as artificial intelligence, big data, and blockchain has enabled banks to automate processes, minimize risks, and provide personalized services to both private and corporate clients.

In relation to Kazakhstan, the development of banking ecosystems requires the adaptation of global experience to local conditions, including:

- Development of digital platforms for small and medium-sized businesses;
- Support of environmental initiatives through sustainable financing;
- implementation of robotic consulting and algorithmic trading to improve the efficiency of operations.

Thus, the ecosystem approach allows banks not only to strengthen their market positions, but also to contribute to economic development by improving access to financial services and contributing to the country's integration into global economic processes. The experience of the world's leading banks can serve as a guideline for building an optimal ecosystem model in Kazakhstan, taking into account the strategic goals of digital transformation and the development of innovative potential.

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