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DEVELOPMENT OF BUSINESS LOANS IN THE REPUBLIC OF AZERBAIJAN: ECONOMETRIC ASSESSMENT OF MACROECONOMIC IMPACTS

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Abstract. This paper investigates the interactions between business loans, household income, expenditures and interest rates from 2020 to 2024 in Azerbaijan using econometric methods. The Augmented Dickey-Fuller (ADF) test, Granger causality test and Johansen cointegration test were employed and long-term cointegration and equilibrium relationships were identified through the Vector Error Correction Model (VECM).

Keywords: Business loans, interest rates, household income and expenditures, econometric analysis, cointegration, error correction model.

AZƏRBAYCAN RESPUBLİKASINDA BİZNES KREDİTLƏRİNİN İNKİŞAFI: MAKROİQTİSADİ TƏSİRLƏRİN EKONOMETRİK QİYMƏTLƏNDİRİLMƏSİ

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Xülasə. Tədqiqatda 2020-2024-cü illər üzrə biznes kreditləri, əhalinin gəlirləri, xərcləri və faiz dərəcələri arasındakı qarşılıqlı təsirlər ekonometrik üsullarla təhlil edilmiş, Genişləndirilmiş Dickey-Fuller (ADF) testi, Granger səbəbiyyət testi və Johansen kointeqrasiya testi tətbiq edilmiş, səhvlərin korreksiyası modeli (VECM) ilə uzunmüddətli kointeqrasiya və tarazlıq münasibətləri müəyyən edilmişdir.
Açar sözlər: Biznes kreditləri, faiz dərəcələri, əhalinin gəlirləri və xərcləri, ekonometrik analiz, kointeqrasiya, səhvlərin korreksiyası modeli.

РАЗВИТИЕ БИЗНЕС-КРЕДИТОВАНИЯ В АЗЕРБАЙДЖАНСКОЙ РЕСПУБЛИКЕ: ЭКОНОМЕТРИЧЕСКАЯ ОЦЕНКА МАКРОЭКОНОМИЧЕСКИХ ПОСЛЕДСТВИЙ

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Резюме. Данное исследование анализирует взаимодействие между объемами бизнес-кредитов, доходами домохозяйств, расходами и процентными ставками в период с 2020 по 2024 годы с использованием эконометрических методов. Были применены тесты дополненного Дики-Фуллера (ADF), причинности Грейнджера и коинтеграции Йохансена, а также с помощью модели коррекции ошибок (VECM) были выявлены долгосрочные коинтеграционные и равновесные зависимости.
Ключевые слова: Бизнес-кредиты, процентные ставки, доходы и расходы населения, эконометрический анализ, коинтеграция, модель коррекции ошибок.

1. Introduction

The financial system of the Republic of Azerbaijan is primarily built around the banking sector and the credit market. The credit market serves as one of the key factors significantly influencing the country's economic development. The formation and development of the credit market in Azerbaijan have been characterized by various economic and political periods, bringing about notable changes in this during the Soviet Union era, the banking system in Azerbaijan was centralized. The economy operated based on state and collective institutions,

making the development of private businesses practically impossible. The banking sector primarily focused on financing state enterprises, while commercial lending was limited to collective institutions and state entities. Banking activities during this period were regulated according to the Soviet Union's centralized economic policies, with no opportunities for credit directed towards the private sector. Enterprises were mainly funded through the state budget, creating an environment where the credit market was entirely under state control.

After gaining independence, Azerbaijan entered a complex economic transformation phase. Economic instability and high inflation were significant factors hindering the development of the banking sector. In the early years, the banking system remained under state control, with limited scope for commercial banks' activities. However, from 1992, the Azerbaijani government initiated economic reforms and implemented measures to regulate the banking sector. The establishment of the Central Bank of the Republic of Azerbaijan in 1992 created the legal foundation for the independent functioning of the banking sector. Nevertheless, economic instability continued to limit commercial banks' ability to provide business loans. In the initial phase, loans were offered at high-interest rates, restricting their widespread use.

In the early 2000s, the strengthening of the oil sector brought stability to Azerbaijan's economy, fostering the development of the banking sector. During this period, commercial banks expanded their operations and began implementing new strategies for business lending. In 2005, improvements in the legislative framework for the “Development of Small and Medium Enterprises” led to advancements in the financing of small and medium-sized businesses. Alongside the state’s support measures, commercial banks began offering business loans on more favorable terms.

The global financial crisis of 2008 did not leave Azerbaijan's economy and banking sector unaffected. The sharp decline in oil prices in the global market created economic difficulties and led to a contraction in the business loan market. However, as a result of support programs implemented by the government, concessional loans for financing small and medium enterprises continued to be provided.

In the early 2010s, dynamism in Azerbaijan's economic growth was observed. Rising oil prices and the development of the non-oil sector created new opportunities for the banking sector. This period is also characterized by the development of digital banking and the application of new approaches in business lending.

After 2014, the government identified the development of small and medium enterprises as a priority direction and implemented financial support programs in this area. Banks, on the other hand, expanded digital banking services, making credit processes faster and more efficient. Innovations such as online loan applications, the digitalization of customer services and mobile banking further facilitated access to business loans.

At the beginning of 2020, the COVID-19 pandemic negatively impacted Azerbaijan's economy and a severe decline in business activity was observed. However, government-

implemented financial support measures and credit moratoriums introduced by banks contributed to easing the financial difficulties faced by businesses.

In the post-pandemic period, the banking sector began to apply more flexible approaches to business lending within the framework of new recovery strategies. Within the strategies aimed at diversifying Azerbaijan's economy and developing the non-oil sector, the banking sector continues to contribute to the expansion of business lending by offering more innovative financial tools and services. Concessional loans provided by the government to small and medium-sized enterprise entities play a significant role in enhancing the sustainability of economic development.

The dynamics of business loan development in Azerbaijan are influenced by various macroeconomic and financial factors. These include GDP growth rates, inflation levels, employment indicators, household financial flows, the volume of bank deposits, the liquidity level of the banking sector, the dynamics of loan interest rates, the share of non-performing loans, as well as external economic factors and geopolitical risks.

This study examines the impact of household financial flows and bank interest rates on business lending. It is well-known that changes in household income and expenditures, as well as dynamic fluctuations in interest rates, are considered key factors influencing the tendencies of expansion or contraction in the loan portfolio.

2. Analysis of recent publications

The number of scientific studies dedicated to examining the dynamics of business loans, financial flows of the population and the interrelationships between interest rates in the Republic of Azerbaijan is limited. Some works focus on analyzing the overall credit portfolio and credit risks of Azerbaijan [10].

Research [11] investigates how bank closures and branch terminations in Russian regions impact loans granted to small and medium-sized enterprises (SMEs). For this purpose, panel data on SME loans and bank closures across Russian regions during 2010-2016 were utilized. Article [9] employs a methodology to determine the macroeconomic-level impact of SME loans on business value addition in Ukraine, applying correlation-regression analysis for this purpose. Another article [5] analyzes the relationship between small business lending and wage levels in the U.S. It examines the extent to which small businesses' access to financial resources, particularly loans, affects employee wages and the labor market overall. Study [2] explores the comparative advantages of different credit technologies employed by large and small banks in the U.S. when lending to SMEs. Traditionally, large banks utilize “hard” data to provide loans to large and transparent enterprises, while small banks rely on “soft” data to lend to smaller and less transparent businesses. This research goes beyond this conventional approach and examines the comparative advantages of large and small banks in various credit technologies. Article [3] investigates the impact of applying credit scoring technologies when

lending to small businesses on credit availability, pricing and risk levels. The focus is specifically on small business loans under $100,000. The research is based on data from major banks in the U.S. Study [15] empirically evaluates the impact of loans provided to the real sector by conventional and Islamic banks operating under Turkey's dual banking system on industrial production. Article [10] establishes a multidimensional regression model aimed at identifying factors influencing banks' credit risks, incorporating variables such as overdue loans, bank assets, bank liabilities, average interest rates and GDP growth rates. This mathematically and statistically robust dynamic model enables further empirical analysis to predict and manage credit risks in banks. To enhance the analytical approach to reducing credit risks, the integration of data from previous years (2015-2019) into the model allows a more comprehensive evaluation of time dynamics, structural stability analysis and improved forecast accuracy. Study [14] considers both direct and inverse relationships between the dynamics of the retail credit market and households' savings, income and expenditures in Russia. Two alternative modeling approaches were applied for analyzing these relationships: a system of simultaneous equations and vector auto-regression (VAR). Article [6] explores the long-term relationship between non-performing loans (NPLs), as one of the key indicators of bank assets and certain macroeconomic factors. Specifically, the study examines the relationship between NPLs and unemployment, inflation, GDP growth rates, loan volume and industrial production indices, considering the formative role of the Turkish banking sector in the economy. Research [12] investigates a new approach to the initial credit assessment of long-term projects for SMEs in Ukraine, considering unconventional cash flows. The study examines the possibility of incorporating value-based management principles into assessing the borrower's creditworthiness and proposes the use of internal rate of return (IRR) in initial credit decision-making.

3. Aim of the study and the methodology

The objective of this research is to analyze the dynamics of business loan development in the Republic of Azerbaijan through econometric modeling. Specifically, the main target is to determine the relationship between household financial flows (income, expenditures), interest rates and the volume of the business loan portfolio. To achieve the study's objectives, a multidimensional statistical regression analysis approach [13] was employed alongside cointegration analysis and the VECM model based on relevant statistical tests.

The quality of the business loan portfolio is closely tied to household income and expenditures, as these indicators directly impact borrowers' ability to repay loans. An increase in income raises consumer demand, enhancing businesses' turnover and strengthening their financial stability. Consequently, businesses can fulfill their credit obligations more effectively, reducing the level of non-performing loans. Conversely, a decrease in income leads to a drop in consumption levels, limiting the revenues of the business sector and increasing the likelihood of delays in loan repayments.

Consumer expenditures also significantly affect the quality of the business loan portfolio. If expenditures rise proportionally to income and consumption remains stable, it positively influences the financial turnover of the business sector, making it easier for enterprises to manage their credit obligations. However, excessive growth in consumer expenditures or an increase in borrowing levels restricts household savings opportunities. In the medium to long term, this may result in a decline in consumption, elevating financial risks for businesses and deteriorating the quality of the loan portfolio.

Interest rates play a crucial role in shaping and determining the quality of the business loan portfolio. Low-interest rates make financing accessible for businesses, expanding their investment opportunities and boosting economic activity. This, in turn, increases business revenues and reduces credit risks. Conversely, high-interest rates elevate borrowing costs, impose financial burdens on businesses and weaken their ability to meet credit obligations. In such conditions, the probability of defaults rises, escalating risks within the banking sector.

Thus, the quality of the business loan portfolio is determined by the interplay between household income, consumer expenditures and interest rates. Maintaining a balance among these factors is strategically significant for ensuring the stability of the credit market. This study utilized monthly data from 2020 to 2024 as the observation period and all variables were naturally logarithmized. Natural logarithmization linearizes relationships between variables, reduces dispersion, enables elasticity interpretation and normalizes statistical distribution, thereby making analyses more reliable.

In the study, the extended Dickey-Fuller test was used to examine stationarity; the Granger test was employed to determine cause-and-effect relationships. For analyzing dynamic interactions among multidimensional variables, a Vector Autoregression (VAR) model was developed. Additionally, cointegration dependencies were identified using Johansen's cointegration test and a vector error correction model (VECM) was established. Econometric methodology was applied for time series analysis.

4. Main results

In this study, considering the dependency between the volume of business loans provided in the Republic of Azerbaijan and factors such as household income, expenditures and bank interest rates, the following form of a multivariate regression model is proposed:

$$lny_t = \alpha_0 + \alpha_1 lnx_{t1} + \alpha_2 lnx_{t2} + \alpha_3 lnx_{t3}, t = \overline{1,60}. \quad (1)$$

In the model, lny_t represents the volume of business loans across the country, lnx_{t1} reflects household income, lnx_{t2} corresponds to household expenditures and lnx_{t3} denotes average interest rates. Here, α_0 is the constant term, while $\alpha_1, \alpha_2, \alpha_3$ are coefficients. It should also be noted that when determining the structure of the model equation, several factors were

taken into account, including the number of variables, previous research conducted in the field and the nature of the econometric method intended to be applied (Johansen, 1988).

The dynamic graphical representation of the logarithmic time series and the descriptive statistics are illustrated in Figure 1 and Table 1.

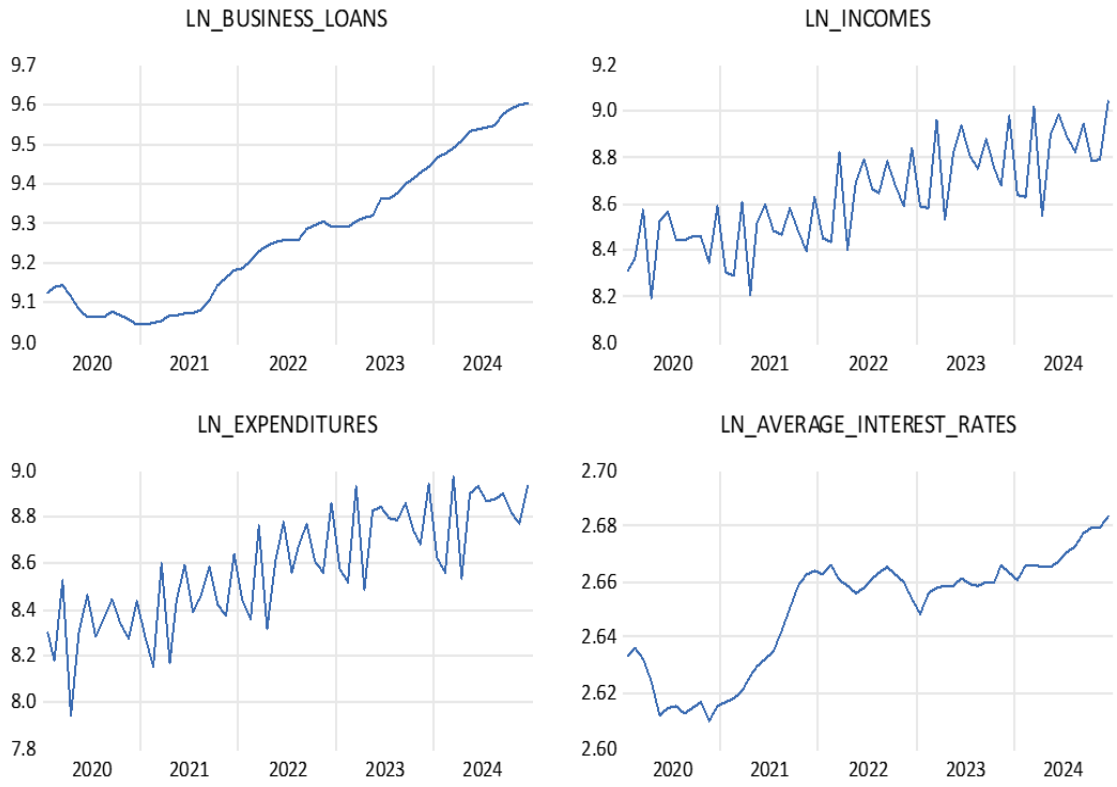

Figure 1. Dynamic descriptions of the data
Source: Developed by the author

In Figure 1, the indicator LN_BUSINESS_LOANS, representing the volume of business loans, showed a slight decline at the beginning of 2020, but entered a growth trend starting from 2021. The observed consistent rise during this period can be explained by increased economic activity, the expansion of the banking sector's credit portfolio and improved access to financial resources for business entities. The continuation of the growth trend until the end of 2024 indicates an expansion of the credit market.

The logarithmic indicator of household income, LN_INCOMES, has exhibited uneven growth since 2020. Particularly from 2023 onwards, the rate of income growth appears to accelerate, which can be associated with positive changes in the labor market, an increase in wage levels and strengthened overall economic activity.

The indicator representing household consumption expenditures, LN_EXPENDITURES, has been accompanied by fluctuations. While variability was observed during 2020-2021, subsequent years recorded relatively stable growth. The accelerated rate of income growth has led to increased consumption, influencing changes in consumer spending behavior.

The logarithmic indicator of average loan interest rates, LN_AVERAGE_INTEREST_RATES, was relatively low in 2020. However, starting from 2021, an upward trend began, which persisted until the end of 2024. The rise in interest rates can be linked to monetary policy adjustments, inflation indicators and the liquidity situation in the banking sector.

Table 1. Descriptive statistics

	LN_BUSINESS_LOANS	**LN_EXPENDITURES**	**LN_INCOMES**	**LN_AVERAGE_INTEREST_ RATE**
Mean	9.266624	8.581282	8.629874	2.649603
Median	9.257877	8.581419	8.596254	2.658465
Maximum	9.601516	8.969338	9.038674	2.683733
Minimum	9.042714	7.945591	8.194506	2.610070
Std. Dev.	0.176944	0.241520	0.212767	0.020867
Skewness	0.396474	-0.246310	0.045843	-0.612206
Kurtosis	1.910261	2.328009	2.211325	2.059964
Jarque-Bera	4.540747	1.735619	1.576036	5.957133
Probability	0.103274	0.419870	0.454745	0.050866
Sum	555.9974	514.8769	517.7924	158.9762
Sum Sq. Dev.	1.847243	3.441580	2.670909	0.025690

Source: Developed by the author

Table 2. Correlation matrix

	LN_BUSINES S_ LOANS	LN_EXPENDITU RES	LN_INCOM ES	LN_AVERAGE_INTEREST_ RATE
LN_BUSINESS_LOANS	1.000000	0.766011	0.762015	0.850180
LN_EXPENDITURES	0.766011	1.000000	0.972746	0.712755
LN_INCOMES	0.762015	0.972746	1.000000	0.673395
LN_AVERAGE_INTEREST_ RATE	0.850180	0.712755	0.673395	1.000000

Source: Developed by the author

Based on the indicators of the correlation matrix, the strength of the relationships between factors is assessed using the Chaddock scale. According to this scale, if the value of the correlation coefficient is less than 0.3, the dependency is weak; if it is between 0.3 and 0.7, the dependency is moderate and if it exceeds 0.7, the dependency is strong and tight. In this correlation matrix, since the correlation coefficient among factors is $|r_{xy}| \geq 0{,}7$ the dependency between the factors is strong.

Table 3. Regression model

Dependent Variable: LN_BUSINESS_LOANS				
Method: Least Squares				
Date: 04/01/25 Time: 01:02				
Sample: 2020M01 2024M12				
Included observations: 60				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_INCOMES	0.458662	0.220785	2.077417	0.0424
LN_EXPENDITURES	-0.166391	0.205001	-0.811660	0.4204
LN_AVERAGE_INTEREST_RATE	5.432682	0.744214	7.299889	0.0000
C	-7.658173	1.681684	-4.553871	0.0000
R-squared	0.790976	Mean dependent var		9.266624
Adjusted R-squared	0.779778	S.D. dependent var		0.176944
S.E. of regression	0.083036	Akaike info criterion		-2.074746
Sum squared resid	0.386118	Schwarz criterion		-1.935123
Log likelihood	66.24238	Hannan-Quinn criter.		-2.020132
F-statistic	70.63729	Durbin-Watson stat		0.676374
Prob(F-statistic)	0.000000			

Source: Developed by the author

The formal description of the multivariate regression model using the least squares method is as follows:

LN_BUSINESS_LOANS = 0.458662126949*LN_INCOMES - 0.166391476928*LN_EXPENDITURES+ 5.43268195307*LN_AVERAGE_INTEREST_RATE - 7.65817277513 (2)

Since the determination coefficient in the presented table is 79%, it indicates that the explanatory power of the model is high. This means that the model accounts for 79% of the variation in the variables, while the remaining 21% is attributed to factors not considered in the model or random variability.

Now, let us evaluate the significance of the regression equation using the Fisher criterion. If Prob (F-statistic) < 0.05 and the calculated F-statistic value exceeds the corresponding critical value, $F_{calculated} > F_{table}$ then the model is considered significant. At a 5% significance level, the table value of the F criterion is as follows: At a 5% significance level, the table value of the F criterion is as follows: For degrees of freedom $k_1 = 3$ and $k_2 = 56$ the table value of the F criterion is $F_{table} = 2{,}76$. Given that $F_{calculated}$ 70,63 > F_{table} 2,76 and F_{prob} 0,00 < 0,05 the model is statistically significant.

Autocorrelation has been tested using the Durbin-Watson statistic Based on the number of observations in the model (60) and the number of explanatory variables (3), the critical boundaries for the Durbin-Watson criterion were determined as $d_l = 1{,}48$ and $d_u = 1{,}69$ according to the corresponding table. Based on the results in Table 3, the observed Durbin-Watson value d_{obs} =0,67 indicates the presence of positive autocorrelation in the residuals.

Table 4. White test heteroscedasticity for the model

F-statistic	2.630702	Prob. F(8,51)	0.0171
Obs*R-squared	17.52691	Prob. Chi-Square(8)	0.0251

Source: Developed by the author

The heteroskedasticity of the residuals is tested using the White test and the results are presented in Table 4. The calculation is based on the formula nR^2, where n represents the number of observations and R^2 denotes the coefficient of determination. In this case, the number of observations is n = 60 and the coefficient of determination, as reported in Table 4, is 17.52691. The critical value $\chi^2_{0,0251}(8) = 17{,}52313443$. Since the corresponding probability is less than 0.05 and $nR^2 > \chi^2_{0,0251}(8)$ the null hypothesis (no heteroskedasticity) is rejected. This indicates that heteroskedasticity is present in the regression model.

Table 5. The Granger causality test

	m=1		**m=2**		**m=3**	
Null Hypothesis:	F-Statistic	Prob.	F-Statistic	Prob.	F-Statistic	Prob.
LN_INCOMES does not Granger Cause LN_BUSINESS_LOANS	0.56151	0.4568	0.36548	0.6956	3.44770	**0.0234**
LN_BUSINESS_LOANS does not Granger Cause LN_INCOMES	58.8374	**3.E-10**	19.8192	**4.E-07**	2.35969	**0.0826**
LN_EXPENDITURES does not Granger Cause LN_BUSINESS_LOANS	4.20491	**0.0450**	1.75911	0.1821	4.52668	**0.0069**
LN_BUSINESS_LOANS does not Granger Cause LN_EXPENDITURES	46.1149	**8.E-09**	11.5449	**7.E-05**	1.29700	0.2858
LN_AVERAGE_INTEREST_RATE does not Granger Cause LN_BUSINESS_LOANS	14.1732	**0.0004**	6.66227	**0.0026**	5.39593	**0.0027**
LN_BUSINESS_LOANS does not Granger Cause LN_AVERAGE_INTEREST_RATE	7.2E-05	0.9933	0.20553	0.8149	0.59185	0.6232
LN_EXPENDITURES does not Granger Cause LN_INCOMES	0.52288	0.4726	1.65218	0.2013	0.30375	0.8225
LN_INCOMES does not Granger Cause LN_EXPENDITURES	0.04479	0.8331	0.89798	0.4135	2.18706	0.1011
LN_AVERAGE_INTEREST_RATE does not Granger Cause LN_INCOMES	27.2259	**3.E-06**	6.72420	**0.0025**	5.67076	**0.0020**
LN_INCOMES does not Granger Cause LN_AVERAGE_INTEREST_RATE	0.19396	0.6613	0.89169	0.4160	0.64598	0.5891
LN_AVERAGE_INTEREST_RATE does not Granger Cause LN_EXPENDITURES	29.1202	**1.E-06**	6.29184	**0.0035**	5.76671	**0.0018**
LN_EXPENDITURES does not Granger Cause LN_AVERAGE_INTEREST_RATE	2.03258	0.1595	1.88019	0.1626	1.25934	0.2984

Source: Developed by the author

We have used the Granger test to determine the existence of cause-and-effect relationships between variables. In the present study, these relationships were tested for lags m = 1, 2 and 3. The results are presented in Table 5.

According to the table, at a 5% significance level for lag 3, there is a unidirectional relationship between LN_INCOMES and LN_BUSINESS_LOANS. For lags 1 and 2 at 5% and lag 3 at a 10% significance level, a unidirectional relationship exists between

LN_BUSINESS_LOANS and LN_INCOMES. Similarly, LN_EXPENDITURES and LN_BUSINESS_LOANS show unidirectional relationships at lags 1 and 3 at the 5% significance level, while LN_BUSINESS_LOANS and LN_EXPENDITURES exhibit unidirectional relationships at lags 1 and 2 at the 5% significance level. Between LN_AVERAGE_INTEREST_RATE and LN_BUSINESS_LOANS, there is a unidirectional cause-and-effect relationship for all three lags at the 5% significance level. This is also true for the relationships between LN_AVERAGE_INTEREST_RATE and LN_INCOMES as well as LN_AVERAGE_INTEREST_RATE and LN_EXPENDITURES.

Table 6. Dickey-Fuller stationarity test

Time series	Test Equation	ADF-value	1% critical value	5% critical value	10% critical value	Prob.	Stationarity
LN_BUSINESS_LOANS	İntercept	2.376802	-3.546099	-2.911730	-2.593551	1.0000	NO
	Trend and int.	-3.125438	-4.121303	-3.487845	-3.172314	0.1101	NO
LN_INCOMES	İntercept	-0.179856	-3.571310	-2.922449	-2.599224	0.9340	NO
	Trend and int.	-2.742905	-4.156734	-3.504330	-3.181826	0.2249	NO
LN_EXPENDITURES	İntercept	-0.671555	-3.571310	-2.922449	-2.599224	0.8442	NO
	Trend and int.	-1.567809	-4.156734	-3.504330	-3.181826	0.7913	NO
LN_AVERAGE_INTEREST_RATE	İntercept	-0.017370	-3.546099	-2.911730	-2.593551	0.9528	NO
	Trend and int.	-2.436174	-4.124265	-3.489228	-3.173114	0.3578	NO
Δ LN_BUSINESS_LOANS	İntercept	-4.473896	-3.548208	-2.912631	-2.594027	0.0006	YES
Δ LN_INCOMES	İntercept	-5.924316	-3.574446	-2.923780	-2.599925	0.0000	YES
Δ LN_EXPENDITURES	İntercept	-5.483069	-3.574446	-2.923780	-2.599925	0.0000	YES
Δ LN_AVERAGE_INTEREST_RATE	İntercept	-5.490356	-3.548208	-2.912631	-2.594027	0.0000	YES

Source: Developed by the author

Let's conduct an econometric analysis of the stationarity of the variables in the model we established, based on the results of the Dickey-Fuller test. As we know, when the probability value accompanying the Dickey-Fuller test statistic is less than 5% (0.05), the null hypothesis stating that the time series has a unit root is rejected. In other words, the alternative hypothesis, which assumes the stationarity of the time series, is accepted. Furthermore, for time series to be stationary, the Dickey-Fuller test statistic should be smaller than the critical values at significance levels of 1%, 5% and 10%.

Let us verify the stationarity of the time series based on the results in Table 6. The findings show that the included variables were non-stationary at their levels. This posed a limitation to the cointegration analysis since one of the conditions for cointegration is that the time series must be stationary at the same order. Subsequently, the first differences of the time series were taken and the aforementioned tests were reapplied. As a result, all indicators were found to be stationary in the l(1) intercept condition.

In the next phase, a Vector Autoregression (VAR) model will be developed, the appropriate lag length will be determined and the Johansen cointegration test will be applied. Since the cointegration test will be conducted on the variables, the VAR model will be constructed based on their level values (I(0)) and then the optimal lag length will be identified.The VAR model neutralizes the difference between endogenous and exogenous variables and allows accurate forecasts for the future by utilizing the lagged values of the dependent variable as explanatory variables in the model.

Table 7. VAR model lag selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	315.4916	NA	2.11e-10	-10.92953	-10.78616	-10.87381
1	553.3028	433.9011	8.79e-14	-18.71238	-17.99552*	-18.43378*
2	563.0000	16.33214	1.11e-13	-18.49123	-17.20088	-17.98975
3	594.6848	48.91695*	6.53e-14*	-19.04157*	-17.17774	-18.31722

Source: Developed by the author

Using the results from Table 7, the most suitable lag length for the model has been determined. According to the Schwarz criterion (SC) and Hannan-Quinn criterion (HQ), the appropriate lag length is 1. However, based on the Akaike criterion (AIC), the Lagrange test (LR) and the Final Prediction Error (FPE), the suggested lag length is 3. In the residual analysis for lag 1, autocorrelation was detected within the residuals. Consequently, the optimal lag length was determined to be 3.

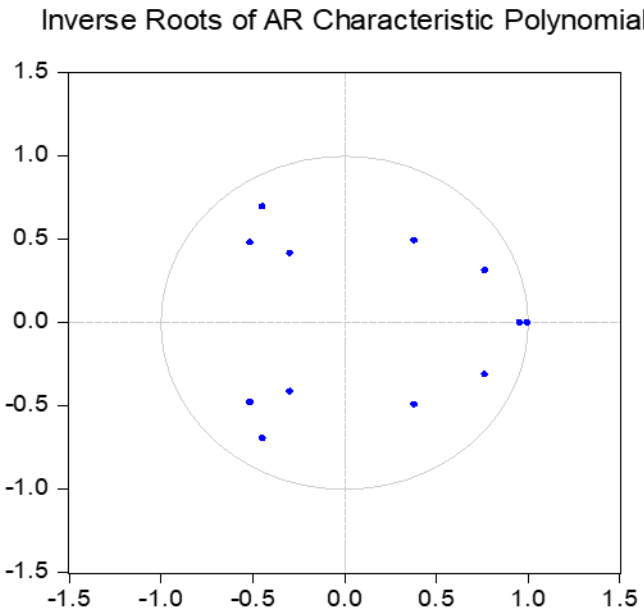

Figure 2. AR roots graph with a lag period of 3

Table 8. Root table of AR characteristic polynomials

Root	Modulus
0.997976	0.997976
0.956955	0.956955
0.766416 - 0.311441i	0.827279
0.766416 + 0.311441i	0.827279
-0.445815 - 0.695031i	0.825724
-0.445815 + 0.695031i	0.825724
-0.512779 - 0.479257i	0.701875
-0.512779 + 0.479257i	0.701875
0.381720 - 0.491338i	0.622192
0.381720 + 0.491338i	0.622192
-0.295021 - 0.414234i	0.508554
-0.295021 + 0.414234i	0.508554

Source: Developed by the author

(AR) model is utilized to analyze changes in time series data and make future predictions. The stability of the model is evaluated based on whether the inverse roots of its characteristic polynomial fall within the unit circle. Observing Figure 2, it is evident that none of the inverse roots lie outside the unit circle, thereby proving that the model is stationary and stable. Moreover, according to the analysis results presented in Table 8, the modulus values of the inverse roots of the AR model range between 0.508554 and 0.997976, all of which are within the unit circle. Although the largest modulus value is 0.997976, indicating proximity to the unit circle, stability is maintained. Since all modulus values are less than 1, the AR model is considered stable and suitable for long-term forecasting.

Table 9. Autocorrelation LM Test

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	12.47770	16	0.7105	0.773942	(16, 113.7)	0.7116
2	18.55449	16	0.2924	1.180843	(16, 113.7)	0.2939
3	14.57625	16	0.5559	0.912151	(16, 113.7)	0.5573
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	12.47770	16	0.7105	0.773942	(16, 113.7)	0.7116
2	39.05952	32	0.1822	1.257444	(32, 123.3)	0.1877
3	62.35298	48	0.0798	1.369011	(48, 113.7)	0.0894

Source: Developed by the author

Table 9 presents the results of the Autocorrelation LM Test (Lagrange Multiplier Test). This test is used to determine whether serial correlation (autocorrelation) exists in the residuals of a model. In other words, it analyzes whether the errors of the model are interrelated. Based on the test results, no serial correlation is detected in the residuals, as all p-values exceed 0.05.

This indicates that the model's errors are not interrelated, which is a positive sign. If autocorrelation were present, it could lead to inaccurate forecasts.

Table 10. VAR Residual Normality Tests

Component	**Skewness**	**Chi-sq**	**df**	**Prob.**
1	-0.211149	0.423545	1	0.5152
2	0.339719	1.096384	1	0.2951
3	-0.228714	0.496946	1	0.4808
4	-0.082701	0.064974	1	0.7988
Joint		2.081849	4	0.7207
Component	**Kurtosis**	**Chi-sq**	**df**	**Prob.**
1	3.545464	0.706636	1	0.4006
2	3.029506	0.002068	1	0.9637
3	3.114124	0.030933	1	0.8604
4	2.628236	0.328245	1	0.5667
Joint		1.067882	4	0.8993
Component	**Jarque-Bera**	**df**	**Prob.**	
1	1.130181	2	0.5683	
2	1.098451	2	0.5774	
3	0.527879	2	0.7680	
4	0.393219	2	0.8215	
Joint	3.149731	8	0.9246	

Source: Developed by the author

Table 10 presents the results of statistical normality tests, which include Skewness, Kurtosis and the Jarque-Bera tests. According to the results of the Skewness test, the skewness values for all components are close to zero. Additionally, the Chi-square test p-values for all components are greater than 0.05, confirming that the distributions are statistically symmetric. Most of the Kurtosis values are close to 3. Furthermore, the high probability values indicate that the distributions do not significantly differ from a normal distribution. The Jarque-Bera test combines both Skewness and Kurtosis measures to provide an overall assessment of normality. The p-values for each component and the overall result exceed 0.05 (with the overall result being $p = 0.9246$). This confirms that the null hypothesis of normal distribution is not rejected. Overall, the distribution characteristics of the analyzed components align with the properties of a normal distribution. The results of the Skewness and Kurtosis tests do not contradict the normality assumption. The high p-values of the Jarque-Bera test further indicate that the data set does not deviate significantly from a statistical normal distribution. Therefore, it can be concluded that the data set conforms to normality.

Table 11. The residual heteroskedasticity test for VAR model

Joint test:		
Chi-sq	df	Prob.
253.0987	240	0.2684

Source: Developed by the author

In Table 11, a heteroskedasticity test was conducted to evaluate the presence of heteroskedasticity in the residuals of the VAR model. Based on the results, the p-value is 0.2684, which is higher than the significance levels of 5% or 10%. Therefore, the null hypothesis (H_0) cannot be rejected, indicating that no heteroskedasticity is observed in the model's residuals. In other words, the residuals of the VAR model exhibit constant variance, signifying that the model specification is accurate and the results obtained are stable and reliable.

Table 12. Johansen's cointegration test

Sample: 2020M01 2024M12					
Included observations: 56					
Series: LN_BUSINESS_LOANS LN_INCOMES LN_EXPENDITURES LN_AVERAGE_INTEREST_RATE					
Lags interval: 1 to 3					
Selected (0.05 level*) Number of Cointegrating Relations by Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept	Intercept	Intercept	Intercept	Intercept
	No Trend	No Trend	No Trend	Trend	Trend
Trace	2	2	1	1	1
Max-Eig	1	0	0	1	1
*Critical values based on MacKinnon-Haug-Michelis (1999)					
Information Criteria by Rank and Model					
Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
Log Likelihood by Rank (rows) and Model (columns)					
0	577.4950	577.4950	584.9258	584.9258	588.7573
1	590.0357	590.6915	597.6437	606.4273	610.0372
2	598.4923	601.9731	605.2075	616.5929	618.0879
3	602.6352	606.1299	609.1371	621.7938	623.0800
4	602.8537	609.5002	609.5002	625.5454	625.5454
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	-18.91053	-18.91053	-19.03306	-19.03306	-19.02705
1	-19.07270	-19.06041	-19.20156	-19.47955	-19.50133
2	-19.08901	-19.14190	-19.18598	-19.52118*	-19.50314
3	-18.95126	-18.96892	-19.04061	-19.38549	-19.39571
4	-18.67335	-18.76786	-18.76786	-19.19805	-19.19805
Schwarz Criteria by Rank (rows) and Model (columns)					
0	-17.17452	-17.17452	-17.15238	-17.15238	-17.00170
1	-17.04735	-16.99889	-17.03154	-17.27336*	-17.18664
2	-16.77432	-16.75487	-16.72663	-16.98949	-16.89912
3	-16.34723	-16.25640	-16.29192	-16.52830	-16.50236
4	-15.77999	-15.72984	-15.72984	-16.01535	-16.01535

Source: Developed by the author

The results of the Johansen cointegration test are presented in Table 12. Analysis based on the Dickey-Fuller test demonstrated that all variables became stationary at their first difference. The Johansen cointegration analysis, which applies to variables of the same stationarity degree and multiple time series, allows for the identification of long-term relationships among the variables. According to the results, the integration order is 1 (I(1)) and the cointegration rank is 1 (r = 1), confirming the existence of a cointegration relationship. Thus, the Johansen cointegration test demonstrates that long-term relationships exist among all the variables.

The final stage of the study involves constructing a Vector Error Correction Model (VECM) to address error corrections. In dynamic regression models, distinguishing between short-term and long-term dynamics is crucial. This differentiation can be analyzed within the framework of the error correction model. The error correction model is a time series model where short-term adjustments are made based on long-term relationships among the variables. If there exists a long-term relationship (cointegration) among the variables, the application of the error correction model is appropriate. Using the Eviews 12 software package, the trend-contained error correction equations were established for the first-order differences of the variables:

D(LN_BUSINESS_LOANS) = - 0.0744778265155*(LN_BUSINESS_LOANS(-1) - 2.20211934475*LN_INCOMES(-1) + 2.15665927666*LN_EXPENDITURES(-1) - 1.48305736098*LN_AVERAGE_INTEREST_RATE(-1) - 0.0122883391784*@TREND(20M01) - 4.4587988895) + 0.286490999468*D(LN_BUSINESS_LOANS(-1)) + 0.178653289172*D(LN_BUSINESS_LOANS(-2)) - 0.00361922130621*D(LN_BUSINESS_LOANS(-3)) - 0.206320015718*D(LN_INCOMES(-1)) - 0.110581342615*D(LN_INCOMES(-2)) - 0.0366234738513*D(LN_INCOMES(-3)) + 0.197833730594*D(LN_EXPENDITURES(-1)) + 0.0946995795724*D(LN_EXPENDITURES(-2)) + 0.0356450099432*D(LN_EXPENDITURES(-3)) + 0.663914007565*D(LN_AVERAGE_INTEREST_RATE(-1)) + 0.492556823447*D(LN_AVERAGE_INTEREST_RATE(-2)) + 0.188942284973*D(LN_AVERAGE_INTEREST_RATE(-3)) + 0.00362102316631 (3)

D(LN_INCOMES) = - 0.514029584812*(LN_BUSINESS_LOANS(-1) - 2.20211934475*LN_INCOMES(-1) + 2.15665927666*LN_EXPENDITURES(-1) - 1.48305736098*LN_AVERAGE_INTEREST_RATE(-1) - 0.0122883391784*@TREND(20M01) - 4.4587988895) + 0.145915046138*D(LN_BUSINESS_LOANS(-1)) - 0.135161419389*D(LN_BUSINESS_LOANS(-2)) + 1.97261168682*D(LN_BUSINESS_LOANS(-3)) - 1.63319955488*D(LN_INCOMES(-1)) - 0.933618702142*D(LN_INCOMES(-2)) + 0.0929794954434*D(LN_INCOMES(-3)) + 0.413490260143*D(LN_EXPENDITURES(-1)) - 0.0667224426836*D(LN_EXPENDITURES(-2)) - 0.309707905662*D(LN_EXPENDITURES(-3)) + 5.77967986434*D(LN_AVERAGE_INTEREST_RATE(-1)) - 7.94941859881*D(LN_AVERAGE_INTEREST_RATE(-2)) + 1.70762617512*D(LN_AVERAGE_INTEREST_RATE(-3)) + 0.0137288729715 (4)

D(LN_EXPENDITURES) = - 1.39852291008*(LN_BUSINESS_LOANS(-1) - 2.20211934475*LN_INCOMES(-1) + 2.15665927666*LN_EXPENDITURES(-1) - 1.48305736098*LN_AVERAGE_INTEREST_RATE(-1) - 0.0122883391784*@TREND(20M01) - 4.4587988895) - 0.166100206041*D(LN_BUSINESS_LOANS(-1)) - 0.0708043612733*D(LN_BUSINESS_LOANS(-2)) + 1.7937315333*D(LN_BUSINESS_LOANS(-3)) - 2.2208805338*D(LN_INCOMES(-1)) - 1.34190018766*D(LN_INCOMES(-2)) - 0.217837396021*D(LN_INCOMES(-3)) + 1.00688178831*D(LN_EXPENDITURES(-1)) + 0.348022994262*D(LN_EXPENDITURES(-2)) + 0.0405519427902*D(LN_EXPENDITURES(-3)) + 7.23771202185*D(LN_AVERAGE_INTEREST_RATE(-1)) - 8.11730594125*D(LN_AVERAGE_INTEREST_RATE(-2)) + 5.6768367386*D(LN_AVERAGE_INTEREST_RATE(-3)) + 0.0134062517637 (5)

D(LN_AVERAGE_INTEREST_RATE) = - 0.00337751720407*(LN_BUSINESS_LOANS(-1) - 2.20211934475*LN_INCOMES(-1) + 2.15665927666*LN_EXPENDITURES(-1) - 1.48305736098*LN_AVERAGE_INTEREST_RATE(-1) - 0.0122883391784*@TREND(20M01) - 4.4587988895) + 0.000225570197566*D(LN_BUSINESS_LOANS(-1)) - 0.0814024958115*D(LN_BUSINESS_LOANS(-2)) + 0.0122559424465*D(LN_BUSINESS_LOANS(-3)) - 0.0254633261943*D(LN_INCOMES(-1)) - 0.0105541341254*D(LN_INCOMES(-2)) - 0.0187684695039*D(LN_INCOMES(-3)) + 0.0293257477904*D(LN_EXPENDITURES(-1)) + 0.0158321437446*D(LN_EXPENDITURES(-2)) + 0.0228264386122*D(LN_EXPENDITURES(-3)) + 0.285610493609*D(LN_AVERAGE_INTEREST_RATE(-1)) - 0.0425096907192*D(LN_AVERAGE_INTEREST_RATE(-2)) + 0.316576105639*D(LN_AVERAGE_INTEREST_RATE(-3)) + 0.00100443270765 (6)

Table 13. Vector Error Correction Estimates

Vector Error Correction Estimates				
Date: 04/01/25 Time: 15:36				
Sample (adjusted): 2020M05 2024M12				
Included observations: 56 after adjustments				
Standard errors in ( ) & t-statistics in [ ]				
Cointegrating Eq:	CointEq1			
LN_BUSINESS_LOANS(-1)	1.000000			
LN_INCOMES(-1)	-2.202119			
	(0.23120)			
	[-9.52489]			
LN_EXPENDITURES(-1)	2.156659			
	(0.22346)			
	[9.65130]			
LN_AVERAGE_INTEREST_RATE(-1)	-1.483057			
	(0.52312)			
	[-2.83500]			
@TREND(20M01)	-0.012288			
	(0.00108)			
	[-11.3799]			

C	-4.458799			
Error Correction:	D(LN_BUSINESS_LOANS)	D(LN_INCOMES)	D(LN_EXPENDITURES)	D(LN_AVERAGE_INTEREST_RATE)
CointEq1	-0.074478	-0.514030	-1.398523	-0.003378
	(0.04995)	(0.52089)	(0.48877)	(0.01777)
	[-1.49110]	[-0.98682]	[-2.86132]	[-0.19002]

Source: Developed by the author

Table 13 presents the results of the Vector Error Correction Model (VECM). The first section, referred to as the Cointegrating Equation, represents the long-term relationship among the variables. The expression of the statistically significant cointegration relationship is illustrated as follows:

$$LN\_BUSINESS\_LOANS = -2.2021*LN\_INCOMES(-1) + 2.1567*LN\_EXPENDITURES(-1) - 1.4831*LN\_AVERAGE\_INTEREST - 0.0123*TREND - 4.4588 \quad (7)$$

The second section of the Vector Error Correction Model (VECM) expresses the short-term dynamics and the rate of return to equilibrium through the Error Correction Term (ECT). One of the key conditions of this model is that the ECT coefficients must be negative and statistically significant. If the coefficients fall within the interval [-1,0], this indicates the system's ability to return to equilibrium, while statistical significance validates the reliability of their impact. Among the four coefficients, only one D(LN_EXPENDITURES) has a t-statistic whose absolute value is less than -1.96. However, the corresponding correction coefficient slightly deviates from the correction interval. Only the first coefficient's correction term can be considered statistically significant, as it falls within the interval [-1,0]. In this case, deviations from the equilibrium trajectory caused by shocks are characterized by relatively slow and delayed adjustments back to the equilibrium trajectory.

Conclusion. This article substantiates the existence of a statistically significant cointegration dependency reflecting a balanced long-term relationship between the business loan portfolio in the Republic of Azerbaijan and household financial flows (income and expenditures) as well as average bank interest rates. A cointegration equation has been derived. The results of the study indicate that business loans exhibit relatively weak and delayed reactions to long-term equilibrium disruptions. This analysis underscores the necessity of implementing more flexible and targeted tools in credit policy formulation. The limited sensitivity of business loans to changes in economic activity and income highlights the need for structural adjustments within the loan portfolio. From this perspective, the empirical results obtained from the VECM model provide valuable analytical foundations for managing risks in business credit policy, directing resources more efficiently and adapting credit conditions to macroeconomic shocks.

References

1. Alizade A. (2024), Johansen's cointegration analysis of some factors of economic growth and exports of products from the Republic of Azerbaijan to Ukraine. The Problems of Economy, Vol.2, No.60, 5-20. https://doi.org/10.32983/2222-0712-2024-2-5-20
2. Berger A.N., Black L.K. (2011), Bank size, lending technologies and small business finance. Journal of Banking & Finance, Vol.35, No.3, 724-735. https://doi.org/10.1016/j.jbankfin.2010.09.004
3. Berger A.N., Frame W.S., Miller N.H. (2005), Credit scoring and the availability, price and riskof small business credit. Journal of Money, Credit and Banking, 191-222. https://doi.org/10.1353/mcb.2005.0019
4. Fanchette Y., Ramenah H., Tanougast C., Benne M. (2020), Applying Johansen VECM cointegration approach to propose aforecast model of photovoltaic power output plant in Reunion Island. AIMS Energy, Vol.8, No.2, 179-213. https://doi.org/10.3934/energy.2020.2.179
5. Foxx A. (2015), The relationship between small business loans and wages. Xavier Journal of Undergraduate Research, Vol.3, No.1, 5. https://www.exhibit.xavier.edu/xjur/vol3/iss1/5
6. Gül S., Koy A. (2023), Relationship between NPL and macroeconomic indicators with MTAR model. Journal of Economics and Financial Researches, Vol.5, No.1, 1-18. https://doi.org/10.56668/jefr.1229535
7. https://www.cbar.az/page-188/credit-institutions
8. https://www.stat.gov.az
9. Ivashchenko A., Polishchuk Y., Dubyna M., Smerichevskyi S., Kornyliuk A. (2023), Modelling the impact of SME lending on business value added. Acta Innovations, Vol.48, 5-21. https://doi.org/10.32933/ActaInnovations.48.1
10. Muqumova G.Z. (2025), Kommersiya banklarının kredit risklərinin qiymətləndirilməsi. Proceedings of the 4th International Scientific and Practical Conference Modern Knowledge: Research and Discoveries, 105-115. https://doi.org/10.51582/interconf.19-20.02.2025.012
11. Novopashina A.N. (2020), Lending to small and medium-sized enterprises in Russian regions: Effects of banking system reorganization. Spatial Economics, Vol.16, No.1, 123-155. https://doi.org/10.14530/se.2020.1.123-155
12. Onikiienko S., Polishchuk Y., Ivashenko A., Kornyliuk A., Demchyshak N. (2021), Prior credit assessment of long-term SME projects with non-standard cash flows. Bank and Bank Systems, Vol.16, No.2, 148-158. https://doi.org/10.21511/bbs.16(2).2021.14
13. Orucov E. (2018), Ekonometrika. Bakı, 384.
14. Pankova V.A. (2022), Modeling the dynamics of retail lending in Russia: A relationship with the dynamics of household savings, incomes and expenses. Studies on Russian Economic Development, Vol.33, No.6, 722-734. https://doi.org/10.1134/S1075700722060090

15. Tekin B. (2021), Empirical reflections of the nexus between banking system credits and industry production in Turkey: Co-integration and causality analysis. Cankiri Karatekin University Journal of the Faculty of Economics and Administrative Sciences, Vol.11, No.2, 595-623. https://doi.org/10.18074/ckuiibfd.896603
16. Yussuf Y.C. (2022), Cointegration test for the long-run economicrelationships of East Africa community: Evidence from a meta-analysis. Asian Journal of Economics and Banking, Vol.6, No.3, 314-336. https://doi.org/10.1108/AJEB-03-2021-0032