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Econometary Analysis of the Impact of Loans on Small Businesses on Macroeconomic Indicators through Ardl Model

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Abstract: The article provides an econometric analysis of the increase in bank lending and its impact on the country's macroeconomic performance through the ARDL model. In addition, the relevant conclusions were drawn from the analysis and recommendations were made on how to increase the volume of lending to small businesses in the future.

Key words: credit, ARDL model, GDP, deflator, exchange rate.

Introduction. The level of economic development of any country is an indication of the level of development of entrepreneurship in that country. World experience shows that the most important factor in the sustainable development of the country's economy, increasing employment and income is the development of entrepreneurship. It is no secret that the rapid development of the economy is determined by the growing share of small business and private entrepreneurship, and the growing share of small business and private entrepreneurship, in turn, contributes to the creation of entrepreneurship in the country. depends on the environment in many ways. Today, the share of small business and private entrepreneurship in the country's GDP is 55,7%[7]. “More than 13 trillion soums of soft loans have been allocated to cover more than 600,000 families in the country as part of a number of social programs aimed at attracting the general population to entrepreneurship and expanding their sources of income [1]” are big steps towards small business development.

The relevance of the topic. According to the International Monetary Fund, “Today, 90 percent of the world's businesses are small and medium-sized businesses, employing 63 percent of the world's population. Across the EU, small and medium-sized businesses account for 99.8% of the total, employing two-thirds of the population [8]”. Also, the majority of small businesses in the world operate as a family business. Family businesses produce 40-50 percent of their gross national product in Europe, 65 to 82 percent in Asia, and about 70 percent in Latin America. Its share in the U.S. economy is more than 95 percent [2]. Based on the above, the share of small business in the development of the country and employment is very large.

Timely financing of small business and private entrepreneurship is very important for its development. According to the experience of developed countries, the main direction of business financing is lending by commercial banks. Today, the competitive environment is improving for commercial banks to provide and offer advanced innovative banking services for the full support and development of business entities and lending. In addition, the complex mechanisms for reviewing loan applications for small businesses, in particular the human factor, the lack of automation of the system, limits the ability to obtain loans quickly, and the lack of resources for loans to small businesses and their solutions. requires scientific research.

A number of foreign and domestic scientists have conducted research on the econometric analysis

of lending and growth of small business and private entrepreneurship, and formed relevant conclusions, developed scientific proposals and practical recommendations.

According to economists F.Allen and D.Gale, there are two systems of financing small and medium-sized businesses - a system based on the activities of banks and a system based on financial markets, emphasizing the relative importance of the first system [3]. This conclusion by F. Allen and D. Gale is of great practical importance for countries in transition. This is due, firstly, to the fact that commercial banks have a leading position in the system of small business lending in these countries; second, it is not possible for small businesses to raise resources through the stock market. The introduction of this system will increase lending opportunities in banks and increase the resource base.

Economist Hernan Ortiz-Molina and Maria Fabiana Penas support the hypothesis that short-term loans serve to alleviate debt risk and problems with asymmetric data specific to small business lending. For firms with a negative credit history, large and inexperienced, it is recommended to set a shorter period [4].

The autoregressive distributed delay (ARDL) model used in our study has also been used to model the relationship between (economic) variables for decades in a single equation of time series, according to economists Engle and Granger, Hassler, and Wolters. used in their work. Its popularity is also due to the fact that the cointegration of non-stationary variables is equal to the error correction process, and the ARDL model is used in the form of EC [5]. The ARDL model is useful for forecasting and distinguishing long-term relationships from short-term dynamics.

The analytical part of this article examines the impact of macroeconomic indicators and the number of small businesses and the growth of loans to it in 2012-2021.

Taking into account the mathematical and economic indicators and characteristics of the selected indicators, it was decided to build econometric modeling using the ARDL (Autoregressive distributed lag model) method with extensive auxiliary tests. All channels of influence are taken into account in the selection of indicators that affect the development of small and medium-sized businesses in the local economy. The econometric model is described as follows:

Research results and their discussion. ARDL - An autoregressive distributed delay model is typically used to analyze dynamic relationships with time interval data within an equation. The current value of the dependent variable is allowed to depend on its past sales - the autoregressive part, as well as the current and past values of the additional explanatory variables - the part of the distributed delay. Variables can be stationary, non-stationary, or a mixture of two types. In equilibrium correction, the ARDL model can be used to distinguish between long-term and short-term effects and to examine cointegration or, in general, the existence of long-term relationships between variables. Based on these information criteria, the ARDL model can be used to evaluate the optimal number of delays. This test is performed as a postestimation command “estat ectest” containing the newly calculated finite sample critical values and approximate p-values. These important values cover a wide range of model configurations and replace previous tables available in the literature. They are performed by selecting the sample size, the selected delay order, the number of explanatory variables, and the components of the unlimited or limited deterministic model. The ARDL command uses Stata's regression command to evaluate the model. As a result, specification tests can be performed with standard follow-up evaluation commands for linear (time series) regressions, and a set of forecast commands can be used to obtain dynamic predictions.

Table 1 Macroeconomic indicators and loans to small businesses and their growth dynamics[6,7]

Years	Share of small business in GDP	Loans allocated by commercial banks to small business entities (billion soums)	Exchange rate	Number of small business enterprises	GDP deflator
	Y	X_1	X_2	X_3	X_4
2012	60,8	5346	1984	198649	21,62651
2013	60,9	7000	1985,46	206146	15,39879
2014	61,9	9200	2202,2	213643	11,98789
2015	64,6	12100	2573,48	221140	14,02492
2016	66,8	15900	2968,9	225998	10,5007
2017	65,3	19600	5140,29	225560	8,930368
2018	62,4	30648,8	8069,05	242379	19,06181
2019	56	55430	8851,36	276232	26,98286
2020	55,7	48389,7	9999,15	419490	17,91
2021	60	55400	10476,92	503538	11,9008

An analysis of the data in Table 1 shows that the country's GDP and the volume of loans to small businesses also showed an upward trend. We can see that the exchange rate has risen accordingly, but we can still see that the GDP deflator has decreased. We will use the data in this table in the analysis we intend to perform.

Long-term relationships: Although some time series are interconnected due to equilibrium forces, individual time series can shift significantly.

ARDL (p, q, . . , q) model:

$$y_t = c_0 + c_1 t + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{i=0}^{q} \beta_i' \mathbf{x}_{t-i} + u_t,$$

$p \geq 1$, $q \geq 0$,

where q is the order of delay, K × 1 is the same for all variables in the vector xt.

The following are used for testing:

including (1-L) y for 2 lag

model: (1-L) y = b0 + (a-1) * y (-1) + ... + e

points for (a - 1): -2.00615

test statistics: tau_c (1) = -6.50852

assimp. p-value 6,518e-09

coefficients. 1st order autocorrelation for e: -0.759

delay for differences: F (2, 3) = 37,368 [0.0076]

The following are used in the calculation of constant and trend:

including (1-L) y for 2 lag.

model: (1-L) y = b0 + b1 * t + (a-1) * y (-1) + ... + e.

estimate for (a - 1): -2,15636.

test statistics: tau_ct (1) = -5,27562.

assimp. p-value 5.04e-05.

coefficients. 1st order autocorrelation for e: -0.784.

delay for differences: F (2, 2) = 19,130 [0.0497]

Table 2 Calculation table

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Variable	Obs	Mean	Std. Dev.	Min	Max
A	10	2016.5	3.02765	2012	2021
y	10	61.44	3.652457	55.7	66.8
x1	10	25901.45	20164.06	5346	55430
x2	10	5425.081	3550.864	1984	10476.92
x3	10	273277.5	103400.2	198649	503538
x4	10	15.83247	5.601665	8.930368	26.98286

In Table 2, we present the minimum and maximum values and deviations of the years under analysis, which can be realized over a period of 10 years.

Let's take a look at the effects of variables in our research

A general information.

	Percentiles	Smallest		
1%	2012	2012		
5%	2012	2013		
10%	2012.5	2014	Obs	10
25%	2014	2015	Sum of Wgt.	10
50%	2016.5	Mean	2016.5	
Largest		Std. Dev.	3.02765	
75%	2019	2018		
90%	2020.5	2019	Variance	9.166667
95%	2021	2020	Skewness	0
99%	2021	2021	Kurtosis	1.775758

Variable "Y" - the impact on the share of small businesses in GDP.

	Percentiles	Smallest		
1%	55.7	55.7		
5%	55.7	56		
10%	55.85	60	Obs	10
25%	60	60.8	Sum of Wgt.	10

50%	61.4	Mean	61.44	
	Largest	Std. Dev.	3.652457	
75%	64.6	62.4		
90%	66.05	64.6	Variance	13.34044
95%	66.8	65.3	Skewness	-.2631437
99%	66.8	66.8	Kurtosis	2.160107

Variable X1 - Impact of loans provided by commercial banks to small businesses (billion soums).

	Percentiles	**Smallest**		
1%	5346	5346		
5%	5346	7000		
10%	6173	9200	Obs	10
25%	9200	12100	Sum of Wgt.	10
50%	17750	Mean	25901.45	
	Largest	Std. Dev.	20164.06	
75%	48389.7	30648.8		
90%	55415	48389.7	Variance	4.07e+08
95%	55430	55400	Skewness	.5559869
99%	55430	55430	Kurtosis	1.647104

Variable X2 is the effect of the exchange rate.

	Percentiles	**Smallest**		
1%	1984	1984		
5%	1984	1985.46		
10%	1984.73	2202.2	Obs	10
25%	2202.2	2573.48	Sum of Wgt.	10
50%	4054.595	Mean	5425.081	
	Largest	Std. Dev.	3550.864	
75%	8851.36	8069.05		
90%	10238.04	8851.36	Variance	1.26e+07
95%	10476.92	9999.15	Skewness	.3410917
99%	10476.92	10476.92	Kurtosis	1.37168

Variable X3 is the number of small businesses

	Percentiles	Smallest		
1%	198649	198649		
5%	198649	206146		
10%	202397.5	213643	Obs	10
25%	213643	221140	Sum of Wgt.	10
50%	225779		Mean	273277.5
	Largest		Std. Dev.	103400.2
75%	276232	242379		
90%	461514	276232	Variance	1.07e+10
95%	503538	419490	Skewness	1.485145
99%	503538	503538	Kurtosis	3.618686

Variable X4 is the GDP deflator

	Percentiles	Smallest		
1%	8.930368	8.930368		
5%	8.930368	10.5007		
10%	9.715534	11.9008	Obs	10
25%	11.9008	11.98789	Sum of Wgt.	10
50%	14.71186		Mean	15.83247
	Largest		Std. Dev.	5.601665
75%	19.06181	17.91		
90%	24.30469	19.06181	Variance	31.37865
95%	26.98286	21.62651	Skewness	.6793378
99%	26.98286	26.98286	Kurtosis	2.540106

In the first stage of the analysis, we decided to obtain the main characteristics of the collected data set, which will allow us to make a decision on the choice of model.

We performed a multi-step analysis to determine the interaction of the variables. They are as follows:

ARDL model analysis. Model 1: MNK, observations used 2012-2021 (T = 10) Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	5,91574	0,655310	9,027	0,0003	***
l_x1	0,00088	0,0599354	0,01480	0,9888	
l_x2	0,01309	0,0746347	0,1755	0,8676	
l_x3	−0,126255	0,0657133	−1,921	0,1127	
l_x4	−0,126950	0,0366654	−3,462	0,0180	**

Srednee zavis. peremen	4,116449		St. otkl. zavis. perem	0,060055
Summa kv. ostatkov	0,006413		St. oshibka modeli	0,035814
R-kvadrat	0,802419		Isprav. R-kvadrat	0,644354
F(4, 5)	5,076521		R-znachenie (F)	0,052163
Log. pravdopodobie	22,57047		Krit. Akaike	−35,14095
Krit. Shvarsa	−33,62802		Krit. Xennana-Kuinna	−36,80062
parametr rho	−0,287180		Stat. Darbina-Uotsona	2,442436

We performed the analysis of the ARDL model through several step-by-step attempts. Such conclusions can be drawn from the analysis performed above. In other words, the increase in lending to small businesses led to an increase in GDP by 0,00088 while the GDP deflator decreased by 0,126950.

Model 2: MNK, observations used 2013-2021 (T = 9)

Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	5,20380	1,60373	3,245	0,0315	**
l_x1	0,0898304	0,114633	0,7836	0,4771	
l_x2_1	−0,119990	0,205398	−0,5842	0,5905	
l_x3	−0,0564028	0,165918	−0,3399	0,7510	
l_x4	−0,106710	0,0792919	−1,346	0,2496	

Srednee zavis. peremen	4,117434		St. otkl. zavis. perem	0,063612
Summa kv. ostatkov	0,005284		St. oshibka modeli	0,036347
R-kvadrat	0,836756		Isprav. R-kvadrat	0,673513
F (4, 4)	5,125815		R-znachenie (F)	0,071245
Log. pravdopodobie	20,71048		Krit. Akaike	−31,42097
Krit. Shvarsa	−30,43485		Krit. Xennana-Kuinna	−33,54902
parametr rho	−0,526754		Stat. Darbina-Uotsona	2,906401

In Phase 2 of the ARDL model analysis, it was found that a 1% increase in the exchange rate variable X2 would result in a decrease in GDP by ,0.119990 units. It also caused small business entities to decrease by −0.0564028, while the GDP deflator also decreased by −0.106710. It can be concluded that the increase in the exchange rate will lead to a decline in macroeconomic indicators in the country.

Model 3: MNK, observations used 2013-2021 (T = 9)

Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	3,40999	1,78374	1,912	0,1285	
l_x1	0,155747	0,0862300	1,806	0,1452	
l_x2_1	−0,266871	0,145534	−1,834	0,1406	
l_x3_1	0,118111	0,167649	0,7045	0,5200	
l_x4	−0,0378414	0,0783040	−0,4833	0,6542	

Srednee zavis. peremen	4,117434		St. otkl. zavis. perem	0,063612
Summa kv. ostatkov	0,004837		St. oshibka modeli	0,034774
R-kvadrat	0,850581		Isprav. R-kvadrat	0,701162
F(4, 4)	5,692583		R-znachenie (F)	0,060306
Log. pravdopodobie	21,10868		Krit. Akaike	−32,21736

Krit. Shvarsa	−31,23124		Krit. Xennana-Kuinna	−34,34541
parametr rho	−0,390572		Stat. Darbina-Uotsona	2,751489

In Phase 3 of the ARDL model analysis, we increased the variables X2 and X3 by 1% (1 lag) to obtain the following. GDP increased by 0.155747, the number of small businesses increased by 0.118111, and the GDP deflator decreased by 00.0378414.

Model 4: MNK, observations used 2013-2021 (T = 9)

Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	3,00437	0,724492	4,147	0,0143	**
l_x1	0,0891753	0,0711009	1,254	0,2781	
l_x2_1	−0,200750	0,0931174	−2,156	0,0973	*
l_x3_1	0,167741	0,0682764	2,457	0,0699	*
l_x4_1	−0,0707022	0,0374147	−1,890	0,1318	

Srednee zavis. peremen	4,117434		St. otkl. zavis. perem	0,063612
Summa kv. ostatkov	0,002705		St. oshibka modeli	0,026004
R-kvadrat	0,916447		Isprav. R-kvadrat	0,832894
F (4, 4)	10,96847		R-znachenie (F)	0,019777
Log. pravdopodobie	23,72442		Krit. Akaike	−37,44885
Krit. Shvarsa	−36,46272		Krit. Xennana-Kuinna	−39,57690
parametr rho	−0,335335		Stat. Darbina-Uotsona	2,624245

In Phase 4 of the ARDL model analysis, we increased the variables X2, X3, and X4 by 1 percent (1 lag) to obtain the following results. GDP increased by 0.0891753, the number of small businesses increased by 0.167741, and the GDP deflator decreased by −0.0707022.

Model 5: MNK, observations used 2013-2021 (T = 9)

Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	3,50139	0,687158	5,095	0,0070	***
l_x1_1	0,0565456	0,0436025	1,297	0,2644	
l_x2_1	−0,150692	0,0536723	−2,808	0,0484	**
l_x3_1	0,127216	0,0667707	1,905	0,1294	
l_x4_1	−0,0959081	0,0277514	−3,456	0,0259	**

Srednee zavis. peremen	4,117434		St. otkl. zavis. perem	0,063612
Summa kv. ostatkov	0,002653		St. oshibka modeli	0,025753
R-kvadrat	0,918047		Isprav. R-kvadrat	0,836093
F(4, 4)	11,20206		R-znachenie (F)	0,019048
Log. pravdopodobie	23,81140		Krit. Akaike	−37,62280
Krit. Shvarsa	−36,63668		Krit. Xennana-Kuinna	−39,75085
parametr rho	−0,277678		Stat. Darbina-Uotsona	2,521071

In Phase 5 of the ARDL model analysis, we increased the variables X1, X2, X3, and X4 by 1 percent (1 lag) to obtain the following results. The increase in GDP by 0.0565456 will reduce the number of small businesses by 0.127216, the GDP deflator by −0.0959081 and the exchange rate by −0.150692. From this we can conclude that increasing lending to small businesses by 1% and the number of small businesses by 1% will have a positive impact on improving macroeconomic performance.

Model 6: MNK, observations used 2013-2021 (T = 9)

Dependent variable: l_y

	Koeffitsient	*St. oshibka*	*t-statistika*	*p-znachenie*	
const	0,653865	2,26314	0,2889	0,7915	
l_x1_1	0,0522787	0,0402823	1,298	0,2851	
l_x2_1	−0,155988	0,0495881	−3,146	0,0514	*
l_x3_1	0,209443	0,0878482	2,384	0,0973	*
l_x4_1	−0,0461996	0,0457364	−1,010	0,3868	
l_y_1	0,431654	0,329386	1,310	0,2813	

Srednee zavis. peremen	4,117434	St. otkl. zavis. perem	0,063612
Summa kv. ostatkov	0,001687	St. oshibka modeli	0,023715
R-kvadrat	0,947882	Isprav. R-kvadrat	0,861018
F(5, 3)	10,91231	R-znachenie (F)	0,038521
Log. pravdopodobie	25,84827	Krit. Akaike	−39,69654
Krit. Shvarsa	−38,51320	Krit. Xennana-Kuinna	−42,25020
parametr rho	−0,592827	h-statistika Darbina	−11,59024

In Phase 6 of the ARDL model analysis, we increased the variables X1, X2, X3, X4, and U by 1 percent (1 lag) to obtain the following. GDP increased by 0.431654, the number of small businesses increased by 0.209443, the GDP deflator decreased by −0.0461996 and the exchange rate decreased by −0.155988. From this we can conclude that increasing lending to small businesses by 1% and the number of small businesses by 1% will have a positive impact on improving macroeconomic performance.

Conclusion. The following proposals and recommendations were developed as a result of the analysis and conclusions of commercial banks on the increase in lending to small businesses and its impact on macroeconomic indicators:

1. It is known that the increase in lending to small businesses will lead to an increase in GDP in the country;
2. An increase in the number of small businesses has been found to lead to an increase in the number of borrowers from commercial banks;
3. It has been proved that the increase in the volume of loans to small businesses does not lead to an increase in the exchange rate.
4. Small business lending should offer a package of services The package of services should cover the process from the business plan to the repayment of the loan;
5. In lending to small businesses, the bank analyzes demand deposits by number of customers over a period of time and allows them to be used as a resource for lending within its balance;
6. Establishment of a credit management service to control the entire process of registration of disbursed loans and their repayment;
7. Commercial banks should constantly improve their lending mechanisms to small businesses, learning from best international practices;
8. It is necessary to expand the geography of small business locations, because the development of regions leads to an increase in income of the population. To ensure this, commercial banks will need to expand their lending practices to businesses.

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