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ECONOMETRIC ANALYSIS OF THE RELATIONSHIP BETWEEN USD/EURO AND EURO/AZN EXCHANGE RATES

Summary

Purpose: The purpose of this study is to empirically investigate the relationship between the Euro-Azerbaijani Manat (EUR/AZN) and the USD-Euro (USD/EUR) exchange rates using econometric methods. By identifying the nature, direction, and statistical significance of this relationship, the research aims to enhance forecasting capabilities and inform stakeholders—including policymakers, investors, and researchers—about how global currency trends may influence Azerbaijan's currency markets.

Method: The dataset spans from 2000 to 2025 and comprises annual observations of the EUR/AZN and USD/EUR exchange rates. We first present descriptive statistics to observe distributional properties, followed by regression models — both static and dynamic — to analyze dependencies. Unit root tests are employed to confirm stationarity.

Result: Preliminary findings indicate that while there is a statistically significant short-term relationship between the EUR/AZN and USD/EUR exchange rates, the influence of EUR/AZN diminishes in more robust dynamic models that account for lagged variables. Stationarity tests further show that both series are integrated of order one, highlighting the importance of using differenced data in time series modeling.

Keywords: Exchange rates, currency modeling, econometric analysis, OLS regression, financial modeling.

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Introduction:

Exchange rate movements are a critical area of focus in international finance, particularly for emerging and developing economies that are highly sensitive to global currency fluctuations. As Azerbaijan continues to expand its economic integration with the European Union and global markets, understanding the behavior of key exchange rates—specifically, the Euro to Azerbaijani Manat (EUR/AZN) and the US Dollar to Euro (USD/EUR)—becomes increasingly important for policymakers, financial institutions, and investors.

The interaction between local currency exchange rates and major global currency pairs is

a subject of considerable empirical interest. Variations in the EUR/AZN rate may reflect both domestic economic factors and broader Eurozone dynamics, while the USD/EUR exchange rate is influenced by global monetary policy shifts, international trade balances, and geopolitical developments. Analyzing the relationship between these two rates offers valuable insights into the transmission mechanisms through which global financial changes impact the Azerbaijani economy.

This study aims to evaluate the nature and strength of the relationship between EUR/AZN and USD/EUR over the period 2000–2025 using econometric methods. Specifically, the research employs descriptive statistics, ordinary least

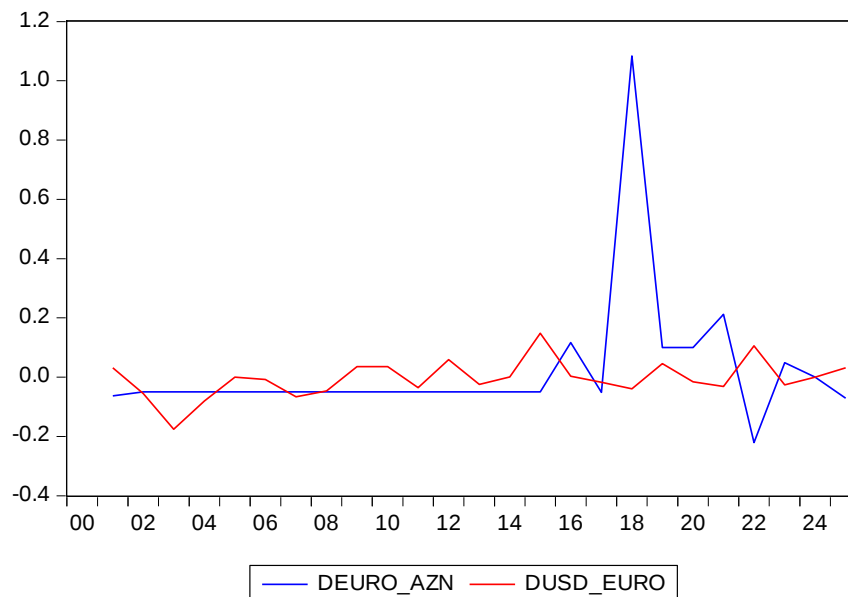
squares (OLS) regression, dynamic time series models, and Augmented Dickey-Fuller (ADF) unit root tests to examine statistical associations, causality, and stationarity characteristics.

Preliminary findings indicate that while there is a statistically significant short-term relationship between the EUR/AZN and USD/EUR exchange rates, the influence of EUR/AZN diminishes in more robust dynamic models that account for lagged variables. Stationarity tests further show that both series are integrated of order one, highlighting the importance of using differenced data in time series modeling.

This investigation contributes to the existing literature by focusing on an underexplored currency pairing relevant to the Azerbaijani context and offers practical implications for exchange rate forecasting, portfolio management, and macroeconomic planning.

To obtain accurate results, let's take a look at some tests. First, let's take a look at the graph obtained from our time series. For this, let's use the tools available in the EViews software package:

Graph 1. Dynamic descriptions of data



Then, let's test the stationarity of each series. The stationarity of the time series was tested using the Augmented Dickey-Fuller (ADF) test

based on the Dickey-Fuller methodology in the EViews 12 software package, and the corresponding results are presented in table 1.

Table 1.

Dickey-Fuller test

Variable	T-statistic	Critical values: 1%	Critical values: 5%	Critical values: 10%	Prob
First difference, intercept					
EURO_AZN	-4.567709	-3.737853	-2.991878	-2.635542	0.0015
USD_EURO	-4.105920	3.737853	-2.991878	-2.635542	0.0043
First difference, trend and intercept					
EURO_AZN	-4.712541	-4.394309	-3.612199	-3.243079	0.0050
USD_EURO	-4.933783	-4.394309	-3.612199	-3.243079	0.0031

The first-order differences of the time series are stationary under conditions of both trend and

intercept. According to the Augmented Dickey-Fuller (ADF) test, if the Prob value corresponding to the test statistic is smaller than 5% (0.05), the null hypothesis (H_0) regarding the presence of a unit root (non-stationarity) in the time series is rejected. This implies acceptance of the alternative hypothesis that the time series is stationary.

Additionally, for a time series to be stationary, the Dickey-Fuller test statistic should also be smaller than the critical values (Test critical

values) at the 1%, 5%, and 10% significance levels.

Based on the test results, all original time series are non-stationary under conditions of intercept without trend, and also under conditions excluding both intercept and trend (none). However, their first-order differences are stationary in all tested scenarios.

After examining our graph and ADF tests, let's analyze the descriptive statistical indicators using the EViews software:

Date: 04/22/25 Time: 15:44			
Sample: 2000 2025			
	USD_EURO	RESID	EURO_AZN
Mean	0.839954	1.16E-18	1.095154
Median	0.846450	-0.011541	0.925000
Maximum	1.061100	0.148520	2.011800
Minimum	0.684000	-0.127382	0.450000
Std. Dev.	0.093543	0.057106	0.536581
Skewness	0.268683	0.432255	0.457309
Kurtosis	2.500266	3.713867	1.606130
Jarque-Bera	0.538497	1.256986	2.779400
Probability	0.763953	0.533395	0.249150
Sum	20.15890	-1.39E-17	26.28370
Sum Sq. Dev.	0.201259	0.075006	6.622146
Observations	24	24	24

As a result of the analysis, it is seen that the both series show mild skewness and kurtosis and EUR/AZN displays greater volatility. Jarque-Bera p-values suggest both series are approximately normally distributed.

Next, we apply the CUSUM test to assess whether the parameters of the multivariable regression equation are stable or unstable. These tests are based on calculating the cumulative sum of recursive residuals and the cumulative sum of squared recursive residuals, and evaluating the corresponding equations.

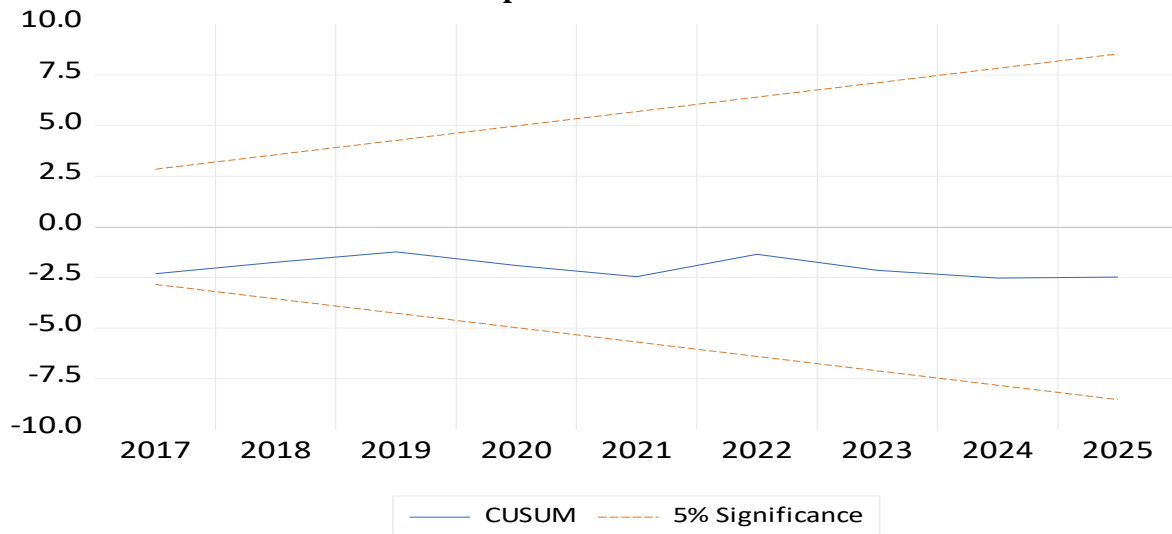
The results are interpreted based on 95% confidence intervals. If the recursive residual estimates fall outside the critical boundaries, it indi-

cates instability in the model parameters. Graphically, if the blue line lies entirely within the red boundaries without crossing them, the null hypothesis H_0 , which states that the parameters are stable, is accepted. On the other hand, if the blue line intersects with or crosses the red lines, the alternative hypothesis H_1 , suggesting parameter instability over the sample period, is accepted.

According to the graphical representation, the blue line remains within the red confidence bands, which indicates that the parameters of the regression model are stable and robust. This stability enhances the reliability and forecasting power of the model we have built.

The result of the CUSUM test is presented in graph 2.

Graph 2. CUSUM test



As a final step, let's construct our model using Ordinary Least Squares (OLS) and test its statistical significance. To estimate the relationship between USD/EURO and EURO/AZN, we use the Ordinary Least Squares (OLS) method. This method provides the best linear unbiased estimators (BLUE) under classical assumptions

and allows us to quantify the influence of independent variables on the dependent variable.

The estimated regression model is as follows:

$$\text{USD_EURO}_t = \beta_0 + \beta_1 \cdot \text{EURO_AZN}_t + \beta_2 \cdot \text{TREND}_t + \varepsilon_t$$

Dependent Variable: USD_EURO				
Method: Least Squares				
Date: 04/22/25 Time: 15:36				
Sample (adjusted): 2001 2025				
Included observations: 25 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EURO_AZN	-0.070559	0.056475	-1.249388	0.2259
C	0.097183	0.101792	0.954724	0.3511
USD_EURO(-1)	0.836496	0.124485	6.719678	0.0000
EURO_AZN(-1)	0.060090	0.051368	1.169780	0.2558
@TREND	0.003882	0.002135	1.818276	0.0840
R-squared	0.767936	Mean dependent var		0.851020
Adjusted R-squared	0.721524	S.D. dependent var		0.106991
S.E. of regression	0.056460	Akaike info criterion		-2.733707
Sum squared resid	0.063755	Schwarz criterion		-2.489932
Log likelihood	39.17134	Hannan-Quinn criter.		-2.666095
F-statistic	16.54581	Durbin-Watson stat		1.918960
Prob(F-statistic)	0.000004			

$$\text{USD_EURO} = -0.0705587004083 \cdot \text{EURO_AZN} + 0.0971829826794 + 0.00388198248291 \cdot \text{@TREND} + 0.836495980232 \cdot \text{USD_EURO}(-1) + 0.0600897934754 \cdot \text{EURO_AZN}(-1)$$

To analyze the dynamics of the relationship between EUR/AZN and USD/EUR exchange

rates, an Ordinary Least Squares (OLS) regression model with lagged variables was estimated.

The dependent variable was the USD/EUR exchange rate, and the model included current and lagged values of EUR/AZN, the lagged dependent variable USD_EURO(-1), and a linear time trend. The model was estimated using 25 observations from 2001 to 2025 after adjusting for lags.

The results obtained can be interpreted as follows:

-The lagged value of USD_EURO (USD_EURO(-1)) is highly significant ($p < 0.01$), showing strong persistence in the exchange rate.

-Current and lagged values of EURO_AZN are not statistically significant, suggesting a weak or indirect effect on USD_EURO in the dynamic model.

-The trend variable is close to significance ($p = 0.084$) and may indicate a slow upward shift in USD_EURO over time.

-The model explains approximately 77% of the variation in the USD/EUR exchange rate ($R^2 = 0.768$), and the F-statistic confirms overall model significance ($p < 0.01$). The Durbin-Watson statistic is close to 2, indicating no major concern regarding autocorrelation in the residuals.

Finally, we can note that the model we have constructed is statistically significant.

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USD/EURO VƏ EURO/AZN MƏZƏNNƏLƏRİ ARASINDAKI ƏLAQƏNİN EKONOMETRİK TƏHLİLİ

Xülasə

Məqsəd: Bu tədqiqatın məqsədi Euro–Azərbaycan manatı (EUR/AZN) və ABŞ dolları–Euro (USD/EUR) məzənnələri arasındakı əlaqəni ekonometrik üsullar ilə empirik şəkildə araşdırmaqdır. Bu ekonometrik əlaqənin istiqaməti və statistik əhəmiyyətliliyini müəyyən etməklə, tədqiqat proqnozlaşdırma imkanlarını artırmağı və siyasətçilər, investorlar və tədqiqatçılar da daxil olmaqla qlobal



valyutalarına Azərbaycanın valyuta bazarlarına necə təsir göstərə biləcəyi barədə məlumatlandırmağı hədəfləyir.

Metod: Məlumat bazası 2000–2025-ci illəri əhatə edir və EUR/AZN və USD/EUR məzənnələrinin illik müşahidələrindən ibarətdir. Əvvəlcə paylanma xüsusiyyətlərini müşahidə etmək üçün deskriptiv statistik göstəricilər təqdim edilir, daha sonra isə asılılıqları təhlil etmək məqsədilə həm statistik, həm də dinamik reqressiya modelləri qurulur. Zaman sıralarının stasionarlığını təsdiqləmək üçün vahid kök (unit root) testlərindən istifadə olunur.

Nəticə: İlkən nəticələr göstərir ki, EUR/AZN və USD/EUR məzənnələri arasında statistik əhəmiyyətli qısa müddətli əlaqə mövcuddur, lakin daha inkişaf etmiş, gecikmiş dəyişənləri nəzərə alan dinamik modellərdə EUR/AZN-nin təsiri azalır. Stasionarlıq testləri hər iki zaman seriyasının birinci dərəcədən inteqrasiya olunmuş ($I(1)$) olduğunu göstərir və bu da zaman sıralarının modeləşdirilməsində fərqləndirilmiş məlumatlardan istifadə edilməsinin vacibliyini vurğulayır.

Açar sözlər: Valyuta məzənnələri, valyuta modeləşdirilməsi, ekonometriya təhlili, OLS reqressiyası, maliyyə modeləşdirilməsi.

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ЭКОНОМЕТРИЧЕСКИЙ АНАЛИЗ ВЗАИМОСВЯЗИ МЕЖДУ КУРСАМИ USD/EUR И EUR/AZN

Резюме

Цель: Цель данного исследования — эмпирически изучить взаимосвязь между курсом евро к азербайджанскому манату (EUR/AZN) и курсом доллара США к евро (USD/EUR) с использованием эконометрических методов. Определив характер, направление и статистическую значимость этой взаимосвязи, исследование направлено на повышение точности прогнозирования и информирование заинтересованных сторон — включая политиков, инвесторов и исследователей — о том, как глобальные валютные тенденции могут влиять на валютный рынок Азербайджана.

Метод: В исследовании используется набор данных за период с 2000 по 2025 год, включающий ежегодные значения курсов EUR/AZN и USD/EUR. Сначала представлены описательные статистики для анализа распределения данных, затем применяются регрессионные модели — как статические, так и динамические — для анализа зависимостей. Для проверки стационарности используются тесты на единичный корень.

Результат: Предварительные результаты показывают, что существует статистически значимая краткосрочная взаимосвязь между курсами EUR/AZN и USD/EUR. Однако влияние курса EUR/AZN снижается в более устойчивых динамических моделях, учитывающих лаговые переменные. Тесты на стационарность показывают, что оба временных ряда интегрированы первого порядка, что подчеркивает необходимость использования разностных данных при моделировании временных рядов.

Ключевые слова: валютные курсы, моделирование валют, эконометрический анализ, OLS-регрессия, финансовое моделирование.