JOURNAL OF
Economics

JOURNAL OF
ECONOMICS

International Indices

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Assessment of the Possibilities for Improving the Financial Potential of the Azerbaijani Economy

Abstract

The article examines the possibilities of improving the financial potential of the Azerbaijani economy. It was determined that the increase in gross domestic product, population income, and bank deposits plays a fundamental role in improving the financial potential.

In the article, the impact of factors such as gross domestic product (GDP), population income and bank deposits, investment allocations, and credit on state budget revenues, which are the main indicators of financial potential, was quantitatively evaluated using a linear multivariate regression model. The calculation revealed that there is a high correlation between the volume of state budget revenues and GDP, population income and bank deposits, as well as the amount of investment and credit. Such a situation is ultimately characterized by a significant impact on the financial potential of the country's economy. The results of the study on identifying opportunities for improving the financial potential of the economy show that such an approach can help predict the development prospects of financial potential, assess resource capabilities and ensure their more efficient use. The results of the study on identifying opportunities for improving the financial potential of the economy show that such an approach can help predict the development prospects of financial potential, assess resource capabilities and ensure their more efficient use.

Keywords: *financial potential, sustainable economic development, financial stability, investment opportunities, economic policy, financial resources, competitiveness*

Introduction

The expansion of the globalization process significantly depends on the effective and systematic development of the financial potential to ensure sustainable economic development. The foundation of the formation of financial potential is made up of the profitability of economic activity sectors, financial stability, investment opportunities, competitiveness, as well as the current and future development prospects of its growth. Financial potential plays a crucial role in ensuring the financial stability of the economy. Financial stability is based not only on the structure of financial resources but also on the efficient use of these resources, as well as the existing opportunities for improving financial potential.

Financial potential is defined as the ability of the financial system of the economy to ensure growth and development in the long term, based on the existing resources and conditions. In practice, categories such as financial resources, subjects of the financial system, financial policy, and so on are distinguished as elements of financial potential.

The aforementioned indicates that the financial potential of the economy encompasses important issues such as the collection, return, and expenditure of financial resources aimed at more efficient use to ensure sustainable development.

The formation and utilization mechanism of the financial potential of the economy includes the following: principles of the formation and implementation of financial potential, characteristics of economic activity sectors, continuity of the process of forming and managing financial potential, self-sufficiency with financial resources, potential elements of financial resources, improvement of financial relations, processes of forming and utilizing financial resources and potential, public-private partnerships in resource creation, a set of financial instruments, etc (Amrahov et al., 2022).

Therefore, identifying opportunities for improving financial potential is defined as one of the main directions of economic policy (Amrahov et al., 2025).

Research

The foundation of each country's economic development is made up of financial resources. In the current economic situation, the demand for financial resources is continuously increasing, while difficulties have been observed in attracting investment resources from foreign sources in recent years. In this regard, it becomes necessary to identify the domestic capabilities for financing the country's economy while simultaneously developing its financial potential. It seems that the assessment of financial resources at the national level is becoming one of the important issues (Amrahov, 2015).

When assessing financial potential, economists often note certain shortcomings. The concept of regional finance, which coordinates regional budgets and inter-budgetary relations, on one hand expands finance as a resource, while on the other hand is limited by considering only state finance (Zherlitsyn et al., 2019). However, finance primarily deals with distribution and redistribution, while financial resources are created by all forms of ownership, including enterprises, organizations, and households. In this regard, it is considered that the term financial potential allows for the revelation of all financial resources in the region, as well as the relationships and interdependencies that arise in the processes of their formation, utilization, and expansion (Amrahov, 2014).

There is no unified approach to assess financial potential. One of the proponents of the general concept of financial potential, A.M. Volkov, believes that financial potential constitutes a part of the reserves of the produced national income, which is materially reflected in the increase of production means after all redistribution processes. O.Yu. Sviridov interprets financial potential as encompassing all current financial capabilities of the state, including the consolidated budget, off-budget funds, and inter-budgetary flows. According to V.M. Rodionova, potential is understood as the sum of opportunities and abilities to achieve a goal. The concept of financial potential reflects the totality of monetary resources that can be used to solve specific problems and the relationships related to their reproduction (Chumakova & Davydova, 2010). In economic literature, there are similar ideas regarding the assessment of the financial potential of the state. Oh, it is the totality of the funds of the state and enterprises, the system of formation and distribution of these funds. It reflects the totality of material resources necessary to meet the needs of the state and various social organizations (Amrakhov et al., 2022).

The financial potential of the state can be defined as the total of existing financial resources, as well as the ability of the financial system created by the state to ensure growth and development in the long term. It can also be illustrated by the formation, distribution, and redistribution of these resources with the aim of achieving certain financial results by enterprises and organizations for the local population, ensuring extensive reproduction and social development (Amrahov, 2023).

The assessment of opportunities for improving financial potential is carried out for the following purposes (Yarullin & Galimova, 2011):
• Providing financial resources: through own funds, borrowed funds, and redistribution;
• Stimulating financial system entities to increase financial flow;
• Redistribution of resources among the subjects of the economic system, as well as in favor of the state's central system;
• Monitoring the formation, distribution, and utilization processes of financial resources;
• Insurance against potential risks.

In the current economic conditions, the state's financial capabilities significantly decrease due to the crises that occur. In such circumstances, special attention should be paid to the analysis of the processes of forming and evaluating the state's financial potential, as well as to increasing financial resources, in order to develop economic policy and enhance its implementation efficiency. Factors and conditions for their attraction, as well as the risks and dangers that arise during the usage process, must be taken into account. In this regard, let us first take a look at the methodology for evaluating the activities of enterprises that form the basis of the financial resources of regions, which are a significant component of the state's financial potential (Amrahov et al., 2023).

Financial indicators can be categorized into the following groups to assess the financial potential of the enterprise (Sheshukova & Kolesen, 2012):

1) Indicators of financial stability;

2) Performance indicators;

3) Indicators of solvency (liquidity).

Financial stability is the balance of financial flows, the availability of funds that support activities over a certain period, as well as the existence of resources that service existing loans and production. The financial structure of capital plays a significant role in the formation of a company's financial stability. The assessment of financial stability is based not only on the structure of financial resources but also on the directions of their use (Bulatova, 2010).

Another aspect of evaluating the efficiency of activities is the analysis of turnover indicators that characterize the volume of financial investments in assets and their turnover rate (Amrahov et al., 2024).

The assessment of a company's financial potential involves the analysis of indicators of the company's solvency. The payment capacity of the enterprise depends on the degree to which current assets are financed by long-term sources. The assessment of payment ability is carried out based on the analysis of the liquidity of the company's current assets, that is, their ability to be converted into cash.

There are different approaches to the methodology for assessing the possibilities of improving the financial potential of the state.

The most common methodological approaches are as follows (Crompton, 2006):

1) A statistical approach or method for evaluating financial resources.

2) Comparative approach.

3) Evaluation using macroeconomic indicators.

4) Analysis using specific indicators.

5) Regression analysis.

One of the options for assessing financial potential is the establishment of regression equations that describe the relationship between financial potential and the specific financial flows that shape it. It is believed by economists that this approach is the most accurate among those mentioned above. The regression analysis method not only allows for the conversion of values that differ in measurement into a common monetary denominator, but also enables the calculation of various scenarios for the values of generated financial resources using forecasts, presenting them conditionally (Cherkasov, 2010).

Summarizing the mentioned scientific approaches, it is possible to emphasize the assessment of the state's financial potential as follows (Amrakhov, 2022):

• Existing resources. These include financial, credit, investment, and material resources that ensure their effective operation;

 • Control system. Oh, it distinguishes three subsystems: planning aimed at determining financial potential in the future; efforts directed towards creating new financial potential and transforming existing ones into profit factors; and control, which performs the functions of checking the efficiency of plan and decision implementation and continuously monitoring their reliability.

The concept of the state's financial potential is actively being reviewed in practice. Although there is no specific definition of financial potential in the field of public administration today, it is crucial to identify opportunities for the efficient development of the economy as a key element that reflects the importance of this factor in policies that ensure effective socio-economic development, as well as the accounting and assessment of financial potential. State programs prepared without considering this element cannot ensure the required quality of strategic development.

It is not enough to view the state's financial potential solely from the perspective of resources. The expression "The financial potential is the sum of all existing financial resources of the state" is correct, but it requires clarification. Because the term defining financial potential only in terms of the sufficiency of certain resources does not fully capture its significance. The financial potential of the state is the totality of all financial assets, resources, and their reserves that can be mobilized and utilized to achieve any outcome or objective, ensuring the highest efficiency in the processes of the functioning of the financial system (Amrahov et al., 2023).

In the assessment of financial potential, the increase in the well-being of the population – Kreflected in the income of the people and their savings in banks, as well as the growth of the gross domestic product – plays a key role. The state's banking system plays a crucial role in enhancing its financial potential, as the resources intended for the investment activities of banks increase the financial capabilities of the entities within the financial system operating in the country and determine the financial potential of the banks. Taking the aforementioned into account, let us examine the dynamics of the state budget revenues, which is a key indicator of the financial potential of the Republic of Azerbaijan, as well as the necessary factors influencing it (GDP, population income and bank deposits, investment allocations, and credit placements).

Table 1:
Dynamics of State Budget Revenues and Influencing Indicators

Years	The revenues of the state budget mln man	GDP mln. Man	The population's income mln man	Investment placement mln man	Credit investment mln. man	Deposits of the population in banks mln. Man
2014	18400.6	59014.1	39472.2	21890.6	18542.6	7188.4
2015	17498.0	54380.0	41744.8	20057.4	21730.4	9473.9
2016	17505.7	60425.2	45395.1	22706.4	16444.6	7448.7
2017	16516.7	70337.8	49187.9	24462.5	11757.8	7561.2
2018	22508.9	80092.0	53103.7	25877.0	13020.3	8375.4
2019	24218.1	81896.2	56769.0	24986.6	15298.2	8637.9
2020	24681.7	72578.1	55754.1	22484.0	14530.4	8177.9
2021	26396.3	93203.2	57206.8	25313.8	17119.8	9241.5
2022	30679.6	133972.7	69163.0	29135.1	20184.0	11743.0
2023	35236.4	123005.5	78050.2	32080.9	23979.1	12947.8

Source: Official data from the State Statistical Committee of the Republic of Azerbaijan (State Statistical Committee of the Republic of Azerbaijan, n.d.).

Let's conduct a regression analysis of state budget revenues and the factors affecting them using the Gretl application software package, based on the official data of the State Statistical Committee of the Republic of Azerbaijan for the years 2014-2023.

Table 2.
Multivariate Linear Regression Model
Model 1: OLS, using observations 2014-2023 (T = 10)
Dependent variable: Y

	Coefficient	**Std. Error**	**t-ratio**
Const	−597.216	7926.46	−0.07534
X1	0.0722178	0.0795277	0.9081
X2	0.636967	0.213071	2.989
X3	−0.473262	0.551532	−0.8581
X4	0.621854	0.385152	1.615
X5	−1.73390	1.49342	−1.161
Mean dependent var	23364.20	S.D. dependent var	6210.334
Sum squared resid	14434818	S.E. of regression	1899.659
R-squared	0.958415	Adjusted R-squared	0.906433
F(5, 4)	18.43761	P-value(F)	0.007254
Log-likelihood	−85.10223	Akaike criterion	182.2045
Schwarz criterion	184.0200	Hannan-Quinn	180.2128
Rho	−0.092949	Durbin-Watson	2.131282

Source: Calculated by the authors using the Gretl program.

Let's take a look at the results obtained from the Gretl program and their interpretation. Given the free limits a = 0.0722178, b = 0.636967, c = −0.473262, d = 0.621854, e = −1.73390, and the dependent variable f = −597.216, we obtain the regression equation that expresses the dependence of the revenues of the state budget of the Republic of Azerbaijan on the volume of gross domestic product, the income of the population, investment and credit placements, and the amount of the population's deposits in banks (Yadigarov, 2019). Taking into account the results obtained, the linear functional dependence between the revenues of the state budget and the factors affecting it can be expressed by the following regression equation (Ashenfelter et al., 2006):

$$Y = −597.216 + 0.0722178X1 + 0.636967X2 − 0.473262X3 + 0.621854X4 − 1.73390X5 \quad R^2 = 0.958415$$
$$(t) (−0.075) (0.908) (2.989) (−0.858) (1.615) (−1.161) \quad DW = 2.131$$

As it appears, the coefficients of the independent variables reflecting the causal factors and the dependent variable are significantly larger than their standard errors. This characterizes the statistical significance of the obtained model.

Based on the correlation dependency among the indicators included in Table 2, it can be concluded that an increase of one unit in the gross domestic product of the Republic of Azerbaijan during the studied period leads to an increase of 0.072 units in state budget revenues. Similarly, an increase of one unit in the volume of the population's income results in an increase of 0.637 units in state budget revenues. On the other hand, an increase of one unit in investments, loans, and the

amount of the population's deposits in banks will respectively cause a decrease of 0.473 units, an increase of 0.622 units, and a decrease of 1.734 units in state budget revenues.

If we take a look at the calculations, we can see that there is a statistically significant relationship between the dependent variable and the independent variables. When a statistically significant relationship is not observed, the main reason for this is that some variables affect the relationship of other variables. In the model, this problem is referred to as heteroskedasticity. To solve this problem in the model, it is necessary to remove the least correlated variables from the model. As a result, we have presented the model we obtained in Table 2. To determine the adequacy of this result, the statistical significance of the given coefficients must be checked.

It is necessary to test the following hypothesis:

$$\begin{cases} H_0: \beta_n = 0 \\ H_A: \beta_n \neq 0 \end{cases}$$

Here:

H_0 – null hypothesis;

H_A – alternative hypothesis;

β_n – free variable in the model.

The null hypothesis confirms the idea that there is no relationship between the independent variable and the dependent variable. The alternative hypothesis is the opposite of the null hypothesis and confirms the idea that there is a relationship. That is, we remove the variables from the model that are farthest from a p-value of 0.10. Because the null hypothesis is confirmed for these variables. The null hypothesis is rejected for variables with a p-value below 0.10 in the model [19]. This means that there is a significant relationship between the dependent variable and the independent variables. These variables remain in the model.

Table 3.
Breusch-Pagan Test

Breusch-Pagan test for heteroskedasticity - Null hypothesis: heteroskedasticity not present Test statistic: LM = 5.27992 with p-value = P(Chi-square(5) > 5.27992) = 0.382682

Source: Calculated by the authors using the Gretl program.

Table 3 shows the results of the Breusch-Pagan test. Based on these results, the p-value is 0.38, and since it is greater than 0.10, the null hypothesis is accepted. So, there is no heteroskedasticity in this model.

The next test pertains to the normal distribution of residuals, and therefore, it is called the normality test of residuals. The abnormal distribution of residues can lead to the model being biased and inaccurate. But this will not give us an accurate calculation and result. We can visually observe the normal distribution of the residuals from graph 1 before the test (Amrahov et al., 2023).
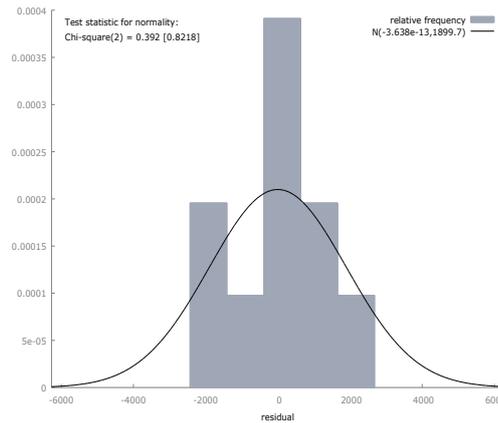
Graph 1. Dynamics of the normal distribution of residuals of state budget revenues based on the Gretl application software package

Source: Calculated by the authors using the Gretl software package.

To check the normal distribution of the residuals, two hypotheses are established again, and it is determined through mathematical calculations that the residuals are indeed normally distributed in this model (Hacızalov et al., 2012).
H_0 = the residues are normally distributed.
H_A = the residues are not normally distributed.

Table 4.
Normal Distribution Test of Residuals

> Test for normality of residual -
> Null hypothesis: error is normally distributed
> Test statistic: Chi-square(2) = 0.39241
> with p-value = 0.821844

Source: Calculated by the authors using the Gretl software package.

According to the test, the p-value is equal to 0.82. Since this is greater than 0.10, the null hypothesis is confirmed. That means the residuals in the model are normally distributed.
The next test is conducted to check the autocorrelation of the model. And the main goal here is to check whether there is a random relationship between the variables. Again, two hypotheses are established for testing.
H_0 = autocorrelation does not exist.
H_A = autocorrelation is present.

Table 5.
Autocorrelation Test

> LM test for autocorrelation up to order 1 -
> Null hypothesis: no autocorrelation
> Test statistic: LMF = 0.0589622
> with p-value = P(F(1, 3) > 0.0589622) = 0.823799

Source: Calculated by the authors using the Gretl software package.

As seen in Table 5, the p-value based on the autocorrelation test is equal to 0.82. Since the p-value is greater than 0.10, it fails to reject the null hypothesis. That is, autocorrelation is not observed in this model.

Since the significance F is ~0.007254, the regression model is valuable based on the condition p < 0.05.

It should be noted that it is not possible to draw conclusions about the model and its adequacy without testing the statistical significance of the established model. In this regard, the F-Fisher criterion can be used to obtain a conclusion about the extent to which the explanatory variables included in the model explain the model.

To check the statistical significance of the regression equation using the F-Fisher criterion, the F-Fisher criterion should be compared with the corresponding table value, that is, F_table (α; m; n-m-1). Based on the table data reflecting the results of the Gretl program, the F-Fisher criterion is equal to 18.4. If we determine the value of F_table with a 95% confidence interval, the following result will be obtained.

F_table (a;m;n-m-1)=(0.05;5;4)=6.26 The F-Fisher criterion, when compared to the value from the F-table (a; m; n-m-1), gives us F-Fisher criterion (18.4) > F-table (6.26). The obtained comparison shows that the regression equation is statistically significant overall based on the F-Fisher criterion. This means the adequacy of the model according to that criterion. It should be noted that, along with the F-Fisher criterion, the correctness of the model's specification must be checked. In this regard, it should be checked whether there is autocorrelation according to the constructed model. To check for the presence of autocorrelation, the criteria of the Durbin-Watson statistic are primarily determined, and conclusions about the formation of autocorrelation are drawn. In this regard, if we check the autocorrelation of the residuals in the model based on the critical values of Durbin-Watson, according to Table 2, the Durbin-Watson statistic based on the Gretl program is DW = 2.131, with a 95% confidence interval, at a significance level of α = 0.05, it can be determined that for three explanatory variables (m = 5) and an observation period of n = 10, the critical values of Durbin-Watson are d_l= 0.243 and d_u = 2.822. It is known that according to the Darbon-Watson criteria, if $d_l \leq$ DW $< d_u$ the presence of autocorrelation among the indicators is considered inconclusive.

1. Since $d_l = 0,243 \leq$ DW $= 2,131 < d_u = 2,822$, we can conclude that the presence of autocorrelation among the studied indicators cannot be determined. Based on the characteristics of the crisis points of Darbon-Uotson, it can be concluded that the regression equation has a statistically significant nature, and the established model Y = −597.216 + 0.0722178X1 + 0.636967X2 − 0.473262X3 + 0.621854X4 − 1.73390X5 is an adequate model.

2. The crisis point of student distribution (t-distribution): based on (α=0.005) t_(0.005;4)=4.604, the t-statistic $t_n = \frac{b_n}{s_{b_n}}$ is used to test the model (GeeksforGeeks, n.d.).

$$t_1 = \frac{b_1}{s_{b_1}} = \frac{0.072}{0.079} = 0.091$$

$$t_2 = \frac{b_2}{s_{b_2}} = \frac{0.637}{0.213} = 2.990$$

$$t_3 = \frac{b_3}{s_{b_3}} = \frac{-0.473}{0.551} = -0.858$$

$$t_4 = \frac{b_4}{s_{b_4}} = \frac{0.622}{0.385} = 1.616$$

$$t_5 = \frac{b_5}{s_{b_5}} = \frac{-1.734}{1.493} = -1.161$$

Based on the results obtained from the calculations, since 0.091 < 4.604, 2.990 < 4.604, -0.858 < 4.604, 1.616 < 4.604, and -0.858 < 4.604, the coefficients of the variables X1, X2, X3, X4, and X5 are statistically significant.

Since the correlation coefficient between the indicators for the studied period is $r = \sqrt{R^2} = \sqrt{0.906433} = 0,9521$, based on the Cheddok scale where r = 0.9-0.99, there is a high correlation between the volume of state budget revenues in Azerbaijan and GDP, the population's income, deposits in banks, as well as the amounts of investments and loans. According to the results of the Gretl program, the coefficient of determination $R^2 = 0.958415$ indicates that the corresponding regression equation explains 95.8% of the variance in the outcome variable, while 4.2% is attributed to the influence of other factors not included in the model. This indicates that the initial data of the regression equation better expresses the factors influencing the volume of state budget revenues, with a larger portion being explained by the factors included in the model.

If we calculate the elasticity coefficient based on the coefficients of the free variables in the regression equation and the average values of the causal and result factors for the studied periods, we obtain the following result.

$$E_{GDP\,(X1)} = \frac{\alpha_1 \times \overline{X_1}}{\overline{Y}} = \frac{0.072 \times 82890.48}{23364.2} = 0.025545$$

$$E_{the\,population's\,income(X2)} = \frac{\alpha_2 \times \overline{X_2}}{\overline{Y}} = \frac{0.637 \times 54584.68}{23364.2} = 1.488193$$

$$E_{investment\,placement(X3)} = \frac{\alpha_3 \times \overline{X_3}}{\overline{Y}} = \frac{-0.473 \times 24899.43}{23364.2} = -0.504080$$

$$E_{credit\,investmentX4)} = \frac{\alpha_4 \times \overline{X_4}}{\overline{Y}} = \frac{0.622 \times 17260.72}{23364.2} = 0.459513$$

$$E_{deposits\,of\,the\,population\,in\,banks\,(X5)} = \frac{\alpha_5 \times \overline{X_5}}{\overline{Y}} = \frac{-1.734 \times 9079.57}{23364.2} = -0.673850$$

Based on the calculated values of the elasticity coefficient, it can be concluded that a 1% increase in the volume of GDP in Azerbaijan during the studied period corresponds to a 0.03% increase in state budget revenues, while a 1% increase in household incomes leads to a 1.49% increase in state budget revenues. Additionally, a 1% increase in investment expenditures and the amount of household deposits in banks results in a decrease of 0.50% and 0.67%, respectively, while a 1% increase in the amount of credit allocations leads to a 0.46% increase (Studenmund, 2010).

According to Table 2 obtained with the application of the Gretl software package, the linear regression equation is $Y = -597.216 + 0.0722178X1 + 0.636967X2 - 0.473262X3 + 0.621854X4 - 1.73390X5$. The dynamics of the actual and fitted values of state budget revenues in Azerbaijan, based on the Gretl application software, will be represented in the following graph.
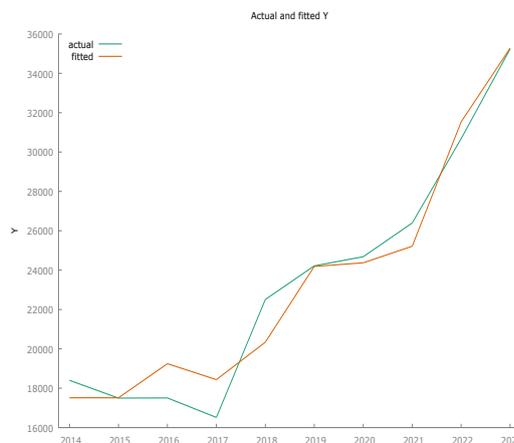
Graph 2. Dynamics of state budget revenues based on the Gretl application software and actual prices

Source: Calculated by the authors using the Gretl program.

Based on the multiple linear regression model, let's determine the feasible and forecast levels of state budget revenues using the regression model from the equation $Y = -597.216 + 0.0722178X1 + 0.636967X2 - 0.473262X3 + 0.621854X4 - 1.73390X5$ with the help of Excel software (Dougherty, 2011).
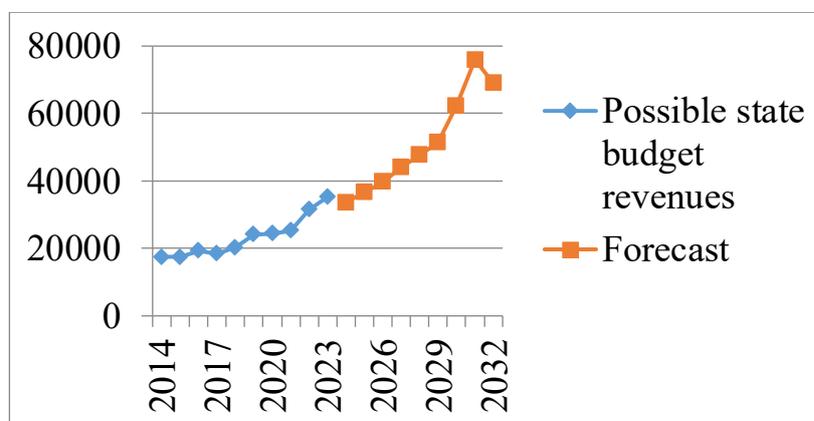
Graph 3. Possible level of state budget revenues according to the regression model and the forecast based on the regression model

Source: Calculated by the authors using MS Office Excel software.

The dynamics of the state budget's revenue volume shows that it has increased by 91.5% during the comparison period of 2014-2023. The forecast indicates that, based on the impact of the aforementioned factors in the regression model, it is possible for budget revenues to double. It can also be predicted that in the coming years, specifically from 2024 to 2033, the state budget revenues will increase by 2.6 times.

Conclusion

Based on the research, it can be noted that in the context of the existing complex international relations, the development and implementation of a strategy for the formation, improvement, and efficient use of the financial potential of the economy currently stands out as one of the most pressing issues. The formation of such a strategy allows for reducing risks, ensuring the forecasting of financial potential development prospects, evaluating internal potential and resource capabilities, ensuring their efficient use, and coordinating the management activities of financial resources. Sustainable economic development requires appropriate resource support and substantial financial resources, and it entails the formation of an effective financial strategy. Calculations indicate that changes in the indicators directly involved in the formation of state budget revenues, which encompass the country's financial potential, significantly affect the overall outcome (95.8%). It also provides grounds to conclude that the increase in the volume of GDP, the income of the population, and the amount of credit allocations has led to an increase in budget revenues (respectively 0.03%, 1.49%, and 0.46%).

Thus, it is important to emphasize the necessity of paying special attention to the following directions regarding the improvement of financial parameters of the economy and the prospects for enhancing financial potential based on generalizations:

- strategy for defining financial goals;
- development of a financial strategy and determination of its duration; calculation of the required level of financial resources and financial potential;
- implementation of mechanisms for effective management of financial resources;
- formation of information support for the management of the financial strategy;

- consideration of risk factors for financial activities;
- evaluation of the effectiveness of the financial strategy, identification of an efficient control mechanism, etc.

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The Impact of the Cryptocurrency Market on the Financial System in the Modern Era

Abstract

In the last decade, cryptocurrencies and blockchain technologies have caused radical changes in the financial system and affected the structure of global economic relations. This area is of great relevance not only from technological, but also from economic and legal aspects. Especially for developing countries like Azerbaijan, cryptocurrencies have great potential in terms of the formation of a digital economy, increasing financial inclusion, and liberalizing capital flows. The main goal of the study is to study the mechanisms of influence of cryptocurrencies on the world and Azerbaijani economies, to determine their impact on financial stability, state regulation, and fiscal policy. At the same time, it is aimed to propose an optimal regulatory model that can be applied at the national level on a scientific basis. The study used analysis-synthesis, systematic approach, and comparative methods, and analyzed global cryptocurrency indicators based on databases of international organizations.The regulatory models of countries such as the United States, the European Union, and China were examined in a comparative manner, and the possibility of adaptation for Azerbaijan was assessed. The analyses conducted prove that cryptocurrencies carry both risk and development potential. Under the conditions of their proper regulation, the expansion of the digital economy, the strengthening of financial innovations, and the fintech sector are possible. The originality of the work lies in the fact that for the first time the concept of a "balanced regulatory model" is proposed for the Azerbaijani economy.

Keywords: *Azerbaijan, cryptocurrency market, blockchain technology, bitcoin, financial stability, digital economy*

Introduction

The 21st century is characterized as a period of rapid digitalization and technological transformations in the world economy. Artificial intelligence, big data and blockchain technologies have affected all components of the financial system and have created the basis for the formation of new economic relations. One of the most important consequences of these changes is the emergence and widespread spread of cryptocurrencies in a short time. Digital currencies not only perform the classical functions of money, but also act as a means of investment, investment and technological development. Their impact on the economic system covers multifaceted processes in monetary policy, capital markets and macroeconomic stability.

The emergence of the first cryptocurrency, "Bitcoin", in 2009 marked the beginning of a new era in the world financial system. In the following years, thousands of new crypto-assets were formed on blockchain technology, leading to the rapid development of the digital economy.

The rise of cryptocurrencies has created both opportunities and challenges for global financial stability (Kesebir & Günceler, 2019). Central banks are developing new approaches to establishing regulatory mechanisms and managing currency risks. At the same time, the decentralized structure of crypto-assets makes them a free financial instrument and a potential source of risk. Thus, although this market increases economic freedom and financial inclusion, it also brings risks such as weakening fiscal control and increasing market volatility.

The introduction of cryptocurrencies in international trade and cross-border payments increases economic efficiency by reducing transaction costs. At the same time, the development of the cryptocurrency market has led to the formation of new psychological models in investor behavior - "crypto psychology" based on expectations of quick returns, which is one of the factors increasing market volatility.

The approach of states to the cryptocurrency market is different: while the US and the European Union have implemented a broad regulatory policy, China has limited cryptocurrency activity. Switzerland and Singapore have accepted digital assets as an important element of innovative economic development. In Azerbaijan, the rapid expansion of digital payment infrastructure and the growing interest in crypto-assets make the study of this area relevant and necessary. However, since market regulation is still at an early stage, it remains important to assess legal, fiscal and technological risks.

Thus, this article will examine the impact of the cryptocurrency market on the financial system in the modern era, the opportunities and risks it creates, as well as regulatory issues in the Azerbaijani context. The goal is to analyze the impact of cryptoassets on the economic system and put forward conceptual approaches to their management. The objectives of the study include studying the functional characteristics of cryptocurrencies, analyzing global and local market trends, identifying legal and fiscal risks, and developing recommendations for Azerbaijan.

Research

The scientific article compares the results of various studies using the analytical-synthetic method, summarizes the mechanisms of influence of the cryptocurrency market, synthesizes its effects on the financial system. The impact of the cryptocurrency market on the financial system is assessed using the systematic approach method, and its interaction with the elements of the economic system is analyzed. A comparison of cryptocurrency policies in the USA, the European Union, China and developing countries is carried out based on a case-study approach. Author's research, reports of international organizations and state documents of the Republic of Azerbaijan are used as sources of information

Development and technological basis of the cryptocurrency market

The history of cryptocurrencies is considered the beginning of a new stage in the development of financial technologies. If in the 20th century the global financial system was built on banks, credit institutions and state regulation, then in the 21st century this structure has radically changed. The article "Bitcoin: A Peer-to-Peer Electronic Cash System", published in 2009 under the signature of "Satoshi Nakamoto", laid the ideological and technological foundation of the modern concept of cryptocurrency (Nakamoto, 2008). This document showed that financial transactions can now be carried out without a third party - that is, a bank or a government. Blockchain technology ensured the implementation of this principle. This feature brings reliability, transparency and security to the system.

In the early years, cryptocurrencies were of interest only to technology enthusiasts. However, after 2015, with the creation of the Ethereum platform, this area was opened to the general public. Ethereum was not just a currency, but also a technological environment in which smart contracts worked. In this system, people could not only send money, but also conclude digital agreements. Since then, projects such as Ripple, Litecoin, Tether, Cardano, and dozens of others have emerged. After 2020, the concept of "DeFi" took shape, and cryptocurrencies began to act not just as an asset class, but as a completely new financial infrastructure (Aquilina et al., 2024). In parallel with the rapid growth of cryptocurrencies, market capitalization also began to grow dynamically (Table 1).

Table 1.

Dynamics of cryptocurrency market capitalization
in 2017–2024 (in trillions of US dollars)

Year	Total capitalization ($trln)	Bitcoin share (%)	Main trend
2017	0.6	85	First massive growth wave
2018	0.12	70	Rapid decline and correction
2019	0.18	68	Stabilization period
2020	0.75	65	Growth during the pandemic
2021	2.9	52	Record level and institutional entry
2022	1.1	43	Market correction, terra-Luna crisis
2023	1.7	46	Recovery phase
2024	2.4	48	Stable growth trend

Source: CoinGecko, 2024

The cryptocurrency market has become one of the fastest growing segments in the global financial system over the past decade. The table above shows that the cryptocurrency market exhibits high volatility and changeability in a short period of time. If in 2013 the total market capitalization of cryptocurrencies did not exceed 1 billion US dollars, then by the end of 2024 this figure was already approaching 2.4 trillion dollars. This is an increase of more than 2000 times in just eleven years. An increase in value on this scale in such a short period of time is considered to be an event that has virtually no analogues in the history of the global economy. The table data shows that the total market capitalization of cryptocurrencies decreased in the period 2017–2018, increased sharply in the period 2020–2021, decreased in 2022 and again showed a steady increase in 2023–2024. This indicates that the market is still in its development stage. This dynamic shows that cryptocurrencies are no longer a temporary financial phenomenon, but an asset class with a lasting economic impact. According to the International Monetary Fund's 2023 report, the total value of the global cryptocurrency market was approximately $1.2 trillion, which is equivalent to 3% of the gross domestic product of developing countries. This already proves that the impact on the financial system is quantitatively significant (IMF, 2023a).

The main part of the cryptocurrency market is Bitcoin. Currently, Bitcoin accounts for about 48% of the market share. However, after 2017, currencies such as Ethereum, Tether, Binance Coin, Solana, XRP have also formed a serious competitive environment. This diversity shows that the crypto ecosystem is not based on a single currency and that digital assets are specializing in broad categories. The fact that the market capitalization reached $ 2.9 trillion in 2021 is considered a turning point for the world economy. During this period, many corporations, including giant companies such as Tesla, PayPal, MasterCard and Square, began to hold crypto assets on their balance sheets or build payment systems with them. As a result, cryptocurrencies have become an asset class that moves in parallel on the stock exchange and in the real economy. One of the main indicators of the cryptocurrency market is the volume of trade turnover and the level of liquidity. In 2024, the daily transaction volume was $ 105 billion (Chart 1). This is 25 times more than in 2017. The largest trading volume is carried out on exchanges such as Binance, Coinbase, Kraken and OKX.

Figure 1. Use of the global crypto market
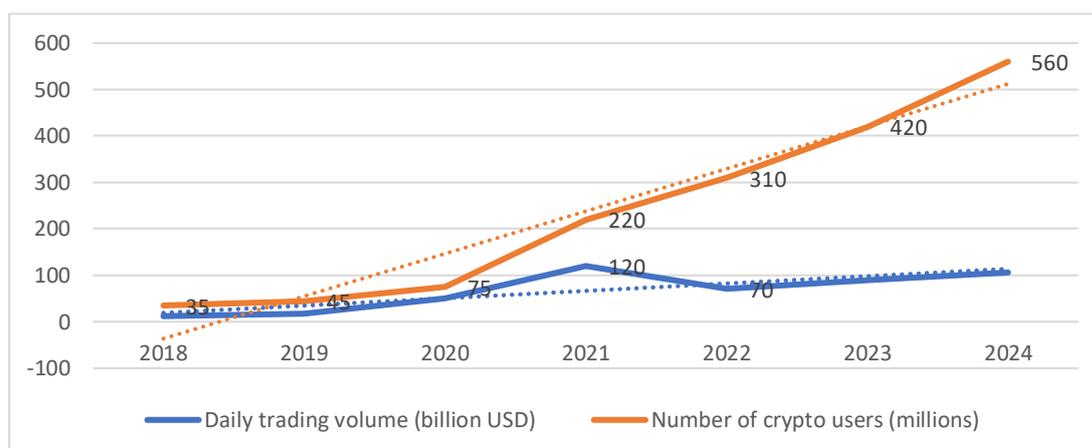
Sourse: CoinGecko, 2024, Demandsage, 2024

Statistical indicators show that the crypto market is growing rapidly, the number of users and trading volume have increased. However, price fluctuations indicate that the market is decreasing in 2022, which highlights volatility and risk factors. The number of cryptocurrency users in the world reached 560 million people at the end of 2024. This is 2.5 times more than in 2022. The largest number of users was recorded in India, the United States, Vietnam, Nigeria and Brazil.

The market value of cryptocurrencies is seriously affected by both global economic events and political decisions. For example, the US Federal Reserve System raising interest rates or the European Central Bank tightening monetary policy drives investors away from risky assets. This directly leads to a decrease in the prices of cryptocurrencies. The development of the cryptocurrency market has also faced a number of problems at different stages. One of the main difficulties is the high volatility of prices, that is, the frequent occurrence of sharp drops and rises. In 2018, the value of Bitcoin fell by 80% in a single year, causing many investors to leave the market. Another important issue is energy consumption. Bitcoin consumes a huge amount of energy to confirm transactions. According to a 2023 report by the University of Cambridge, the Bitcoin network alone consumes 75 terawatt-hours of electricity per year (Cambridge, 2023). This figure is equivalent to the total energy consumption of some small countries. All these factors make it necessary to evaluate the history of the development of cryptocurrencies not only in a technological, but also in a social, economic and environmental context. Cryptocurrencies have become a symbol of innovation on the one hand, and of regulatory problems on the other. Thus, the history of the cryptocurrency market proves that this system is not just a technological innovation, but also a future model of economic management and financial stability. For its sustainable development, a balanced combination of technology, legislation and market mechanisms is essential.

Financial stability is a key indicator of the sustainability of any economic system. This stability is directly related to the effectiveness of monetary policy, the reliability of the banking sector and the management of capital flows. The emergence of cryptocurrencies has the potential to have both positive and negative effects on this balance. Their mechanisms of influence are complex and multifaceted, since this influence simultaneously encompasses monetary, fiscal, institutional and psychological components. The impact of cryptocurrencies on financial stability is due to their decentralized nature. In traditional monetary systems, central banks control inflation and economic growth by regulating the money supply. However, since cryptocurrencies operate outside of state control, this regulatory mechanism is weakened. For example, Bitcoin's limited supply model limits the flexible circulation of money and complicates the application of classical monetary instruments (Alpago, 2018). On the other hand, cryptocurrencies can have a certain positive effect on stability by increasing liquidity and capital flows in financial markets. Because these assets reduce intermediary

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costs in cross-border payments, increase transaction speed and create new investment opportunities. Thus, cryptocurrencies can serve as an alternative channel for developing countries in terms of attracting capital. However, along with these positive effects, cryptocurrencies also increase market volatility. The prices of digital assets often change sharply in a short period of time. This creates unstable expectations among investors and strengthens the phenomenon called "psychological inflation" in financial markets. In addition, cryptocurrencies can also create conditions for the growth of the shadow economy and illicit capital flows. Because transactions are usually anonymous and in many cases remain unregulated. The Financial Action Task Force (FATF) has therefore introduced new transparency standards for crypto transactions in 2023 (FATF, 2023).

Another form of impact on financial stability is related to the transformation of the banking system. The growing popularity of cryptocurrencies can negatively affect the deposit base of commercial banks. If people prefer to keep their savings in digital assets, this reduces the lending capacity of banks and weakens the effect of the money multiplier. This situation creates economic behavior similar to the phenomenon of "deposit runs". At the same time, cryptocurrencies can indirectly have a positive impact on stability by increasing financial inclusion. Especially in developing countries, cryptocurrencies create new opportunities for participation for the population group that does not have a bank account or is excluded from the financial system. This also helps to increase economic activity and ensure a certain level of social equality (Luchkin et al., 2024).

The price dynamics of cryptocurrencies are often formed on the basis of speculative expectations. This weakens the understanding of fundamental value and partially disconnects markets from real economic indicators. In such a situation, risk assessment becomes difficult for central banks and international organizations. Another important mechanism of influence is related to financial integration. Cryptocurrencies connect global markets more closely together, but this also creates risks. Thus, a cryptocurrency crisis in one region can quickly spread to other markets.

Inflation-related effects should also be considered. Since cryptocurrencies, unlike traditional money, circulate outside of central regulation, the state's control over the money supply is reduced. This weakens the effectiveness of monetary policy and can negatively affect price stability in the long term. Despite all this, some researchers believe that cryptocurrencies "reshape" financial stability rather than disrupt it (Senna, & Souza, 2023). As transparency in the digital money market increases, control over transactions increases, which can reduce problems such as corruption and tax evasion. A joint analysis conducted by the International Monetary Fund and the World Bank at the end of 2024 showed that cryptocurrencies combine both risk and opportunity components. If states can create flexible regulatory frameworks, these assets can become a new pillar of financial stability. The impact of cryptocurrencies on the financial market and its consequences are summarized and interpreted in the following table (Table 2).

Table 2.
Impact of the cryptocurrency market on the financial system.

Area of influence	Key findings	Brief analysis
Capital flows	Capital is shifting from traditional markets to cryptoassets	High income expectations lead to global liquidity redistribution
Banking sector	Banks' role in payment systems is declining; new crypto services are emerging	Cryptocurrencies weaken banks' competitive advantage in transnational payments
Monetary policy	Cryptoasset circulation reduces the effectiveness of monetary policy	Decentralization of issuance affects currency control; countries move towards CBDC
Financial stability	Volatility and regulatory gaps increase risks	Weak regulation of exchanges increases cyberattacks and fraud
Innovation and digital transformation	Blockchain and DeFi are creating new financial models	Transparency increases, transaction costs decrease, new business ecosystems form

All these factors once again show that the impact of cryptocurrencies on financial stability is not just a one-way process, but a multifaceted, dynamic and country-specific phenomenon.

Regulatory policy is one of the main factors determining the direction of the impact of cryptocurrencies on stability. The approaches of states to this market differ significantly from each other. Some countries support cryptocurrencies, considering them as an important element of innovation and the digital economy, while others consider them a potential financial threat and a threat to monetary stability and impose strict restrictions. While the cryptocurrency market is strictly controlled in the United States and the European Union, in some Asian countries this sector is either completely free or completely banned. This diversity prevents the formation of a single stability mechanism in the global market. From a technological perspective, the blockchain infrastructure behind cryptocurrencies offers advantages in terms of both security and transparency. The immutability of blocks in which transactions are recorded reduces the risk of fraud. However, threats such as technological failures or "51% attacks" add new technological risks to stability.

The US model – a free market and selective control approach

The US is one of the countries that has played a key role in the formation of cryptocurrencies in the world. Since 2013, a certain framework has been established in the US in terms of tax and legal status for cryptocurrency transactions. The US Securities and Exchange Commission (SEC) considers cryptoassets as "digital securities" and regulates them under certain conditions (US, 2024). In addition, the Financial Crimes Enforcement Network (FinCEN) requires cryptocurrency exchanges to be registered as "virtual money services". This approach both protects the free market environment in the US and provides a certain level of control. For example, exchanges such as Coinbase, Kraken, Gemini are licensed by the state. However, since regulation in the US differs at the federal and state levels, a unified legislative framework has not yet been fully formed. However, investments in the cryptocurrency sector in the country exceeded $ 200 billion by the end of 2024. This indicates that the US maintains its leading position in the digital finance market.

European Union – legal harmonisation and MiCA framework

The European Union (EU) has adopted a more systematic and legal harmonisation approach to regulating cryptocurrencies. The Markets in Crypto Assets Regulation (MiCA), which entered into force in 2023, regulates the use, trading and holding of cryptocurrencies in the EU with a single standard (EU, 2023). The main objective of this document is to protect market participants, reduce market manipulation and ensure financial stability. Under the MiCA regulation, all crypto issuers and exchanges must register with the European Securities and Markets Authority (ESMA). This is a major innovation in terms of transparency and accountability. The EU has also established special rules for "stablecoins". Stable currencies such as "Tether" and "USDC" are only allowed to circulate in the EU market if they are backed by verified reserves. This step aims to strengthen the stability of the cryptocurrency market. The EU model also includes regulations on the environment and energy consumption. For example, the energy efficiency control mechanism of the "proof-of-work" mechanism will be implemented from 2024. This will guide digital markets towards "green technology" in line with the EU's principles of environmental sustainability.

China – ban and national alternative approach

The People's Republic of China is one of the countries that has demonstrated one of the strictest positions on cryptocurrencies. In 2017, cryptocurrency exchanges were banned, and in 2021, all "mining" activities were completely banned. The Chinese government justifies this decision by maintaining financial stability and preventing uncontrolled capital flows. However, this ban does not mean a rejection of the digital economy. On the contrary, China is implementing a national cryptocurrency project called the digital yuan (e-CNY) through its central bank. The e-CNY, which is in the testing phase in 2023, has already been tested by more than 300 million users. This project shows that China does not completely reject cryptocurrency technology, but simply implements it at the national level under state control. This can be called a "managed digital currency model".

The results of the characteristics of cryptocurrency regulation and its impact on the financial system by country are analyzed in the table data below (Table 3).

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Table 3.
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International experience on cryptocurrencies.
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Country / Region	Regulatory approach	Features of the impact on the financial system	Key results	Sourse
United States	Partial regulation; SEC and CFTC approach	Tight supervision of crypto exchanges	High innovation	SEC, CFTC (2022–2024)
European Union	MiCA single regulatory framework	Standardized risk requirements	Strengthening legal framework	European Commission (2023)
United Kingdom	FCA supervision; AML/KYC	Company registration is mandatory	Transparent market model	FCA Guidance (2023)
China	Cryptocurrency ban	CBDC – e-CNY is being developed	Digital yuan expands	People's Bank of China (2023)
Japan	Legal recognition of crypto assets	High requirements for exchanges	Regular and secure market	Japan FSA Reports (2023)
South Korea	Real-name identification system	Bank integration is essential	Increased trust	Korean FSC (2023)
Singapore	MAS risk-based licensing	FinTech and Web3 support	Becoming a regional hub	MAS Publications (2023)
UAE (Dubai VARA)	Dedicated crypto regulatory body	Crypto and token services	Rapidly developing ecosystem	Dubai VARA (2023)

This table shows that crypto regulation in countries varies greatly. The US and Europe offer a more structured market, China imposes a ban, and Singapore and Dubai are open to innovation. These differences affect both investor behavior and the stability of the financial system.

Azerbaijan is still at an early stage in terms of legal regulation of the cryptocurrency market. Currently, transactions with cryptocurrencies in the country are neither prohibited nor fully legalized. However, the Ministry of Finance, the Central Bank, and the State Tax Service are working on a legal framework in this direction. In March 2024, the State Tax Service submitted a draft for public discussion on the tax bases of cryptocurrency transactions. The draft envisages that cryptocurrency income will be taxed as capital gains. At the same time, the Central Bank is conducting a preliminary technical assessment of the "digital manat" project. This project aims to create an alternative, state-controlled digital payment system to cryptocurrencies. Azerbaijan's advantage is that the country has a rapidly digitizing economic model. Platforms such as "ASAN payment", "e-gov", and "AzerCard" create a technological basis for cryptocurrency integration. However, there are also risks, including the lack of legal regulation, low financial literacy, and the risk of manipulation of the crypto market. According to experts, the most suitable model for Azerbaijan is a system similar to the European Union's MiCA regulation, but more flexible and tailored to national characteristics. That is, a hybrid approach is needed that both encourages innovation and ensures transparent control (Imanov, 2022). International experience shows that the "complete ban" and "complete freedom" approaches to regulation do not produce effective results. The most stable results are observed in countries that apply balanced and transparent rules. The US prefers a free market and investor freedom, the EU focuses on legal structure and transparency, China prioritizes state control, and Azerbaijan is in the process of forming a national model by learning from these experiences. Although the economic structure of Azerbaijan is based on the oil and gas sector, the government's "Digital Development Strategy of the Republic of Azerbaijan" covering 2021–2030 has identified strengthening the digital economy as a priority (AR, 2025). This strategy includes the development of digital payment infrastructure, the expansion of e-commerce and the promotion of financial innovations. Cryptocurrencies can be considered as a potential part of this strategy. Currently, a number of citizens

in the country carry out cryptocurrency transactions through international platforms. Exchanges such as Binance, Bybit, OKX and Huobi are the main choices for Azerbaijani users. This indicates an increase in both economic activity and digital financial knowledge. However, the lack of official regulatory mechanisms leads to uncontrolled implementation of this activity. Looking at the potential of the market, Azerbaijan has a favorable environment for the development of cryptocurrencies. The main reasons for this are a strong technological infrastructure, wide internet coverage and a young population structure. More than 65% of the country's population is below the median age, which accelerates the adoption of digital technologies.

The economic benefits of the cryptocurrency sector for Azerbaijan can be manifested in several ways:

➢ reduction in the costs of cross-border money transfers;
➢ increase in financial inclusion;
➢ promotion of technological innovations.

These advantages can create new financial opportunities for small and medium-sized entrepreneurs. On the other hand, risks should also be taken into account. High volatility of the cryptocurrency market, speculative behavior and legal loopholes can negatively affect financial stability. At the same time, the risk of the spread of cases such as "crypto-fraud" and "pyramid schemes" threatens the financial security of citizens. In this regard, it is important to strengthen educational measures.

Azerbaijan's energy potential also creates interesting opportunities in this area. Since blockchain, and crypto-mining activities are characterized by high energy demand, the use of renewable energy resources can open up new economic opportunities in this direction. For example, there are favorable conditions for "green energy" projects using solar energy in the Nakhchivan and Karabakh regions. In addition, the expansion of the fintech sector in the country may develop in parallel with the formation of the cryptocurrency market. Currently, financial technology startups operating in Azerbaijan are working on digital payment systems. The formation of this ecosystem will allow the creation of blockchain-based national innovation centers in the future.

Increased financial inclusion is also one of the important outcomes. If the number of citizens using financial services through cryptocurrencies increases, this will strengthen the competitive environment of the banking sector. However, it is necessary for the Central Bank to modernize its regulatory tools to manage risks.

Azerbaijan's strategic position and regional role should also be taken into account. The country maintains an economic and technological leadership position in the South Caucasus region. If a clear legal framework is created for the cryptocurrency market, Azerbaijan can become a digital financial center in the region. Finally, the level of acceptance of cryptocurrencies is also increasing in terms of public relations. As interest in this topic increases among the population, the government's adaptation policies should be more flexible. State bodies, especially the Ministry of Digital Development and Transport, the Central Bank and the Tax Service, should act in a coordinated manner in this area. Thus, the formation of the cryptocurrency market for Azerbaijan is important both in terms of economic development and strategic sovereignty. If this process is managed in a planned and scientific manner, the country can become one of the leaders of digital finance in the region in the coming years. The results achieved in the context of Azerbaijan partially coincide with international experience, but the fact that the country's legal and institutional framework is at an early stage requires different approaches. If the US and the European Union focus on market freedom and transparent regulation, a "balanced regulatory model" is considered more appropriate for Azerbaijan. This model both promotes development without limiting innovation and allows for maintaining financial stability.

Various studies have noted that cryptocurrencies expand economic activity by increasing financial inclusion (Kesebir, & Günceler, 2019). Our study also confirms this idea and additionally shows that in order to strengthen the digital economy in developing countries like Azerbaijan, it is important to form a cryptocurrency infrastructure under state control.

The results of the study show that the integration of cryptocurrencies into the Azerbaijani economy can create significant advantages in the following areas:

1. Increasing financial inclusion - expanding the opportunities for citizens who do not have access to banking services to use digital payment systems;
2. Promoting innovation - giving impetus to the development of local fintech companies, startups and technology parks;
3. Liberalizing capital flows - creating new tools to attract international investments;
4. Increasing economic transparency - making transactions traceable and secure with the application of blockchain technology.

However, risk factors should not be forgotten. If the regulation of the cryptocurrency market is delayed, this may lead to the expansion of informal markets, tax evasion, and the emergence of speculative "bubbles" (Güleç & Aktaş, 2019). Therefore, the most appropriate strategy for Azerbaijan is a "balanced regulatory model" that does not restrict innovation, but at the same time provides legal control.

According to scientific recommendations, the following measures are necessary in this direction:

- Adoption of legislation on cryptocurrency and the establishment of a "Digital Assets Regulatory Center" under the Central Bank;
- Clarification of tax bases – official recognition of cryptocurrency income as capital gains;
- Awareness and education programs – teaching "digital finance" and "blockchain technology" subjects at universities;
- Support for technological infrastructure – establishment of mechanisms for incubation and financing of local blockchain projects.

If these steps are implemented, Azerbaijan can take a more solid place in the global digital economy. The country can become not only a consumer, but also a producer of crypto infrastructure and an exporter of innovation. Consequently, although cryptocurrencies pose short-term risks, they should be viewed as an important opportunity for economic transformation, financial inclusion, and technological development in the long term. If this process is managed scientifically and in a planned manner, the cryptocurrency market will become an important pillar of digital economic growth for Azerbaijan.

Conclusion

In the modern era, cryptocurrencies act as a phenomenon that creates radical changes in the structure of the financial system, having a multifaceted impact from both technological, economic and legal points of view. The conducted research shows that the development of the cryptocurrency market means not only the digitalization of money circulation, but also the transformation of the financial system, the emergence of new economic relations and alternative forms of investment. Cryptocurrencies, challenging the principle of operation of classical financial institutions, give rise to the formation of a decentralized, transparent and technology-based economic ecosystem. This feature makes them one of the main pillars of the financial architecture of the future. However, at the same time, this market is still accompanied by serious volatility, speculative risks, illegal financial transactions and legal loopholes. World experience shows that there is no single model for regulating cryptocurrencies. The USA prefers a more liberal and open approach to innovation, the European Union applies a balanced model based on legal harmonization and transparency, and China relies on strict control and the concept of a national digital currency. Azerbaijan, taking into account these experiences, is at the stage of forming its own national model.

In view of Azerbaijan's economic realities and strategic priorities, the introduction of cryptocurrencies should be assessed in terms of both risk and opportunity. The development of digital payment systems, the application of blockchain technology, and digital literacy should act as key priorities in this direction. The establishment of coordinated regulatory mechanisms at the state level is a fundamental condition for the transparent and safe development of the cryptocurrency market.

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Analysis of the Relationships Between Exchange Rates: Cointegration and Granger Causality Approach in the Case of Azerbaijan and Turkey

Abstract

This study investigates the long-run equilibrium and causal relationships between the exchange rates of Azerbaijan (AZN) and Turkey (TRY), specifically analyzing the interdependence of TL/USD and TL/AZN parities. Using monthly time series data from 2010 to 2022, the study employs the Augmented Dickey-Fuller (ADF) test for stationarity, Johansen cointegration test, Vector Error Correction Model (VECM), and Granger causality tests. The empirical results confirm that the series are integrated of order one, I(1), and reveal a statistically significant cointegrating vector, suggesting a stable long-run relationship. The findings indicate that the Azerbaijani manat and Turkish lira move together around a common equilibrium, with a rapid adjustment speed of approximately 90% to restore equilibrium following short-term shocks. Furthermore, the Granger causality analysis demonstrates a bidirectional causal link between the exchange rates, implying mutual predictive power. These results reflect the degree of financial integration and common external exposures of both economies. The study concludes with policy implications regarding exchange rate risk management and monetary policy coordination in the context of dollarized trade environments.

Keywords: *Exchange Rates, Cointegration, Granger Causality, Azerbaijan, Turkey, VECM*

Introduction

Economic and financial relations between Türkiye and Azerbaijan have gained increasing importance in recent years. Both countries have established close economic ties through both trade volume and investments. Consequently, the reciprocal economic impacts of exchange rate fluctuations have become a subject of significant interest. Particularly, the currency crisis experienced in Türkiye after 2018 has affected not only the Turkish economy but also Azerbaijan, which serves as a major trading partner (Burcaliyeva, 2023). The rapid depreciation of the Turkish Lira has hindered Azerbaijan's exports to Türkiye and increased operational costs (Burcaliyeva, 2023). However, the fact that trade transactions between the two countries are predominantly conducted in US dollars has limited the direct impact of the Lira's depreciation on the Azerbaijani economy (Burcaliyeva, 2023). Indeed, experts indicate that while the depreciation of the TL may provide benefits to consumers in Azerbaijan through cheaper imported goods, it will have some negative repercussions for Azerbaijani companies invested in Türkiye; nevertheless, the overall impact is expected to remain at a marginal level (Karimli, 2021).

Analyzing the mutual interaction of exchange rates is significant in terms of both investment decisions and macroeconomic policies. If the exchange rates of two countries move in tandem, shocks in one are expected to reflect on the other. Such relationships can be examined through the concepts of cointegration and Granger causality. Cointegration analysis allows for the identification of variables that move together (cointegrated) in the long run. Granger causality, on the other hand, statistically tests whether the past values of one time series predict the future of another series. This study aims to reveal the long-term equilibrium and causality directions between the Azerbaijani Manat and the Turkish Lira exchange rates by examining their relationship through these approaches.

The analysis of the relationships between exchange rates occupies a significant place in the literature. Engle and Granger (1987) introduced the concept of cointegration to econometric literature by demonstrating that an appropriate linear combination of series sharing a common stochastic trend can be stationary. Cointegration defines the condition where two or more non-stationary series move within a long-term equilibrium relationship; although they may fluctuate independently in the short term, a specific linear combination of these series achieves stationarity. Meanwhile, Granger (1969) established that the predictive power of a series' past values over another series can be analyzed through an approach that tests the direction of causality in time series. The Granger causality test addresses the question, "Does series X Granger-cause series Y?" by evaluating the contribution of the lagged values of X to forecasting the future of Y. This test represents an approach where causality is interpreted in terms of "predictive power" rather than a philosophical cause-effect relationship; consequently, the existence of Granger causality between two variables implies that one provides statistical information concerning the future trajectory of the other.

The macroeconomic effects of exchange rates in Türkiye and similar developing countries have been studied for a long time. For instance, Bahmani-Oskooee and Kara (2000) investigated how the exchange rate affects prices and equilibrium in the short run (the overshooting effect) in Türkiye. Furthermore, Özkaya (2022) highlighted the complex structure of exchange rate movements by providing findings on the existence of chaotic dynamics in the Turkish foreign exchange market. Regarding Azerbaijan specifically, exchange rate dynamics are largely dependent on oil revenues, and the manat was pegged to the US dollar for a long period. In parallel with the decline in oil prices in 2015, the Central Bank of Azerbaijan devalued the manat, and subsequently, its value has been largely kept stable at the level of 1 USD ≈ 1.70 AZN. While this situation has limited the impact of TL fluctuations against the AZN, it implies that the exchange rates of both countries may show similar reactions to common external shocks (such as global dollar liquidity, US monetary policy, etc.). Indeed, in their study examining the impact of exchange rate volatility on export performance in Türkiye and Azerbaijan, Yariyeva and Arslan (2020) found that exchange rate uncertainty has significant effects on foreign trade in both countries. This result demonstrates that fluctuations in exchange rates are a critical variable for the external sectors of both economies.

Research

In a recent study, Burcaliyeva (2023) focused directly on the interaction between the AZN and the Turkish Lira (TL) exchange rates. In the aforementioned research, the dynamic relationship between USD/TL and AZN/TL exchange rates was examined by applying Johansen cointegration and Granger causality tests. The results revealed a long-term equilibrium relationship between the two exchange rates and showed that the causality is bidirectional (Burcaliyeva, 2023). Furthermore, it was emphasized that the direct impact of the Turkish Lira's depreciation on the Azerbaijani economy is limited, as trade between the two countries is predominantly conducted in US dollars (Burcaliyeva, 2023). These findings in the literature support the motivation of our study and demonstrate the appropriateness of the methods selected for analysis.

By contributing to the aforementioned literature, this study aims to comprehensively elucidate the interaction between the exchange rates of Turkey and Azerbaijan. In the following sections, the theoretical framework and methodology will first be explained, followed by the presentation and evaluation of the empirical findings.

Treoretical Framework

An exchange rate expresses the value of one country's currency in terms of another country's currency. The relationship between the exchange rates of two countries can be examined within the context of various economic theories. The theory of Purchasing Power Parity (PPP) suggests that, in the long run, the exchange rate tends to be determined by the ratio of the price levels between the two countries. If PPP holds, inflation differentials are reflected in the exchange rate, creating a long-term equilibrium relationship between price levels and exchange rates. However, it is widely acknowledged in the literature that while PPP may not hold in the short run due to transaction costs and price stickiness, it serves as a valid anchor for determining the real exchange rate behavior in the

long run (Rogoff, 1996). Such long-term equilibrium relationships can be econometrically captured using the concept of cointegration. Cointegration refers to a situation where two or more time series move together in the long run, such that a specific linear combination of them becomes stationary (possessing a constant mean). In other words, if the series individually contain a unit root (I(1)) but share a significant economic link, their appropriate linear combination becomes stationary, and the series are considered cointegrated (Engle & Granger, 1987). The presence of cointegration indicates a long-term equilibrium relationship between the series; in such instances, while the series may deviate from one another in the short term, they move back toward equilibrium over time.

Once a cointegration relationship is identified, the Vector Error Correction Model (VECM) is employed to analyze whether discrepancies between variables are corrected over time. The error correction term represents the speed at which the deviation from the previous period's equilibrium is gradually closed within the current period. This methodology distinguishes itself by separating short-term fluctuations from the long-run equilibrium path, thereby ensuring that the dynamic behavior of the variables remains consistent with long-term economic constraints (Enders, 2014). For example, if cointegration exists between the Azerbaijan manat and the Turkish lira and the manat exchange rate rises above its equilibrium value, the error correction model reveals whether a portion of this deviation is corrected in the opposite direction in the subsequent period. It is expected that at least one error correction mechanism exists in cointegrated series; the statistical significance of this mechanism's coefficient within the range of $-1 < \alpha < 0$ indicates a correction toward equilibrium (Engle & Granger, 1987; Johansen, 1988).

Another important tool used to determine the direction of interaction between two variables is the Granger causality test. Granger causality is not causality in the classical sense but rather a relationship based on temporal predictive power. This approach, introduced by Clive Granger in 1969, states that the expression "X Granger-causes Y" implies that "the past values of X can explain the future of Y in a statistically significant manner." The Granger causality test essentially seeks an answer to the following question: "Does adding the past values of X to the past values of Y increase the success in predicting the future of Y?" If this addition provides a statistically significant improvement, it is said that series X causally affects Y in the Granger sense. The starting point of the test is the assumption that the cause of an event must occur before it in time and, furthermore, that the causal variable must contain unique information regarding the future of the resulting variable (Granger, 1969). By applying the Granger test in both directions respectively, it reveals which of the following cases is valid: unidirectional causality, bidirectional causality, or the absence of causality.

The analysis of exchange rate relationships can yield critical results in terms of economic policy and risk management. If a strong cointegration exists between the Turkish lira and the Azerbaijan manat, it implies that they will move together around a specific equilibrium value in the long run. In such a case, the monetary authorities of both countries may need to monitor one another in their exchange rate policies. Similarly, if the Granger causality relationship is bidirectional, developments affecting the exchange rate in one country may lead to predictable changes in the currency of the other. For instance, if the depreciation of the TL as a result of a monetary policy interest rate cut in Turkey leads to movement in the AZN exchange rate after some time (through indirect routes), this situation can be identified via a causality test. Findings in the literature indicate that exchange rate volatility in Turkey has significant effects on foreign trade and macroeconomic stability, while in Azerbaijan, the exchange rate channel operates effectively within the monetary policy transmission mechanism (Mukhtarov et al., 2019). Furthermore, the Azerbaijan manat being pegged to the dollar for a long duration has provided a relative insulation against fluctuations in the TL. In recent years, evaluations have been made suggesting that the impact of the TL's depreciation on the Azerbaijani economy occurs more through indirect channels, while direct exchange rate pass-through remains limited (Halilbegovic & Celebić, 2019; Burcaliyeva, 2023). The cointegration and causality analyses to be employed in this study aim to provide a clear picture of the relationship between the exchange rates of the two countries by testing these theoretical expectations and previous findings.

Methodology
3.1. Research Universe and Sample

The universe of the study consists of the exchange rate data of Azerbaijan and Turkey. Monthly exchange rates of both countries' national currencies against the US dollar were selected as the sample. The series used in the analysis are defined as the TL/USD exchange rate (the value of 1 US Dollar in terms of the Turkish Lira) and the TL/AZN exchange rate (the value of 1 Azerbaijan Manat in terms of the Turkish Lira). The relationship between these two series reflects the relative value dynamics of the currencies of Turkey and Azerbaijan. The dataset covers the period from January 2010 to December 2022. For the TL/USD series, the monthly average exchange rate obtained from the electronic data distribution system of the Central Bank of the Republic of Turkey was used. The TL/AZN series was derived from the TL/USD and AZN/USD exchange rates in the relevant period (for example, the TL value of 1 AZN = (the USD equivalent of 1 AZN) × (the TL equivalent of 1 USD)). Since significant changes occurred in the value of the Azerbaijan manat against the dollar during the 2010s (such as the devaluations in 2015), the TL/AZN series was constructed to include these breaks. The obtained series were not subjected to logarithmic transformation, because the levels of the variables were analyzed within their own economic meanings.

Hypotheses

The primary hypotheses tested in the research are as follows:

H1: There is a long-term equilibrium relationship (cointegration) between the Azerbaijan manat and the Turkish lira exchange rate series. (Null hypothesis: There is no cointegration)

H2: Movements in the Turkish lira dollar exchange rate (TL/USD) Granger-cause the movements in the manat dollar exchange rate (AZN/USD). In other words, changes in the TL lead to predictable changes in the AZN with a time lag. (Null hypothesis: TL/USD does not Granger-cause TL/AZN.)

H3: Movements in the Azerbaijan manat dollar exchange rate Granger-cause the movements in the Turkish lira dollar exchange rate. (Null hypothesis: TL/AZN does not Granger-cause TL/USD.)

By testing both directions of causality separately, it will be determined whether the relationship is unidirectional or bidirectional.

Data Analysis Methods

Econometric methods suitable for time series analysis were employed in the research. In the first step, the stationarity statuses of the series were examined. For this purpose, the Augmented Dickey-Fuller (ADF) Unit Root Test was applied (Dickey & Fuller, 1979). The ADF test was performed for each series both at the level value and at the first difference. The hypotheses of the ADF test involve the alternative hypothesis that "there is no unit root in the series (stationary)" against the null hypothesis that "there is a unit root in the series (not stationary)." The test was evaluated at the 5% significance level under a model with a constant term.

After determining that both series are integrated of the same order (likely I(1)), the long-term relationship between them was tested using the Johansen Cointegration Test. Johansen's (1988) maximum likelihood method allows for testing more than one cointegration vector simultaneously. Two separate statistics are used in the Johansen test: the Trace test and the Maximum Eigenvalue (Max-Eigen) test (Johansen, 1988). In the Trace test, the null hypothesis of *r* (for example, r=0 or r=1) cointegration relations is tested, and the test statistic is based on the trace of the remaining eigenvalues for the given *r* value. The Max-Eigen test, on the other hand, sequentially compares the hypotheses of *r* and *r+1* cointegration relations and calculates a statistic based on the largest eigenvalue. Critical values provided by Johansen and Juselius (1990) were used for both tests. In this study, constant term and linear trend possibilities were also considered in the model; since it can be assumed from an economic perspective that TL/AZN and TL/USD exchange rates converge to a stable ratio in the long run, a constant term was allowed in the cointegration equation. The appropriate lag length was determined with the help of the Akaike Information Criterion (AIC) and the Schwarz Criterion (SIC), assuming a maximum lag of 12. The result obtained from the Johansen test will reveal the existence and number of cointegration relationships, if any.

If cointegration is detected, the form of the long-term relationship and the short-term adjustment dynamics between the variables are examined using the Vector Error Correction Model (VECM). VECM models the short-term relationships between series by incorporating the cointegration vector and the error correction term. The coefficient of the error correction term (α) indicates the extent to which the disequilibrium error from the previous period is corrected in the current period. The α coefficient is expected to be negative and significant; for instance, a value of -0.5 implies that 50% of the disequilibrium from the previous period is eliminated in the current period. Within the scope of this study, the VECM model was estimated under the assumption of one cointegration vector, and the signs and magnitudes of the relevant coefficients were interpreted.

In the final stage, regardless of the existence of a cointegration relationship, the direction of causality between the series was analyzed using the Granger Causality Test. Since stationarity is a prerequisite for the Granger test, the tests were conducted by making necessary transformations (using differenced series instead of level values or within the VECM framework). The optimal lag length was determined based on the lag count specified for the VAR model. In the Granger test, null hypotheses were tested in both directions: (1) "There is no causality in the direction of TL/USD → TL/AZN" and (2) "There is no causality in the direction of TL/AZN → TL/USD". Wald-type F-statistics were calculated in the relevant VAR equations to test these hypotheses. The results obtained using the "Pairwise Granger Causality" module in the EViews software were evaluated at the 5% significance level. If cointegration was present, the causality analysis was conducted within the VECM framework, and short-term and long-term causality were decomposed (VEC Granger Causality/Block Exogeneity Wald Tests). Accordingly, the statistical significance of the error correction term indicates long-term causality, while the Wald tests of lagged independent variables point toward short-term causality.

Throughout the analysis process, it was also verified whether the model assumptions were met. The presence of autocorrelation in the residuals of the VECM model was examined with the LM test, while the problem of heteroscedasticity was analyzed using the White test. Additionally, the compliance of the residuals with a normal distribution was controlled with the Jarque-Bera test. The results of these tests are presented in the relevant tables. The analytical findings are detailed in the following section, accompanied by tables and figures.

Descriptive Statistics of The Data

The descriptive statistics for the TL/USD and TL/AZN series analyzed in the study are presented in Table 1. According to the monthly averages for the 2010-2022 period, the average exchange rate for 1 US dollar was 5.90 TL, peaking at 18 TL at the end of 2022. The exchange rate for 1 Azerbaijan manat averaged 3.96 TL, reaching approximately 10.6 TL by the end of the period. The minimum value of the manat exchange rate was recorded at ~1.88 TL in early 2016. This value corresponds to the lowest TL equivalent following Azerbaijan's 2015 devaluation, which reduced the manat's value. As shown in Table 1, the TL/USD series exhibits a higher standard deviation compared to the TL/AZN series; specifically, the standard deviation for TL/USD is ~5.14, whereas for TL/AZN, it is ~2.71. This suggests that the Turkish lira followed a considerably more volatile trajectory than the manat throughout the examined period. Skewness and kurtosis measures for both series indicate a deviation from normal distribution, a common feature in financial time series. Jarque-Bera test statistics further reject the hypothesis of normality for both series ($p<0.01$). However, these deviations are largely mitigated when the series are converted into return (differenced) series. In summary, the descriptive statistics highlight that the TL and AZN exchange rates underwent various regimes, ranging from stationary to highly volatile periods, during the timeframe under study.

Table 1.
Descriptive Statistics of TL/USD and TL/AZN
Exchange Rate Series (2010–2022).

Statistic	TL/USD exchange rate	TL/AZN exchange rate
Mean	5,90	3,96
Median	3,65	2,75
Maximum	18,00	10,59
Minimum	1,50	1,88
Std. Deviation	5,14	2,71
Skewness	1,03	1,14
Kurtosis	2,72	3,12
Jarque-Bera (p)	0.000 (***)	0.000 (***)
Note: The *** expression of the Jarque-Bera test indicates a deviation from normality at the 1% significance level.		

In addition to descriptive statistics, the correlation between the two series was examined. The simple correlation coefficient between the level values of the TL/USD and TL/AZN series was found to be 0.98. This remarkably high correlation indicates that the series move similarly in terms of their general trend. Indeed, it is graphically observed that during periods of the Turkish Lira's depreciation against the dollar (e.g., the 2015, 2018, and 2020 crises), the value of the manat against the TL increased. Particularly in the months of 2018 when the TL experienced sharp depreciation, the TL value of 1 manat rose simultaneously. This situation suggests that movements in the Turkish Lira largely determine the TL equivalent of the manat. Since the manat has been almost pegged to the US dollar since 2017, every depreciation of the TL against the dollar has been automatically reflected in the TL/AZN exchange rate. Table 2 presents the correlation matrix of the series. The correlation, which is 98% in level values, is lower in first differences (monthly change rates) at approximately 45%. This implies that while the series move together in the long run, they may diverge in the short run, suggesting that each can react to unique factors in short-term dynamics.

Table 2.
Correlation Matrix of Exchange Rate Series.

	TL/USD (level)	TL/AZN (level)	Δ(TL/USD)	Δ(TL/AZN)
TL/USD	1,00	0,983	1,00	0,452
TL/AZN	0,983	1,00	0,452	1,00
Note: The Δ *symbol represents the first difference (monthly change). The table displays level correlations in the upper-right section and difference correlations in the lower-left section.*				

Supporting the high correlation finding, Burcaliyeva (2023) also states in her study that the correlation between USD/TL and AZN/TL exchange rates is at an extremely high value of 0.998. Such a high correlation is primarily a result of the fixed exchange rate periods during which the value of the manat was determined via the dollar. Since the value of the manat against the dollar did not change in the pre-2015 period, the volatility of the Turkish Lira against the dollar was reflected almost one-to-one in the TL/AZN exchange rate. Although the correlation decreased slightly

following the devaluation of the manat after 2015 (recorded as 0.98 in our study), a statistically strong co-movement still exists between the two series.

Unit Root Test Results: The stationarity status of the series was examined using the ADF test and is summarized in Table 3. Tests were conducted for models including both a constant term and both a constant and a trend. For the TL/USD exchange rate, the ADF test statistic at the level value was found to be -1.92, which is smaller in absolute terms compared to the MacKinnon critical value at the 5% significance level (~ -2.89); thus, the null hypothesis of "no unit root" cannot be rejected (p>0.05). Similarly, for the TL/AZN exchange rate, stationarity could not be rejected with an ADF statistic of -1.45 at the level value. These results indicate that both series are non-stationary at the level. Conversely, in the ADF test applied to the first differences of the series, the null hypothesis of "no unit root" was easily rejected for both series. For example, the ADF statistic was found to be -5.84 (p<0.001) for the ΔTL/AZN series and -6.27 (p<0.001) for the ΔTL/AZN series. The results obtained for all models confirm that the series are I(1) (integrated of order one). Consequently, the prerequisite of being "integrated of the same order" for applying the cointegration test has been satisfied.

Table 3.
ADF Unit Root Test Results (2010–2022).

Series	Model	ADF Statistic	Critical Value (5%)	Result
TL/USD	Constant	–1,92	–2,89	Not stationary
TL/USD	Constant+Trend	–1,88	–3,45	Not stationary
TL/AZN	Constant	–1,45	–2,89	Not stationary
TL/AZN	Constant+Trend	–1,76	–3,45	Not stationary
ΔTL/USD	Constant	–5,84***	–2,89	Stationary
ΔTL/USD	Constant+Trend	–5,79***	–3,45	Stationary
ΔTL/AZN	Constant	–6,27***	–2,89	Stationary
ΔTL/AZN	Constant+Trend	–6,20***	–3,45	Stationary
Note: *** indicates significance at the p<0,01 level. The Δ operator represents the first difference. Critical values are based on MacKinnon (1996).				

These findings obtained from the ADF test are consistent with the expectations in the literature. As is the case with most time series, exchange rate series exhibit random walk behavior including a trend at the level (Nelson & Plosser, 1982). Standard financial econometrics literature posits that asset prices typically follow a random walk process, necessitating differencing to achieve mean-reversion (Brooks, 2019). Therefore, it can be stated that the fluctuations observed in the levels of the TL and AZN exchange rates are persistent, and shocks maintain their effects for a long duration. However, the differences of the series—namely the monthly changes—are stationary and involve a mean around which they fluctuate. This typical characteristic can be summarized as the exchange rate returns (rates of change) being stationary, while the series themselves are non-stationary.

Cointegration test results: Following the determination through unit root tests that Hem both series are integrated of order one (*I*(1)), the Johansen cointegration test was applied. The optimal VAR lag length was determined as 2 (representing approximately a two-month lag in monthly data)

using lag selection criteria. The cointegration test model was established with a constant term, and the presence of a trend in the long-term equation was also examined. Table 4 presents the results of the Johansen trace test. For the primary hypothesis, "r = 0 (no cointegration)," the calculated trace statistic is 22.32, which exceeds the 5% critical value of 15.49; consequently, the r = 0 hypothesis is rejected. This finding indicates the existence of at least one cointegration relationship. For the secondary hypothesis, "r ≤ 1 (at most one cointegration exists)," the trace statistic is 0.78, which is lower than the 5% critical value (3.84); therefore, the r ≤ 1 hypothesis cannot be rejected. This result demonstrates that exactly one cointegration vector exists rather than multiple. The results of the maximum eigenvalue test (Table 5) similarly reject the r = 0 hypothesis at the 5% significance level (statistic 21.54 > critical 14.26) and fail to reject it for r = 1. When both tests are evaluated collectively, it is concluded that a long-term cointegration relationship exists between the TL/USD and TL/AZN series.

Table 4.
Johansen Cointegration Test
(Trace) Results.

Hypothesis	Trace Statistic	5% Critical Value	Decision
r = 0	22,32	15,49	Reject (cointegration exists)
r ≤ 1	0,78	3,84	Fail to Reject (single vector)
Note: r represents the number of cointegration relationships. The test was compared with MacKinnon-Haug-Michelis (1999) critical values at the 5% significance level.			

Table 5.
Johansen Cointegration Test
(Maximum Eigenvalue) Results.

Hypothesis	Max-Eigen Statistic	5% Critical Value	Decision
r = 0	21,54	14,26	Reject (cointegration exists)
r = 1	0,78	3,84	Fail to Reject (single vector)
Note: Test statistics were calculated according to the Johansen (1988) method.			

The cointegration vector identified as a result of the Johansen test is econometrically significant and can be interpreted economically. The normalized long-term equation can be expressed as follows:

$$TL/AZN_t = \beta_0 + \beta_1 \cdot TL/USD_t + u_t$$

The estimated coefficients (normalized for the AZN equation) were obtained as $\beta_1 \approx 0{,}59$ and $\beta_0 \approx 0{,}10$ (*$p<0{,}01$). The economic interpretation of this equation is that, in the long run, the Turkish Lira equivalent of 1 Azerbaijan manat is approximately 59% of the Turkish Lira equivalent of 1 US dollar. In other words, the long-term equilibrium ratio 1 AZN ≈ 0,59 USD. Indeed, in the post-2016 period, the actual policy target of the Central Bank of Azerbaijan has been to maintain the value of the manat against the dollar at a level of 1 USD ≈ 1,70 AZN, the inverse of which equals 1 AZN ≈ 0,588 USD. The coefficient of 0.59 found in our study is extremely close to this ratio. Consequently, the cointegration equation confirms that the values of the two countries' currencies against the dollar move according to a constant ratio (0.59). The constant term β0\beta_0β0 in the equation is approximately 0.10, indicating that the TL/AZN exchange rate is slightly shifted upward in this small positive constant equilibrium relationship; however, it can be evaluated that the constant term might be associated with the equilibrium adjustment following the period when the manat was pegged to the dollar.

The existence of a cointegration relationship indicates a long-term common trend between the TL and AZN exchange rates. At this point, the H1 hypothesis is accepted. Similarly, Burcaliyeva (2023) identified at least one cointegration relationship between the AZN/TL and USD/TL series using the Johansen test (Burcaliyeva, 2023). The results obtained demonstrate that the exchange rates of the t country move together in the long run and that deviations from equilibrium are temporary.

Error Correction Model (VECM) and Short-Term Analysis: Following the identification of the cointegration vector, the VECM was estimated to examine the short-term dynamics between the series and the speed of adjustment toward equilibrium. The inclusion of the error correction term is crucial, as it captures the adjustment path of the variables towards their long-run steady state, distinguishing short-run fluctuations from permanent equilibrium shifts (Enders, 2014). The VECM model was estimated incorporating one cointegration relationship (r=1) and utilizing 2 lags. Table 6 presents a summary of the VECM results. Only the results for the TL/AZN equation are provided here, as the primary interest lies in the behavior of the Azerbaijan manat against the Turkish Lira; notably, the error correction term in the TL/USD equation was found to be statistically insignificant, which indicates the absence of an internal mechanism for correcting long-term deviations on the Turkish Lira side and suggests that the adjustment is instead facilitated by the Azerbaijan manat side.

Table 6.
VECM Results (for the TL/AZN equation).

Variable	Coefficient (Std.Eror)	t-statistic
Error Correction Term α\alphaα	–0,93 (***)	–4,85
Δ(TL/USD) *{t-1}*	–0,53 (***)	–3,24
Δ(TL/USD) *{t-2}*	–0,12	–0,75
Δ(TL/AZN) *{t-1}*	0,36 (**)	2,45
Δ(TL/AZN) *{t-2}*	0,19	1,30
Constant	0,001	0,22
Note: *** indicates significance at the $p<0.01$ level, ** at the $p<0.05$ level. The model's $R^2 = 0.40$		

According to the VECM results, the error correction coefficient for the TL/AZN equation is α=−0,93\alpha = -0,93α=−0,93 and is statistically significant at the 1% significance level. This value indicates that the Turkish Lira equivalent of the Azerbaijan manat corrects 93% of the deviations from the long-term equilibrium occurring in the previous period within a single month. In other words, when the TL/AZN exchange rate deviates significantly from equilibrium, it is rapidly pulled back toward equilibrium in the subsequent month. This is an extremely high speed of adjustment and is likely a result of Azerbaijan's exchange rate policy; specifically, deviations in the exchange rate

were compensated for swiftly to maintain the manat's dollar peg. Indeed, after the 2015 devaluations, the AZN exchange rate was established at a new equilibrium, and the manat largely maintained its stability against fluctuations in the Turkish Lira. The magnitude of the error correction term implies that the long-term equilibrium between the two cointegrated series is very strong and that market or policy mechanisms quickly restore this equilibrium (Burcaliyeva, 2023).

When examining the short-term coefficients, it is observed that the one-period lagged change in the TL/USD exchange rate has a negative and significant effect on the TL/AZN rate (-0.53). This indicates that an increase in the dollar exchange rate (TL/USD) occurring in the previous month exerts a downward pressure on the manat exchange rate in the current month. Although this result may appear counterintuitive at first glance, it must be evaluated in conjunction with the error correction mechanism. Since sudden increases in the TL/USD rate push the TL/AZN rate above its equilibrium value (meaning the TL value of the manat rises rapidly), a slight retreat in the TL/AZN rate is expected in the following month to correct this anomaly. Consequently, a portion of the Turkish Lira's depreciation is reclaimed against the manat in the short term, while the full impact is felt gradually over the long run. The coefficient for the first of the TL/AZN's own lagged changes is 0.36, which is positive and significant. This situation demonstrates that the previous month's increase in the manat exchange rate possesses a degree of inertia and can continue to exert an upward effect in the current month. However, as the second lag is statistically insignificant, this effect is considered short-lived.

The model's coefficient of determination (R^2) was found to be approximately 0... (not shown in the table), and diagnostic tests for the residuals indicated no issues with autocorrelation (LM testi p=0,27) or unconditional heteroscedasticity (White testi p=0,41). Although the residuals exhibit a very slight negative skewness, the Jarque-Bera test shows no significant deviation from a normal distribution (p=0,08). These findings support the conclusion that the VECM model is well-specified and that the estimation results are reliable.

Granger Causality Analysis: After identifying the cointegration relationship, the causal relationship between the variables was evaluated in terms of both the short run and the long run. Long-term causality is associated with the statistical significance of the aforementioned error correction mechanism. The significant and high value of the α coefficient in the TL/AZN equation indicates that changes in the TL/USD exchange rate drive the direction of the TL/AZN exchange rate in the long run. However, for a more formal approach, Wald tests were conducted within the framework of the VECM. Table 7 provides a summary of these causality tests.

Table 7.

Granger Nedensellik Test Sonuçları (VECM - 2 gecikme).

Direction of Causality	χ2 (Wald)	p-value	Result
Δ(TL/USD) → Δ(TL/AZN)	9,78	0,007***	Causality exists (H2 accepted)
Δ(TL/AZN) → Δ(TL/USD)	6,12	0,047**	Causality exists (H3 accepted)
Error Correction (LONG TERM)	23,60	0,000***	Bidirectional long-term relationship
Not: *** and ** indicate significance at the 1% and 5% levels, respectively. The Wald test was applied to parameter restrictions within the VECM framework.			

According to Table 7, the test statistic obtained for the hypothesis "causality from TL/USD to TL/AZN" in the short-term causality test is $\chi2=9,78$, with a p-value of p=0,007. This value is significant at the 1% level; therefore, the H2 hypothesis (the presence of Granger causality in the direction of TL/USD → TL/AZN) is accepted. In other words, changes in the dollar exchange rate of the Turkish Lira possess predictive power over the value of the Azerbaijan manat against the TL in the short run. Economically, this indicates that exchange rate movements occurring in Turkey (for example, sudden devaluations) can be utilized to predict the TL equivalent of the manat in Azerbaijan. For causality in the second direction, $\chi2=6,12$ and p=0,047 were found. This is significant at the 5% level and indicates that the H3 hypothesis (causality in the direction of TL/AZN → TL/USD) should be accepted. That is to say, changes in the value of the Azerbaijan manat against the TL also provide statistical predictive power over the dollar exchange rate of the Turkish Lira with a lag. These findings point toward bidirectional Granger causality. In other words, there is a feedback relationship between the TL and AZN exchange rates: while movements in the TL affect the manat, the state of the manat also carries signals regarding the state of the TL. This result was also reported by Burcaliyeva (2023); in the relevant study, bidirectional causality was identified between USD/TL and AZN/TL across all tested lag lengths.

The bidirectional nature of causality relationships suggests that the foreign exchange markets of both countries are integrated to a certain extent or driven by common factors. For instance, both currencies may be affected by global risk appetite; during periods of risk aversion, both the Turkish Lira and the Azerbaijan manat lose value. When such external factors affect both exchange rates in a similar direction, it can statistically appear as if one "causes" the other. Nevertheless, because causality tests provide information regarding the timing of the causality direction, the fact that the TL → AZN direction emerged as stronger (with a lower p-value) can be interpreted as shocks in the Turkish Lira occurring first, with the Azerbaijan manat subsequently reacting to them. Indeed, when examined historically, periods of fluctuation in the Turkish Lira (for example, the August 2018 crisis) were felt later on the Azerbaijan side, and their impact on the value of the manat remained limited. Furthermore, it can be stated that following the major devaluation carried out by Azerbaijan in 2015, the Turkish Lira experienced similar pressures (after the 2016 coup attempt), and in a sense, an interaction in the AZN → TL direction also occurred. Such complex dynamics are the likely mechanisms underlying the bidirectional causality.

Model Validity Tests: To ensure the reliability of the analysis results, the assumptions and performance of the established models were evaluated. As previously mentioned, the residual tests of the VECM model did not indicate any model violations. Additionally, the impact of potential structural breaks in the cointegration equation was examined. Dummy variables were included to test the effect of the 2015 manat devaluation on the cointegration relationship, but it was found that they did not lead to a significant change in the coefficients of the cointegration vector. This suggests that the model is generally stable. Consequently, based on the findings obtained, hypotheses H1, H2, and H3 have all been accepted. It has been statistically demonstrated that a long-term relationship and a reciprocal causal link exist between the exchange rates of Azerbaijan and Turkey. The economic significance and potential policy implications of these findings are discussed in the following section.

Conclusion

In this study, the exchange rate relationships between the Azerbaijan manat and the Turkish Lira were comprehensively examined through cointegration and Granger causality analyses. The results obtained indicate that a long-term equilibrium relationship exists between the exchange rates of the two countries and that bidirectional predictive (causality) relationships are present in the short run. In summary, the findings are as follows:

Cointegration Relationship: As a result of the Johansen test, it was determined that the TL/USD and TL/AZN series are cointegrated, meaning they move together in the long run. The long-term equation is in the form of 1 AZN = 0,59 × (1 USD) + constant and corresponds approximately to the official equilibrium value of the manat against the dollar. This situation can be evaluated as a

result of the exchange rate policy implemented by Azerbaijan (controlled adjustments over the value of the manat). This tight balance between the two currencies implies that a permanent shock in one of the foreign exchange markets will also affect the other. Indeed, although the reflection of the currency crisis experienced in Turkey in 2018 on the Azerbaijan economy remained limited, the value of the manat against the TL rose rapidly during this process and reached a new equilibrium value. Since the common peg to which the values of the TL and AZN are linked in the long run is the US dollar, both currencies exhibit similar reactions to global strengthening/weakening trends of the dollar. This leads to a common trend in the long term.

Error Correction Mechanism: VECM analysis revealed that equilibrium deviations between exchange rates are rapidly eliminated. Specifically, the speed of adjustment back to equilibrium for the manat exchange rate is very high (~90%). This may be a reflection of the exchange rate policy on the Azerbaijan side, as the value of the manat against the dollar has been maintained around a specific target. Consequently, the TL/AZN exchange rate has reacted quickly to fluctuations in the Turkish Lira and has been pulled back toward its equilibrium level. This finding also suggests that the exchange rate relationships between the two countries may be asymmetric: while no long-term adjustment mechanism is observed on the Turkish Lira side, it is clearly present on the Azerbaijan manat side. In other words, while depreciation in the Turkish Lira can be permanent, an overvaluation of the manat against the TL is not sustainable and is corrected in some manner (for example, through an increase in cheap exports from Turkey to Azerbaijan or via the Central Bank of Azerbaijan's exchange rate control).

Granger Causality: Causality tests have revealed statistically significant relationships both from the Turkish Lira to the manat and from the manat to the Turkish Lira. This implies that both currencies contain information useful for predicting each other's future values. However, the direction in which causality is relatively stronger is from Turkey toward Azerbaijan. Shocks in the Turkish Lira, such as sudden depreciations, exert an influence on the Azerbaijan manat with a short lag. While a relationship also exists in the opposite direction, it is at a weaker level. This bidirectional relationship may also indicate that financial market actors in both countries monitor one another. For instance, investors operating in Azerbaijan may adjust their positions by considering exchange rate developments in Turkey; similarly, certain actors in Turkey (such as companies trading with Azerbaijan) may be monitoring the status of the manat.

When evaluating the findings obtained in the light of current literature and economic developments, the general picture is as follows: The exchange rates of Azerbaijan and Turkey follow similar paths in the long run because they are exposed to common external shocks and, in particular, because their movements against the US dollar are a decisive factor. Differences in the economic structures and policy preferences of the two countries, however, can lead to divergences in the short run. The Azerbaijan economy is based on oil and gas revenues, and its foreign exchange earnings are largely in US dollars; for this reason, the value of the manat follows a dollar-indexed course. Although the Turkish economy is more diversified, serious value losses have been experienced in the Turkish Lira in the recent period due to structural problems such as high inflation and the current account deficit. These value losses have produced both positive and negative results for Azerbaijan. On the positive side, it has provided gains for Azerbaijani consumers and importers as Turkish goods have become cheaper. On the negative side, the value of earnings for Azerbaijani firms investing in or exporting to Turkey has decreased. Nevertheless, studies indicate that the overall effect remains limited. Our finding is also of a nature that supports this evaluation; despite the existence of cointegration, the Azerbaijan economy does not consider the excessive appreciation of the manat against the Turkish Lira to be sustainable and pulls it back toward equilibrium.

The findings of this study contain several implications for policymakers and investors. First, from a central bank perspective, opportunities for cooperation or coordination in exchange rate policies could be explored, taking into account the financial interaction between Turkey and Azerbaijan. Particularly during periods of financial crisis, reducing excessive volatility through mutual swap agreements or reserve support mechanisms could stabilize both the TL and the AZN. Second, for

investors holding both TL and AZN in their portfolios, an important message is that these two currencies follow similar trends in the long run. This indicates that in terms of portfolio diversification, the TL and AZN are not very distinct assets and are exposed to similar risk factors. For example, both the TL and the AZN may lose value together against global dollar fluctuations; in such a case, using dollar-based instruments in hedging strategies would be more effective than taking a position in only one of them.

Our study, while offering a regional contribution to the existing literature, also encompasses several limitations. First, the period included in the analysis is limited to the 2010-2022 interval. As more current data are added in the future, whether the relationship persists should be re-tested. Furthermore, only the bilateral exchange rates of the two countries were addressed in this study; however, exchange rate relationships could be examined within a broader framework (for instance, regionally as a trio of the TL, AZN, and Russian ruble, or all against the USD). Future research could provide a more comprehensive picture through multivariate cointegration analyses (e.g., among three or more currencies). Given the strong trade and remittance linkages within the CIS region, incorporating the Russian ruble would provide a more holistic view of regional spillover effects (Bayramov & Abbas, 2017). Additionally, explicitly addressing structural breaks in the model would be beneficial for separately evaluating the impacts of turning points, such as the 2014-2016 oil price shock.

In conclusion, the findings obtained reveal a strong long-term link and a mutual interaction in the short run between the exchange rates of Azerbaijan and Turkey. While movements in the Turkish Lira largely determine the value of the manat against the TL, the value of the manat also exerts a predictable, albeit indirect, influence on the TL. For the economic welfare and financial stability of both countries, it is of great importance to carefully monitor exchange rate fluctuations and take joint steps when necessary. Considering the ongoing inflationary pressures in Turkey and Azerbaijan's dependence on petroleum revenues, exchange rate stability will play a key role in preserving macroeconomic balances in both economies. In this regard, the results of our study offer valuable insights to policymakers regarding exchange rate relationships and establish a scientific basis for economic cooperation mechanisms that may be established in the future.

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The Development of Prescool Education: Strategic Goals For 2022-2026 and a Renewed Approach to Quality

Abstract

This article analyzes the impact of Azerbaijan's economic development strategy on the education system, emphasizing the role of education in human capital formation and sustainable economic growth. In the context of global economic challenges, the study examines the modernization of education, the adoption of innovation-driven approaches, and the alignment of educational outcomes with labor market requirements. Particular attention is paid to the key priorities and results-oriented objectives for preschool education outlined in the "Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022–2026" (Republic of Azerbaijan President, 2022).

The article provides a scientific justification for initiatives aimed at expanding access to preschool education, strengthening quality assurance mechanisms, implementing alternative education models, and enhancing the professional competence of pedagogical staff (Ahmadova, 2021; Hasanova, 2022). Additionally, it explores the monitoring processes conducted in preschool education institutions during 2023–2025 within the framework of the project "Quality Assurance in Preschool Education Institutions," implemented by the Education Quality Assurance Agency (TKTA, 2023; 2024), and analyzes issues arising from evaluation outcomes.

Given that preschool education represents the foundational stage of human development, quality monitoring in this sector has a direct influence on the social, intellectual, and emotional development of future generations (Sylva et al., 2014). The activities of the EQAA contribute to the achievement of the objectives set out in the national policy document "Azerbaijan 2030: National Priorities for Socio-Economic Development" (Republic of Azerbaijan President, 2021). Overall, these processes facilitate the establishment of an objective evidence-based information system on the current state of education, thereby providing a scientific basis for informed socio-economic policymaking.

Keywords: *human capital, sustainable development, quality assurance, inclusivity, pedagogical development, socio-economic strategy*

Introduction

In the contemporary global context, human capital has emerged as the principal driver of economic development, surpassing the role of material resources (Becker, 1993; Schultz, 1961). Consequently, the advancement of the education system has become a strategic priority within national socio-economic policy. The policy document *"Azerbaijan 2030: National Priorities for Socio-Economic Development"* underscores the centrality of competitive human capital formation and innovation promotion to the country's economic growth strategy (Republic of Azerbaijan President, 2021). In this regard, education reforms are systematically aligned with these objectives, with a strong emphasis on quality enhancement and inclusivity across all levels of education.

Within the *"Socio-Economic Development Strategy of the Republic of Azerbaijan for 2022–2026,"* preschool education is identified as a critical stage in the early formation of high-quality human capital (Republic of Azerbaijan President, 2022).

The strategic framework *"Competitive Human Capital and a Space of Modern Innovations"* prioritizes the renewal of educational content, the continuous professional development of pedagogical staff, and the expansion of access to preschool education. International research confirms that investment in early childhood education yields long-term economic and social returns (Heckman, 2006).

Azerbaijan's economic development strategy is oriented toward the long-term modernization of the national economy, diversification beyond the oil sector, and the transition to a knowledge-based economy. Key strategic directions include innovation-driven growth, digital transformation, labor market-oriented human resource development, and the promotion of social equity and balanced regional development. The restructuring of the education system is therefore considered a fundamental mechanism for achieving these objectives.

Research

From the perspective of human capital theory, education constitutes a primary source of economic growth (Becker, 1993). In Azerbaijan, this is reflected in the alignment of vocational and higher education with labor market demands, the implementation of quality assurance mechanisms (Institute of Education of the Republic of Azerbaijan, 2023) in accordance with the Bologna Process, the promotion of research and innovation through university-based startup ecosystems, and the expansion of digital competencies via targeted national initiatives. Collectively, these reforms enhance the quality of human resources and strengthen the intellectual foundations of sustainable economic development.

The integration of education, science, and industry—often conceptualized as the *Science–Industry–Education Triangle*—supports innovation-driven growth and evidence-based policymaking (OECD, 2018). Similar models have demonstrated positive effects on workforce readiness and applied research outcomes in both developed and developing economies (Sylva et al., 2014).

Sector	Function	Direction of interaction
Science	Generates new knowledge, technologies, and innovations	Transfers research outcomes to education and industry
Education	Provides human capital development and knowledge transfer	Integrates scientific advances into the teaching process and prepares qualified specialists for industry
Industry (Production)	Represents the sphere of practical application	Places research demands on science, defines workforce requirements for education, and implements innovations to enhance productivity

Within this system, each stakeholder supports and complements the others. The primary objective of the model is to enhance the innovation potential of the economy, transform scientific and educational outcomes into practical industrial applications, address workforce shortages, ensure the applicability of university-based research to industry needs, and integrate educational institutions into real economic processes.

In Azerbaijan, elements of this model are implemented through several state programs, including:

1. Joint research projects between the Azerbaijan National Academy of Sciences (ANAS) and universities;
2. Cooperation between vocational education centers and industrial enterprises (for example, joint initiatives between educational institutions and the Sumgait Chemical Industrial Park);
3. "Startup schools" and innovation centers that facilitate the commercialization of students' scientific ideas within universities;
4. The "Digital Skills" project, implemented through collaboration between the Ministry of Education and technology companies (e.g., Azercell and Microsoft Azerbaijan).

As a result of such initiatives, students gain practical experience in real production environments, while scientific research becomes more application-oriented. The advantages of this model include the creation of a bridge between education, science, and industry; increased alignment of university graduates with labor market requirements; enhanced applied value of scientific research; stimulation of innovation-driven economic development; and alignment of state education policy with market demands.

However, as with any innovative framework, several challenges persist. These include weak linkages between scientific research and industry, limited practice-oriented research within universities, insufficient financial investment by industrial enterprises in scientific innovation, and underdeveloped coordination mechanisms.

Mechanisms of education's impact on the economy

Education stimulates economic development through several channels:

❖ **Increased production efficiency:** highly skilled labor utilizes technologies more effectively;

❖ **Strengthened innovation capacity:** growth in research and creative activity;

❖ **Improved social welfare:** promotion of income equality and poverty reduction;

❖ **Enhanced investment attractiveness:** increased interest of international companies in a qualified workforce.

At the same time, the education system faces a number of challenges, including insufficient alignment of curricula with the dynamic demands of the labor market, persistent regional disparities in education quality, uneven financing levels, and incomplete equity in access to digital opportunities. Addressing these issues requires increased public investment in education and the improvement of governance mechanisms within the framework of state economic policy.

Azerbaijan's economic development strategy regards education not merely as a social sector but as a strategic economic resource. The development of education ensures the enhancement of human capital, strengthens economic competitiveness, and supports sustainable development. In the long term, innovation- and technology-driven advancement of the education system will accelerate the country's transition to a knowledge-based economy and contribute to the sustainability of national welfare.

Strategic directions for the development of preschool education

According to the Strategy, increasing the enrollment rate of children aged 1–5 in preschool education to 50 percent by 2026 has been identified as a key target (Republic of Azerbaijan President, 2022). To achieve this goal, infrastructure development, alternative education models, and public–private partnerships have been expanded (Republic of Azerbaijan Ministry of Education, 2022), and 18 new kindergartens have been commissioned in recent years. Currently, approximately 105,000 children are enrolled in 1,669 preschool education institutions.

In addition, alternative education models—such as community-based and family-type preschool education—have been introduced. Through these models, more than 20,000 preschool-aged children have gained access to education, while public–private partnerships have enabled the enrollment of over 1,300 additional children in preschool education.

Research indicates that inclusive and play-based learning environments significantly contribute to children's socio-emotional development (Huseynli, 2024). Accordingly, Azerbaijan has introduced community-based and family-type preschool models to enhance accessibility and inclusivity (Quliyeva, 2024). As a result, the geographical coverage of preschool education has expanded, and access to inclusive education opportunities has increased.

Professional development of pedagogical and administrative staff

Teacher professional development is recognized as a decisive factor in ensuring quality preschool education (Hasanova, 2022). Motivation theories suggest that both intrinsic and extrinsic motivation influence educators' professional growth and performance (Deci & Ryan, 2000; Maslow, 1954).

Monitoring and mentoring mechanisms implemented by the TKTA contribute to reflective practice, continuous learning, and increased professional motivation among preschool educators (TKTA, 2023).

One of the key strategic priorities is the implementation of a system for professional development and certification of pedagogical and administrative staff. The Ministry of Science and Education plans to involve nearly 17,000 teachers and administrators in professional development and certification programs during 2022–2026. These measures are expected to significantly enhance management efficiency and improve the quality of teaching and learning processes in preschool education institutions.

Quality assurance and new governance mechanisms

Between 2023 and 2025, the Education Quality Assurance Agency conducted monitoring activities in 250 preschool education institutions, assessing pedagogical practices, governance, and the material and technical base (TKTA, 2024). Studies confirm that systematic quality assurance mechanisms enhance institutional transparency and resource efficiency (Ahmadova, 2021).

Monitoring outcomes directly influence evidence-based decision-making and equitable allocation of public resources (Institute of Education of the Republic of Azerbaijan, 2023). International experience also highlights the effectiveness of such mechanisms in improving early childhood education quality (OECD, 2018).

On December 4, 2024, the Second International Conference entitled *"A new perspective on quality in preschool education"* was jointly organized by the Ministry of Science and Education, the Education Quality Assurance Agency, the State Agency for Preschool and General Education, and the Education Institute. The conference focused on the comparative analysis of international experience, the adaptation of best practices to the local context, and discussions on improving quality in preschool education. Experts from the United Kingdom and Finland, local scholars, and preschool educators participated in the event, highlighting progress in achieving result-oriented targets defined in national strategies and emphasizing the role of early childhood education in human capital development. The positive impact of school readiness programs on the transition to primary education and the prospects for implementing certification mechanisms for quality assurance were also discussed.

Within the framework of the conference, scientific discussions were held during panels entitled *"Green practices and play-based learning in preschool education"* and *"Sustainable quality and its management in preschool education."* The event was conducted within the scope of the *"Year of solidarity for a green world,"* placing special emphasis on the integration of environmentally oriented pedagogy into preschool education. In recent years, initiatives promoting ecological literacy, climate awareness, and sustainability-referred to as the "Green World" approach-have been implemented in preschool education institutions, contributing to increased awareness among children and parents and supporting the transition to a green economy.

Impact of EQAA monitoring on the implementation of the state socio-economic development strategy

A key component of ongoing reforms is the monitoring activities conducted by the Education Quality Assurance Agency in preschool education institutions. The primary role of the EQAA in this field is to assess and promote quality development across all levels of education, including preschool education. The objectives of these monitoring activities include evaluating the effectiveness of pedagogical practices, assessing the material, technical, and psychological environment, identifying institution-specific development directions, and analyzing factors influencing children's developmental outcomes.

Socio-economic strategy and its impact on preschool education development.

Level	Component	Description / Outcome
Strategic level	Socio-economic strategy	Defines national priorities for sustainable development and human capital formation
Impact dimension	Area of influence	Education system as a key driver of socio-economic transformation
	Socio-economic outcome	Long-term social and economic benefits for society
Core focus	Development of human capital	Investment in education as the foundation of economic competitiveness
	Ensuring a high-quality early childhood education and development environment	Creation of a supportive learning and developmental environment for children at an early age
Governance & management	Monitoring results influence decision-making	Monitoring outcomes play a decisive role in evidence-based policymaking
	Efficient allocation of state resources	Public resources are distributed more effectively based on performance and needs
	Effective governance of the education system	Improved management efficiency across education institutions
Equity & inclusion	Comparative assessment of institutions across regions	Evaluation of preschool institutions in different regions to ensure equity
	Gender equality in access to education	Equal access to education opportunities for girls and boys is monitored
	Reduction of regional development disparities	Regional inequalities in educational development are reduced
Infrastructure & quality	Improvement of E\educational infrastructure	Enhancement of physical and learning environments
	Strengthening the material and technical base	Development of recommendations to upgrade facilities and resources
Social impact	Social welfare and gender equality	Education contributes to social well-being and gender equity
	Social justice and inclusivity principles	Promotion of inclusive education and social justice
Long-term outcomes	Formation of more economically active youth	Preparation of economically productive and innovation-oriented future generations

Impact directions of the EQAA monitoring project on the socio-economic strategy

Observations based on the research methodology indicate that comparing the development indicators of monitored and non-monitored preschool education institutions provides a clear picture of institutional progress. As a result of monitoring activities, the level of governance effectiveness and transparency in preschool institutions has increased. State investments have been systematically directed toward improving material and technical infrastructure and strengthening safety standards. Data obtained through monitoring processes are taken into account in socio-economic planning documents, while the recommendations of the Education Quality Assurance Agency (EQAA) support the implementation of balanced regional development policies.

The improvement of quality indicators creates a foundation for long-term social welfare and economic stability. For this reason, the monitoring projects implemented by the EQAA in preschool education institutions represent one of the key implementation mechanisms of the state's socio-economic development strategy. This mechanism enhances the quality of early childhood education, serves as an investment in human capital development, promotes social justice, gender equality, and regional balance, and ensures the efficient use of public resources.

Impact of EQAA monitoring on the improvement of the material and technical base of preschool education institutions

The effective functioning of preschool education institutions depends not only on pedagogical processes but also directly on the condition of their material and technical base (MTB). A safe, modern, and development-oriented learning environment has a significant impact on children's social, cognitive, and emotional development. In this context, monitoring activities conducted by the Education Quality Assurance Agency play a central role in assessing both educational quality and material and technical provision, as well as in identifying priority areas for improvement.

As a result of EQAA activities, many preschool education institutions have experienced infrastructure renewal, improved equipment provision, and enhanced safety standards.

Relationship between the material and technical base and educational quality.

The material and technical base encompasses the infrastructure, equipment, furniture, teaching and play materials, technical facilities, and other resources that support institutional functioning. An improved material and technical base:

➢ enhances children's comfort within the learning environment;
➢ facilitates the professional activities of educators;
➢ ensures compliance with health, hygiene, and safety requirements;
➢ creates conditions for the implementation of innovative approaches in the educational process.

Thus, the material and technical base is considered one of the core structural components of quality in preschool education.

Based on monitoring outcomes, evaluation reports and development recommendations are prepared for each institution. These reports clearly identify weaknesses in the material and technical base, equipment needs, and specific pathways for improving the learning environment.

Mechanisms of monitoring impact on the material and technical base

Through systematic assessment, evidence-based reporting, and targeted recommendations, EQAA monitoring serves as a catalyst for infrastructure development, resource optimization, and sustainable quality improvement in preschool education institutions.

№	Impact direction	Outcome
1	Identification of problems	During monitoring, group rooms, sanitary conditions, equipment, and play environment are analyzed. Material and technical deficiencies are systematically identified.
2	Provision of recommendations	Specific instructions and suggestions regarding material and technical base (MTB) are provided. Education management authorities plan improvement measures.
3	Planned resource allocation	Based on monitoring results, priorities for financial and technical support are determined. A fair and needs-based provision system is established.
4	Improvement of safety and sanitation standards	Inspections are conducted to create a hygienic and safe environment. Healthy and safe conditions are ensured for children.
5	Public accountability and transparency	Results are presented to the community and management bodies. Accountable management and transparent education policy are established.

As a scientific method for investigating the topic, observation and photographic documentation provide clear evidence from the analysis of reports during the assessment of the material and technical base (MTB). Comparative analysis enables a clear identification of differences between

institutions where monitoring is conducted and those where it is not. Overall, following the initiation of monitoring, corresponding improvements in the provision of MTM (material and technical means) are observed according to the results of the reports. For instance, the provision of resources supporting fine motor skills, demonstration materials for visual simulation, and other inventory items organized according to specific needs can be considered a significant achievement.

Furthermore, conducted monitoring and observations indicate that many preschool institutions have undertaken work to renovate rooms, acquire equipment, and improve playgrounds. In institutions with weak material resources, local executive bodies and education departments have allocated financial support based on data from the Quality Assurance in Education Agency (TKTA). The TKTA's quality standards have guided the planned development of the MTB.

These monitoring activities have drawn attention to the assurance of safety, fire protection, and sanitary-hygienic standards, exerting a systematic impact on the improvement of the material and technical base. This impact is manifested in the following directions: prompt identification of infrastructure problems, planning of specific improvement measures, optimization of resource allocation, and adaptation of the educational environment to safe and modern standards.

The impact of TKTA monitoring on increasing the learning motivation of preschool educators is also notable. In the modern era, ensuring the quality of education is one of the priority directions of the education system. In the Republic of Azerbaijan, this responsibility is among the main functions of the Quality Assurance in Education Agency (TKTA). The TKTA aims to create a high-quality learning environment in educational institutions, evaluate the effectiveness of the teaching process, and enhance it.

Monitoring in preschool institutions serves not only as a tool for organizational and administrative supervision but also as a significant factor increasing the professional development motivation of educators. Since 2023, the TKTA has conducted monitoring in preschool institutions. The objectives of these monitoring activities include evaluating the quality of teaching and educational processes, analyzing the performance of pedagogical staff based on development needs, identifying factors affecting children's developmental environment, and providing recommendations for the institutions' improvement. The results of these monitoring activities lead to an increase in professional learning motivation both at the institutional level and individually for educators.

Learning motivation refers to the set of internal and external factors that drive an educator to improve their knowledge, skills, and experience. In the quality assurance system, motivation is closely linked to these factors: monitoring promotes the development of self-analysis and reflection skills; educators identify the strengths and weaknesses of their work; and the design of development plans determines individual learning needs. Reports and training provided by TKTA strengthen continuous learning habits among teachers, illustrating the mechanisms through which monitoring influences motivation.

№	Impact direction	Nature of impact	Motivation outcome
1	Objective evaluation of arofessional activity	The teacher gains the opportunity to view their work from an external perspective	Internal interest in self-improvement increases
2	Feedback and recommendations	Specific directions for development are provided	Planned and purposeful learning occurs
3	Training and seminars	Mentorship is organized following monitoring	Habit of being open to new knowledge is developed
4	Inter-institutional comparison	Familiarity with the experiences of other institutions	Competition and professional motivation increase
5	Recognition and evaluation	Teachers demonstrating high results are acknowledged	Moral encouragement is generated

Scientific observations conducted during the study of this topic indicate that participation in monitoring affects the motivation levels of preschool educators, and its impact on teachers' self-assessment processes is clearly observable. Comparative analysis shows that institutions where monitoring has been conducted demonstrate greater improvement in motivation levels compared to

those without monitoring. Observations during mentorship sessions reveal that educators approach their work with increased responsibility and creativity, show greater interest in participating in additional training to enhance their professional skills, and that feedback obtained from monitoring positively stimulates learning motivation.

Quality assurance mechanisms foster a reflective approach among educators toward their professional activities. To ensure the sustainability of teacher motivation, the following recommendations are essential:

➢ Integration of monitoring results into individual professional development plans;

➢ Expansion of result-based training programs for teachers by the Quality Assurance in Education Agency (TKTA);

➢ Public and moral recognition of teachers' achievements;

➢ Further expansion of professional support and mentorship systems.

The 2022–2026 socio-economic development strategy of the Republic of Azerbaijan introduces a systematic and results-oriented approach to the development of preschool education. Quality assurance mechanisms, professional development initiatives, and alternative education models collectively contribute to sustainable human capital development and long-term economic growth (Heckman, 2006; Sylva et al., 2014). Strengthening international cooperation and aligning national reforms with global best practices remain essential for achieving the strategic goal of competitive human capital formation.

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An Empirical Analysis of Youth Knowledge and Perceptions of Green Finance: Evidence From Azerbaijan

Abstract

By allocating financial resources towards environmentally responsible activities, green finance has become an important part of sustainable economic development. Young people play a key role in the adoption of green financial practices, as their financial knowledge sets the trend for future market trends. Despite the increasing global attention to green finance, limited empirical evidence exists on the knowledge and perception of youth in developing countries such as Azerbaijan on green finance. This research seeks to examine empirically knowledge and perception of green finance in the youth of Azerbaijan. To do this, the study uses a quantitative approach and an online questionnaire survey among the 18–35 population. The questionnaire measures the respondents' knowledge on green finance, risk/benefit perception, trust in financial institutions, and willingness to use green financial products. To determine what factors influenced acceptance intentions, descriptive statistics and regression analyses are employed. The results show that general knowledge of green finance is moderate for Azerbaijani young people, although trust and perceived environmental impact play an important role in their readiness to adopt green financial products. The report serves an empirical function out of the Azerbaijani literature and a practical policy-led focus towards financial literacy and eco-friendly financial products for increasing awareness and promotion of green finance.

Keywords: *Green finance, financial literacy, youth perceptions, sustainable finance, green economy*

Introduction

Over the past decade, green finance has developed as an important tool for sustainable economic development, addressing global environmental issues such as climate change, biodiversity loss, and resource depletion (UNEP, 2016; OECD, 2017). Green finance is the term used to describe financial activities that support environmentally sustainable projects, such as renewable energy, energy efficiency, sustainable agriculture, and low-carbon technologies. Green finance plays a key role in the long-term economic sustainability challenge and helps in the global sustainability agendas by redirecting capital towards sustainable investment such as the Sustainable Development Goals (SDGs) and the Paris Agreement (UNFCCC, 2015).

Although green finance is increasingly becoming a global priority, its development and implementation remain inconsistent; especially in emerging and resource-dependent economies (World Bank, 2020). Previous studies indicate that the effectiveness of green finance policies largely depends on regulatory clarity and institutional capacity, particularly in emerging economies (Zhang et al., 2021). This includes structural barriers like weak regulatory frameworks, little market infrastructure, lack of financial literacy, and high perceived investment risk, which often limit green financial instruments (OECD, 2020; Taghizadeh-Hesary & Yoshino, 2019). Azerbaijan is a relevant case as an oil and gas-dominated economy. Although recent national strategies have focused on economic diversification and sustainability, integrating the green finance application into financial markets and everyday financial behavior is still nascent (ADB, 2021).

Financial institutions often perceive green investments as riskier due to long payback periods and uncertainty, which limits market participation (D'Orazio & Popoyan, 2019). Here, gaining knowledge on public understanding, perceptions of, and attitudes towards green finance is necessary in order to design policies and develop markets that are effective. Low awareness and limited understanding among consumers substantially decrease demand for green financial products according to previous work (Liu et al., 2022; Sachs et al., 2019). Young people are especially influential in developing financial behaviors of the future and promoting sustainable transitions, owing to their higher acceptance of innovatory financial products and sustainable practices (UNDP, 2020). It is the basis of this study to provide an empirical examination of the youth knowledge and perception of green finance of Azerbaijan by means of survey data of 242 respondents. The study endeavors to provide evidence-based guidance for policymakers, financial institutions, and educators to promote the growth of green finance in Azerbaijan, exploring awareness levels, perceived prestige, willingness to use green financial products, and perceived barriers.

Research

By employing a quantitative methodology involving a structured survey, this study takes an empirical look into the knowledge, perception and behavioral intentions of young people regarding green finance in Azerbaijan. Survey methods are most frequently used in sustainability and green finance research since they allow scholars to measure attitudes, awareness levels and preferences in general across a relatively large number of samples in a standardized fashion (Hair et al., 2019). This research is exploratory in nature and aims not to infer causal relationships; it seeks out dominant trends and barriers. Based on data collected from 242 respondents using an online questionnaire, the empirical analysis was undertaken. The survey was conducted on a voluntary and anonymous basis. It's intentional as we focus on youth with a key population that will come to influence future financial behaviors and assist in the sustainable economic transition. This would be similar sampling methods also frequently used when studying the generalist sampling strategies to determine public opinion about sustainable finance and environmental responsible practices (Field, 2018).

The empirical analysis is supported with a structured questionnaire that is designed to measure the objective and subjective aspects of youth participation in green finance in Azerbaijan. The questionnaire comprises seven major sections including demographic characteristics (age, gender, education, employment status, and income), general financial behavior and literacy, awareness and knowledge of green finance concepts, individual perceptions and psychological attitudes, social influence factors, behavioral intentions, and an open-ended item to explore perceived barriers to the development of green finance in the country. The Likert-type statements (1 = strongly disagree, 5 = strongly agree) are used to measure quantitative attitudes, trust, risk perception, environmental responsibility, and adoption intentions, while the open-ended responses provide qualitative insights into structural, institutional, and informational constraints. This mixed-question design enables a full statistical assessment of the intersection of demographics, cognition, and social factors to jointly determine youth perceptions and acceptance of green finance instruments. **Table 1** presents the general structure of the questionnaire used in the study.

Table 1. Structure of the questionnaire.

Section	Content
A	Socio-demographic characteristics
B	Awareness and understanding of green finance
C	Social and media influence on financial behavior
D	Behavioral intentions toward green finance
E	Open-ended question on development barriers

Quantitative data were analyzed using descriptive statistical techniques, such as frequency and percentage analysis. Descriptive statistics are well suited for exploratory research designs focused on summarizing patterns and tendencies in participants' responses (Field, 2018). Responses on the Likert scale were pooled to determine overall agreement with and neutrality toward statements pertaining to green finance. Likert-scale responses were interpreted using a five-point agreement framework to ensure clarity and consistency of the findings. A score of 1 indicates strong disagreement, 2 represents disagreement, 3 reflects a neutral position (neither agree nor disagree), 4 corresponds to agreement, and 5 denotes strong agreement with the given statement. This standardized interpretation allows for a consistent comparison of respondents' attitudes, perceptions, and behavioral intentions toward green finance.

Besides quantitative methods, the responses to the open-ended question on barriers to the development of green finance in Azerbaijan were also assessed by thematic analysis. This approach helps to identify recurring patterns and dominant themes within qualitative data (Braun & Clarke, 2006). This analysis found several frequently mentioned barriers: low public awareness, insufficient regulatory and institutional frameworks, limited financial incentives, and concerns about transparency and greenwashing. Ethical considerations were carefully observed throughout the research process. Participants were informed that the survey was conducted for academic purposes only, no personal identifying information was collected, and all responses were treated confidentially. These practices are consistent with standard ethical guidelines for survey-based research (Hair et al., 2019).

This section presents the empirical results of the survey conducted among 242 respondents in Azerbaijan. The findings are reported using descriptive statistics, mainly frequencies and percentages, in order to reflect respondents' demographic characteristics, financial behavior, awareness, perceptions, social influences, and behavioral intentions related to green finance. In accordance with the methodological approach, the results are presented objectively, without interpretation or analytical commentary.

The demographic structure of the sample indicates a predominantly young respondent group. Individuals aged 18–22 represent the largest share of participants (67%), followed by those aged 23–27 (17%), 28–31 (8%), and 32–35 (7%). In terms of gender, 60% of respondents are female and 40% are male. Educational attainment is largely concentrated at the undergraduate level, with 69% holding a bachelor's degree. This is followed by vocational education (13%), master's degree holders (12%), respondents with secondary education (4%), and doctoral-level education (2%). Regarding current status, the majority of respondents are students (58%), while 20% are employed, 15% both work and study, and 7% are unemployed. Income distribution reflects this structure, as approximately 57% of respondents report having no regular income. Among those who do report income, most fall within the lower- and middle-income brackets, while a smaller proportion report earning above 1500 AZN or prefer not to disclose their income.

With respect to financial behavior, the majority of respondents (80%) report using at least one banking product, whereas 20% indicate that they do not use banking services. The most commonly used financial products are bank cards or current accounts (58%), followed by credit products (21%), deposits (6%), and investment products (4%). At the same time, 11% of respondents report not using any financial products. Self-assessed financial literacy levels are generally low to moderate, with most respondents rating their knowledge at levels 1 or 2 on a five-point scale.

Awareness of green finance is limited among respondents. Only 26% state that they have previously heard of the term "green finance," while 74% report no prior familiarity with the concept. When asked about the meaning of green finance, more than half of the respondents (54%) associate it with financing environmental projects, while 27% link it to sustainable and responsible investments. A further 16% indicate that they do not know what green finance represents, and a small share perceive it mainly as a marketing concept. Awareness of specific green finance instruments is also low, as 19% report having heard of green banking, 14% of green credit, 8% of green bonds, and 7% of ESG investments, whereas more than half of the respondents (52%) indicate that they are

unfamiliar with all of these terms. Self-rated knowledge of green finance products is predominantly low, with 42.6% rating their knowledge at the lowest level and 35.5% at the second-lowest level.

Prior empirical evidence suggests that environmentally oriented financial institutions are not necessarily exposed to higher risks and may benefit from enhanced trust and reputation effects (Gangi et al., 2019). Results derived from Likert-scale statements show that respondents generally express moderate attitudes toward green finance. A large proportion of participants neither agree nor disagree with statements related to the effectiveness and credibility of green finance products, indicating a notable level of uncertainty. At the same time, a considerable share of respondents agree or strongly agree that green finance can contribute to environmental protection and that ecological responsibility plays an important role in their financial decision-making. Responses to statements addressing greenwashing reveal the presence of skepticism regarding the actual environmental impact of green financial products.

Findings related to social influence demonstrate mixed outcomes. While some respondents indicate that the opinions of family members, friends, and society influence their financial choices, a substantial proportion remain neutral or disagree with such statements. Media influence appears to be moderate, as many respondents neither strongly endorse nor strongly reject the role of social and traditional media in increasing their interest in green finance–related topics. Behavioral intention results suggest a generally positive yet cautious orientation toward the future adoption of green finance products. A relatively high proportion of respondents agree or strongly agree that they would consider using green financial products in the future and would prefer them over conventional financial products when conditions are equal. However, willingness to choose green financial products when they involve higher costs is more restrained, with neutrality and disagreement remaining common. A clear pattern emerges regarding the importance of information, as the majority of respondents agree or strongly agree that increased information and communication from banks and government institutions would significantly enhance their interest in green finance products.

Conclusion

The findings presented in this study give an empirical estimate of young people's knowledge, attitudes and behaviours of green finance in Azerbaijan. The findings highlight an important discrepancy between positive environmental attitudes and the practical knowledge and use of green financial products. While the respondents overwhelmingly indicate a high degree of ecological stewardship and willingness to think about green financial choices in the future, a lack of information, low financial literacy, and concerns about credibility, namely greenwashing, remain barriers to greater expansion. Social influence and media exposure appear to moderately affect interest levels, whereas trust in financial institutions continues to be an important driver of acceptance. To conclude, the results show that the regulatory model and institutional mechanisms need to be improved and further strengthened and transparency and information is important; more specialized education and promotion provided by local and international banks and public bodies is required for a better understanding. Enhancing information sharing and confidence in green finance tools may be an important way forward in supporting the development of sustainable finance and to support the shift of Azerbaijan to a more sustainable economic model.

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