

Econometric Analysis of Financial Support for Business Entities

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ABSTRACT: The factors affecting the growth of loans allocated as an instrument of financial support by commercial banks to small business entities in Uzbekistan include the following. In particular, the volume of loans granted by commercial banks to small business entities is a random variable, and the independent variables are inflationary expectations of business entities, the key interest rate of the central bank, the volume of deposits of commercial banks, the volume of capital of commercial banks, non-performing loans (NPL) of commercial banks, the volume of liquid assets of commercial banks, the volume of profits of commercial banks, and the impact of the interest rate on deposits of commercial banks are analyzed based on an econometric model.

KEYWORDS: loans, inflation expectation, interest rate, deposit, capital, NPL, liquid assets, profit, deposit interest rate.

INTRODUCTION

In our study, we evaluated the impact of these factors on the volume of loans allocated to small businesses from commercial banks, the factors affecting it, such as inflation expectations of business entities, the key interest rate of the Central Bank, the volume of deposits of commercial banks, the volume of capital of commercial banks, non-performing loans of commercial banks, the volume of liquid assets of commercial banks, the volume of profit of commercial banks, and the interest rate on deposits of commercial banks based on an econometric model. Today, financial support to small businesses through the allocation of loans by commercial banks is one of the main goals in Uzbekistan. Therefore, based on quarterly data on the volume of loans granted to small businesses from commercial banks as a dependent variable, inflation expectations of business entities as a dependent variable, the key interest rate of the central bank, the volume of deposits of commercial banks, the volume of capital of commercial banks, non-performing loans (NPL) of commercial banks, the volume of liquid assets of commercial banks, the volume of profit of commercial banks and the interest rate of deposits of commercial banks, the factors affecting the volume of loans granted to small businesses and their influence on the autoregressive distributed lag (ARDL) model [1] based on complex econometric methods are selected from monthly indicators from 2020 to 2024 (the main tables of the econometric analysis are given in the appendix).

LITERATURE REVIEW

In econometrics, in many cases, special models are important in time series analysis to capture complex dynamic relationships and to solve non-stationary problems [2]. Among them, VECM-vector error correction models, VAR-vector autoregression, and ARDL-autoregressive distributed lag models are common econometric tools, each of which offers its own advantages in addressing research questions. Vector autoregression studies any endogenous variable by calculating its past values, as well as the past values of all other endogenous variables in the system, as a linear function, which is suitable for analyzing and forecasting impulse responses based on a series of time series that are interrelated [3]. However, according to standard VAR models, variables are interpreted as stationary [4]. When non-stationary variables exhibit long-term relationships, VECMs are the preferred modeling approach, combining dynamic adjustment and balancing mechanisms into a single model [5]. Unlike VAR and VECM models, ARDL models provide a flexible alternative that is useful for capturing long-term relationships [6]. The recent advancements in ARDL models to capture asymmetric and nonlinear generalizations, quantile-related approaches, and even spatiotemporal dynamics are considered to be recent advances in ARDL models, increasing their utility in various research contexts [2]. ARDL models can also effectively handle serial correlation, endogeneity, and heteroskedasticity [7] [8]. In addition, another advantage of the ARDL model is that it differs from other cointegration methods in that it can accommodate variables with mixed orders of integration [7] [9]. The ability of the ARDL model to integrate variables in different integration patterns gives it an

advantage over traditional cointegration methods that require all variables to be combined in the same order [10]. In addition, the ability of the ARDL model to simultaneously estimate short- and long-run coefficients in a single equation increases its effectiveness in economic analysis on a large scale [11].

The formula (1) above expresses a simple functional relationship and explains the composition of arbitrary and capricious variables. The data we are analyzing are based on monthly data from 2020-2024, and a dynamic time series econometric analysis was performed on the selected data. The reason why we conducted econometric analysis based on the autoregressive distributed lag (ARDL) model is that this model is more suitable for determining the dependencies and errors of variables than other models, in particular the vector auto-regression (VAR) model and the vector error correction (VECM) model [12], and taking into account the possibility of long-term and short-term forecasting, the autoregressive distributed lag (ARDL) model was chosen for our study. We conducted an analysis in this model to determine the long-term and short-term dependencies of arbitrary and capricious variables through the autoregressive distributed lag (ARDL) model of Pesaran and Shin. The convenience of this model is that it allows you to determine whether the selected variables have a long-term and short-term relationship with each other and which variables will have a greater impact in the future. The autoregressive distributed lag (ARDL) model determines the stationary state of the variables through the unit root test for econometric analysis.

LOANS = (inflation expectation, interest rate, deposit, capital, NPL, liquid assets, profit, deposit interest rate).

deposit interest rate – change in the interest rate on deposits of commercial banks:

The founders of the autoregressive distributed lag (ARDL) model, Pesaran, Shin and Smith, explained in their research that the selected variables $I(0)$ and $I(1)$ have cointegration with the zero and first differences, respectively. Based on the research of these scientists, we will perform a unit root test for the variables for econometric analysis. (Table 1).

Variables	Extended Dickey-Fuller's Test (ADF)	Phillips-Perron's Test (PP) [14]
[13]		

	Constant	Trend	Constant	Trend
<i>Lnloans</i>	-4.395751***	-6.101731***	-4.315747***	-6.101731***
<i>Indeposit_interest_rate</i>	-3.005748**	-2.971732**	-3.013204**	-3.005748**
<i>Lnprofit</i>	-4.215587***	-4.545047***	-4.229801***	-4.594571**
First Order				
<i>Dlncapital</i>	-8.652921***	-8.948335***	-8.596153***	-8.944021***
<i>dIndeposit</i>	-6.679079***	-6.617768***	-6.679079***	-6.617768***
<i>dlninflation_expectation</i>	-9.990193***	-9.896753***	-12.09719***	-11.94786***
<i>dlninterest_rate</i>	-7.545597***	-7.485072***	-7.575607***	-7.509313***
<i>dlnliquid_asset</i>	-7.753537***	-7.740128***	-7.755278***	-7.746153***
<i>Dlnnpl</i>	-7.121599***	-7.416520***	-7.237121***	-7.482454***

*** indicates statistical significance at 1%, ** indicates statistical significance at 5%, * indicates statistical significance at 10%.

¹ Prepared by the author using Eviews-12.0 software based on data from the Central Bank of the Republic of Uzbekistan.

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The Extended Dickey-Fuller and Phillips-Perron tests based on Table 1 show that the variables $dlncapital\ I(1)$, $dlndeposit\ I(1)$, $dlninflation_expectation\ I(1)$, $dlninterest_rate\ I(1)$, $dlnliquid_asset\ I(1)$ and $dlnnpl\ I(1)$ are stationary in the primary difference, in particular in the first order, while $lnloans\ I(0)$, $Indeposit_interest_rate\ I(0)$ and $lnprofit\ I(0)$ are stationary in the zero order. The reliability level of the results of the extended Dickey-Fuller and Phillips-Perron tests is considered reliable at 95%. Since the analysis results show that the statistical significance of all variables is significant at 5%, the reliability level is therefore considered reliable at 95%. According to the nature of the ARDL model, the variables must be stationary in the zero and first orders. After the unit root test, we perform the ARDL bounds test to determine whether there is cointegration between the variables. Based on it, we perform hypothesis testing. We perform hypothesis testing as follows: null hypothesis (N0): there is no long-run relationship, (N1) there is a long-run relationship. The ARDL bounds test is shown in the table below (Table 2).

(ARDL) bounds test. Null hypothesis (N0): no long-run relationship exists²

Statistical Test	Value	K
F-Statistics	3.231052*	8
The Essential Value Of Connection		
Importance Level	I(0) bound	I(1) bound
10%	1.85	2.85
5%	2.11	3.15
2,5%	2.33	3.42
1%	2.62	3.77

*** indicates statistical significance at 1%, ** indicates statistical significance at 5%, * indicates statistical significance at 10%.

The test results in Table 2 show that there is a long-run relationship between the variables. The bounds test F-statistic is 3.231052, which means that the statistical significance of the relationship value is higher than 10%, which means that there is a long-run relationship between the arbitrary variable $lnloans$ and the arbitrary variables $Indeposit_interest_rate$, $lnprofit$, $dlncapital$, $dlndeposit$, $dlninflation_expectation$, $dlninterest_rate$, $dlnliquid_asset$ and $dlnnpl$. Since the hypothesis test showed that (N0): rejects the long-run relationship, (N1) accepts the hypothesis that there is a long-run relationship. It is worth noting that this indicates that there is long-run cointegration between the arbitrary and arbitrary variables. Once the existence of cointegration is proven, we determine the long-run correlation (ARDL) model:

$$lnloans_t = \varphi_0 + \beta_1 Indeposit_interest_rate_{t-1} + \beta_2 lnprofit_{t-1} + \beta_3 dlncapital_{t-1} + \beta_4 dlndeposit_{t-1} + \beta_5 dlninflation_expectation_{t-1} + \beta_6 dlninterest_rate_{t-1} + \beta_7 dlnliquidity_asset_{t-1} + \beta_8 dlnnpl_{t-1} + \varepsilon_t \quad (2)$$

Based on the above formula (2), in our econometric analysis, a long-run correlation test was conducted using the ARDL method to determine the degree of influence of factors affecting the volume of loans allocated by commercial banks to small businesses. The results of this test are reflected in the following table (Table 3).

Table 3: Estimation in the autoregressive distributed lag (ARDL) model³

Variables	(ARDL) (1,2,3,3)			
	Coefficient	Standard Error	F-statistics	Plausibility
Inloans (-1)	0.192419	0.092990	2.069252	0.0469
Inloans (-2)	-0.000101	0.217620	-0.000466	0.9996
Inloans (-3)	0.541615	0.114412	4.733897	0.0000
Indeposit _interest_rate	0.730321	0.225569	3.237677	0.0029**
lnprofit	-0.022161	0.092138	-0.240517	0.8115

² Prepared by the author using Eviews-12.0 software based on data from the Central Bank of the Republic of Uzbekistan.

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Inprofit (-1)	0.085241	0.077593	1.098564	0.2804
Inprofit (-2)	-0.108585	0.066002	-1.645176	0.1100
Dlncapital	-0.570674	3.762666	-0.151668	0.8804
dlndeposit	-2.778726	3.656167	-0.760011	0.4530
dlndeposit (-1)	4.839602	2.634982	1.836673	0.0759
dlninflation_expectation	-0.897396	0.452068	-1.985091	0.0560
dlninflation_expectation (-1)	-0.193954	0.545811	-0.355351	0.7247
dlninflation_expectation (-2)	-0.708221	0.566969	-1.249136	0.2210
dlninflation_expectation (-3)	-1.009430	0.394022	-2.561858	0.0155
dlninterest_rate	-0.814477	0.785195	-1.037293	0.3076
dlninterest_rate (-1)	-0.159228	0.726860	-0.219062	0.8280
dlninterest_rate (-2)	2.421489	1.121983	2.158223	0.0388
dlninterest_rate (-3)	0.745252	1.332372	0.559343	0.5799
dlninterest_rate (-4)	2.708201	1.015043	2.668064	0.0120
dlnliquid_asset	-0.000610	1.006230	-0.000606	0.9995
dlnliquid_asset (-1)	-1.862672	0.887418	-2.098980	0.0441
dlnliquid_asset (-2)	-1.362469	0.503125	-2.708011	0.0109
Dlnnpl	0.838444	0.315943	2.653783	0.0124**
C	0.776507	1.864106	0.416557	0.6799
Model Criteria				
Residue Square	0.864695			
Square Of The Modified Residuals	0.815921			
F-Statistics	2.671881			
Plausibility (F-statistics)	0.000667**			

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The data in Table 3 show that, as can be seen from the ARDL coefficients, the volume of commercial bank loans to small businesses is positively affected by the interest rate on commercial bank deposits and the problem loans of commercial banks. However, the increase in the volume of commercial bank loans to small businesses is mainly caused by the increase in the interest rate on commercial bank deposits and the problem loans of commercial banks. With other factors remaining unchanged (*seteris paribus*), an increase in the interest rate on commercial bank deposits by one percent will lead to an increase in the volume of commercial bank loans to small businesses by 0.73 percent. Also, an increase in the volume of problem loans of commercial banks by one percent will lead to a decrease in the volume of commercial bank loans to small businesses by 0.83 percent. It is clear from this that the increase in the volume of commercial bank loans to small businesses is directly proportional to the increase in the volume of problem loans of commercial banks.

Since the program used automatically selects the most optimal one from the distributed lags based on the Schwarz criterion [15], we consider the Schwarz criterion coefficients for the lag combination (Figure 3).

Akaike Information Criteria (top 20 models)

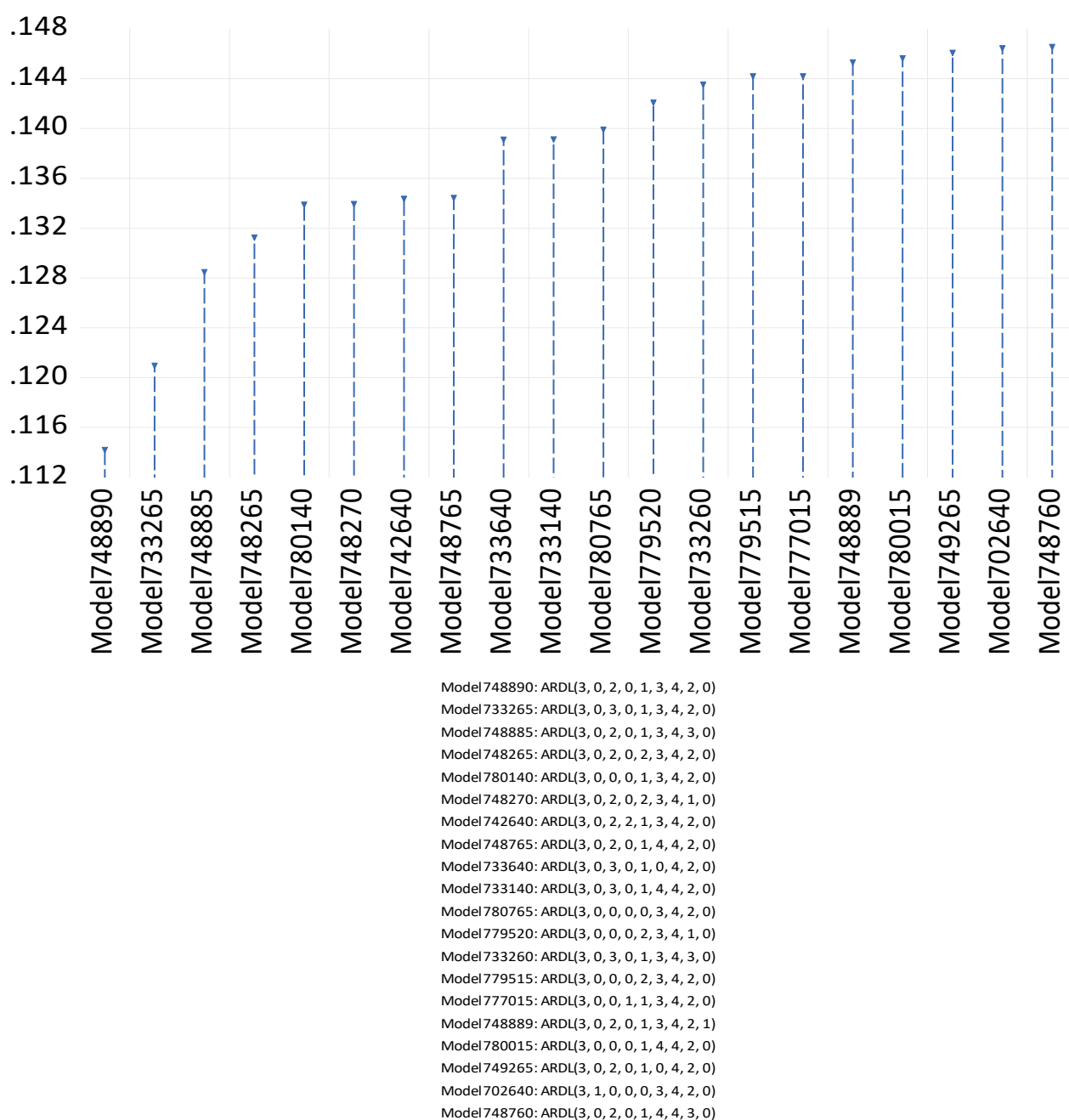


Figure 1. Schwarz criterion (top 20 models)⁴

⁴ Prepared by the author using Eviews-12.0 software based on data from the Central Bank of the Republic of Uzbekistan.

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Like the Akaike and Hanna-Quinn criteria, the Schwarz criterion selects the model with the smallest value. As can be seen from Figure 1, the (ARDL) lag distribution with the smallest value, that is, the most optimal model choice, is the lag with the combination distribution (3, 0, 2, 0, 1, 3, 4, 2, 0), and the result in Table 3 above is based on this distribution.

In order to achieve a perfect and detailed result in econometric analysis, it is advisable to check the short-term and long-term dependence in the ARDL model. To conduct a short-term dependence test, we introduce the elements of the error correction mechanism into the econometric model and bring it to the following form:

$$\begin{aligned} \ln loans_t = & \alpha_0 + \sum_t^p \alpha_1 \ln deposit_interest_rate_{t-i} + \sum_t^q \alpha_2 \ln profit_{t-i} + \sum_t^q \alpha_3 \ln capital_{t-i} + \sum_t^q \alpha_4 \ln deposit_{t-i} \\ & + \sum_t^q \alpha_5 \ln inflation_expectation_{t-i} + \sum_t^q \alpha_6 \ln inflation_expectation_{t-1} + \sum_t^q \alpha_7 \ln liquidity_asset_{t-1} \\ & + \sum_t^q \alpha_8 \ln npl_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \end{aligned}$$

Here;

α_0 – constant, ε_t – standard error, $\alpha_1, \dots, \alpha_6$ – short-term coefficient, $\beta_1, \dots, \beta_5$ – long-term elasticity, ECM – error correction coefficient, γ – rate of change (coefficient of variation).

Table 4: Cointegration form and short-run dependence test⁵

Variables	Coefficient	Standard Error	F-Statistics	Plausibility
C	0.776507	1.612508	0.481552	0.6335
<i>lnloans</i> (-1)*	-0.266068	0.166923	-1.593957	0.1211
<i>lndeposit_interest_rate</i> **	0.730321	0.353464	2.066180	0.0473
<i>lnprofit</i> (-1)	-0.045504	0.088709	-0.512959	0.6116
<i>dlncapital</i> **	-0.570674	4.563119	-0.125062	0.9013
<i>dlndeposit</i> (-1)	2.060875	3.761403	0.547901	0.5877
<i>dlninflation_expectation</i> (-1)	-2.809001	1.698064	-1.654237	0.1082
<i>dlninterest_rate</i> (-1)	4.901237	3.273745	1.497134	0.1445
<i>dlnliquid_asset</i> (-1)	-3.225751	1.398354	-2.306820	0.0279
<i>dlnnpl</i> **	0.838444	0.462327	1.813530	0.0094
$\partial(\ln loans(-1))$	-0.541513	0.182851	-2.961504	0.0058
$\partial(\ln loans(-2))$	-0.541615	0.161115	-3.361669	0.0021
$\partial(\ln profit)$	-0.022161	0.076230	-0.290708	0.7732
$\partial(\ln profit(-1))$	0.108585	0.066072	1.643416	0.1104
$\partial(\ln deposit)$	-2.778726	2.773083	-1.002035	0.3241
$\partial(\ln inflation_expectation)$	-0.897396	0.583638	-1.537592	0.1343
$\partial(\ln inflation_expectation(-1))$	1.717651	0.907544	1.892636	0.0678
$\partial(\ln inflation_expectation(-2))$	1.009430	0.523139	1.929564	0.0629
$\partial(\ln interest_rate)$	-0.814477	1.245350	-0.654015	0.5179
$\partial(\ln interest_rate(-1))$	-5.874942	2.254097	-2.606340	0.0139
$\partial(\ln interest_rate(-2))$	-3.453453	1.794196	-1.924791	0.0635
$\partial(\ln interest_rate(-3))$	-2.708201	1.341460	-2.018846	0.0522
$\partial(\ln liquid_asset)$	-0.000610	0.957940	-0.000636	0.9995
$\partial(\ln liquid_asset(-1))$	1.362469	0.518258	2.628938	0.0132
$ec = \ln loans - (2.7449 * \ln deposit_interest_rate - 0.1710 * \ln profit - 2.1448 * \ln capital + 7.7457 * \ln deposit - 10.5575 * \ln inflation_expectation + 18.4210 * \ln interest_rate - 12.1238 * \ln liquid_asset + 3.1512 * \ln npl - 2.9185)$				

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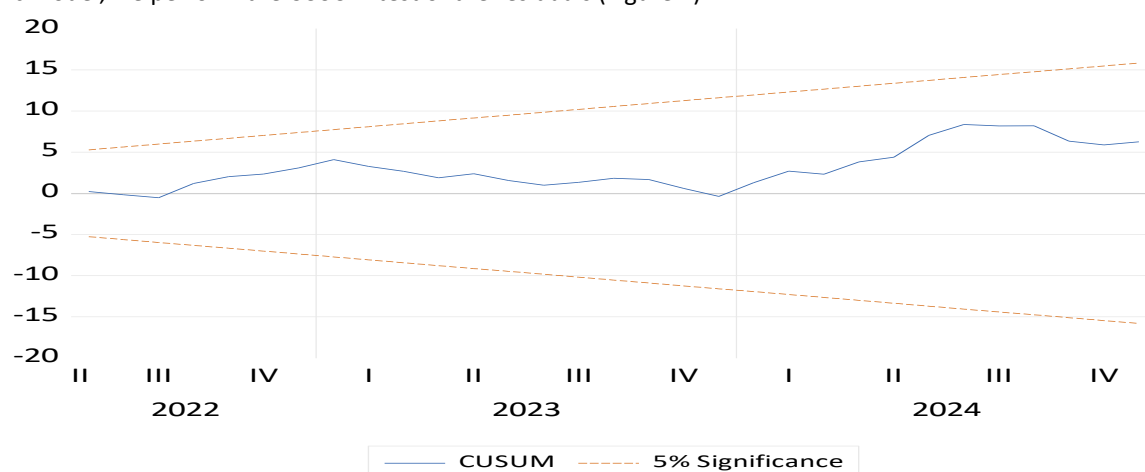
Based on the data in Table 4, we conducted a cointegration form and short-term correlation test. After the errors are corrected, the growth of commercial bank loans to business entities is positively affected by the independent variables of the interest rate on commercial bank deposits and the increase in commercial bank problem loans. Based on the hypothesis test, the coefficients of the interest rate on commercial bank deposits and the increase in commercial bank problem loans are positively significant with a probability value of 0.0000. The coefficient of the interest rate on commercial bank deposits is 0.0473, indicating a 95% confidence level. In addition, the coefficient of the problem loans of commercial banks is 0.0094, indicating a 99% confidence level. The error correction coefficient $\text{CointEq}(-1)$ has a probability value of 0.0000, and the confidence level of the coefficient is 99 percent. The error correction coefficient means that the deviation from the long-term to the short-term is corrected by 99 percent every quarter. The coefficient $\text{CointEq}(-1)$ of -2.9185 indicates that the deviation from the long-term to the short-term is corrected by 2.91 percent. The short-term correlation test shows that the growth of commercial bank loans to small business entities is associated with the interest rate on commercial bank deposits and commercial bank non-performing loans. The fact that these variables have a long-term correlation is shown in the table below (Table 5).

Table 5: Long-term dependency test⁶

Variables	Coefficients	Standard Error	F-statistics	Plausibility
LNDEPOSIT_INTEREST_RATE	2.744867	2.959234	0.927560	0.3608
LNPROFIT	-0.171025	0.521736	-0.327799	0.7453
DLNCAPITAL	-2.144845	14.54280	-0.147485	0.8837
DLNDEPOSIT	7.745672	25.01016	0.309701	0.7589
DLNINFLATION_EXPECTATION	-10.55746	11.78231	-0.896043	0.3771
DLNINTEREST_RATE	18.42100	15.14592	1.216235	0.2331
DLNLIQUID_ASSET	-12.12378	16.27969	-0.744718	0.4621
DLNNPL	3.151241	3.048171	1.033814	0.3092
C	2.918453	4.576047	0.637767	0.5283

*** indicates statistical significance at 1%, ** indicates statistical significance at 5%, * indicates statistical significance at 10%.

The data in Table 5 show that the long-term correlation test showed some variation in the impact of the factors. In particular, the increase in the volume of commercial bank loans to small businesses is not affected by the increase in the interest rate on commercial bank deposits and the increase in problem loans of commercial banks, which is not statistically significant. The coefficients of these indicators are statistically insignificant, and we can see that the effect of these coefficients is not present even at the 99% confidence level. As can be seen from the econometric model, the selected variables have only a short-term correlation, and therefore provide the opportunity to forecast in the short term. In order to check the robustness of our econometric model, we perform the CUSUM test of the residuals (Figure 2).



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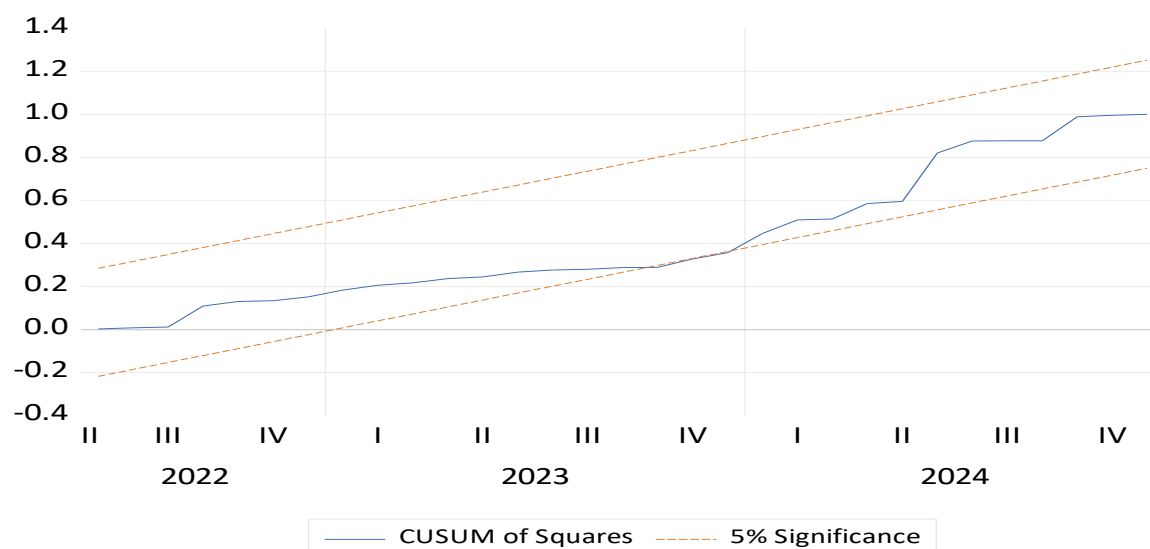


Figure 2. CUSUM test of the total sum of residuals⁷

As can be seen from the CUSUM test [16], the total sum of the residuals of the variables is stable. In addition, the sum of the squares of the residuals of the variables is also stable. Because the interval of the residuals does not go beyond the interval of statistical significance of five percent. The econometric model formed based on the results of the CUSUM test can only make short-term forecasts.

In conclusion, it can be said that the result of the in-depth econometric analysis conducted in the autoregressive distributed lag (ARDL) model was the study of the effect of the interest rate on commercial bank deposits and problem loans of commercial banks, which are arbitrary variables, on the growth of commercial bank loans to small business entities. As a result, with other factors remaining unchanged (*seteris paribus*), an increase in the interest rate on commercial bank deposits by 1 percent leads to an increase in the volume of commercial bank loans to small business entities by 0.73 percent. Also, an increase in problem loans of commercial banks by 1% will lead to an increase in the volume of commercial bank loans to business entities by 0.83%. As can be seen from our research, it is necessary to pay attention to the resolution of short-term problem loans of commercial banks, taking into account the short-term importance of short-term deposit interest rates and liquidity assets, and we believe that monetary policy and bank liquidity management strategies should be closely linked with credit policy in order to effectively influence the volume of commercial bank loans to business entities in the economy.

Based on the developed econometric model, we make a forecast of the volume of commercial bank loans to business entities until 2030.

Table 6: Forecast of the growth trend of the volume of commercial bank loans to business entities, billions of soums [17]

<i>Years</i>	<i>The Volume Of Loans Allocated By Commercial Banks To Small Businesses</i>	<i>Volume Of Non-Performing Loans (NPL)</i>	<i>Average Interest Rates On Bank Deposits</i>
2024	92 424,8	21 185,00	19,60
2025	93 866,63	22 943,36	21,03
2026	95 330,95	24 847,65	22,57
2027	96 818,11	26 910,01	24,21
2028	98 328,47	29 143,54	25,98
2029	99 862,40	31 562,45	27,88
2030	101 420,25	34 182,14	29,91

As can be seen from the data in Table 6, the volume of loans granted by commercial banks to small businesses is on an upward trend and is expected to reach 101,420.25 billion soums in 2030. We can see that this figure is expected to increase by 9.7% compared to 2024. As a result of the increase in the volume of loans granted by commercial banks to small businesses, the

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volume of non-performing loans (NPL) in commercial banks is expected to increase by 1.61 times and the average interest rates on commercial bank deposits are expected to increase by 52%. Therefore, the volume of loans granted by commercial banks to small businesses will lead to an increase in the volume of non-performing loans (NPL) in commercial banks and the average interest rates on commercial bank deposits.

CONCLUSION

The scientific innovation is based on the proposal to forecast the growth of loans granted by commercial banks to small businesses until 2030 based on the autoregressive distributed lag (ARDL) econometric model. As a result of the practical implementation of this scientific result, the long-term and short-term impact of the average interest rate on commercial bank deposits and problem loans on the growth of loans granted by commercial banks to small businesses was assessed. As a result, with other factors remaining unchanged (*seteris paribus*), an increase in the interest rate on commercial bank deposits by 1 percent leads to an increase in the volume of commercial bank loans to small businesses by 0.73 percent. It is also justified that the increase in problem loans of commercial banks by 1 percent and the increase in the volume of commercial bank loans to business entities by 0.83 percent.

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