

INTERRELATION BETWEEN THE INDICATORS OF THE MORTGAGE LENDING MARKET OF THE REPUBLIC OF ARMENIA

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Abstract

The essence of regression analysis is to determine the analytical expression of the correlation, when the observed change in the value of the dependent output is associated with one or more independent factors, in which other dependent factors of magnitude are assumed as constant means. In the article a correlation-regression analysis was carried out and a linear regression equation was obtained the significance of which we assessed on the basis of Fisher's statistics. Checking the statistical significance of the entire equation and using the Student's test, we determined the coefficient of correlation and standard error. In this article we have created a trend line chart and an output forecast chart.

Key words: Mortgage lending rate, independent change, dependent change, coefficient of correlation, regression coefficient, standard curve, medium curve approximations, coefficient autocorrelation.

Introduction

Long-term mortgage lending plays a key role in the whole housing finance system leading to the development of the housing finance system, and, consequently, the economy as a whole. This tool is a link between the banking system and the real sector of the economy, financial and real estate markets, investors and borrowers. It is no coincidence that the development of the mortgage lending system was the main impetus for the economic development of a number of countries, in particular, Roosevelt's New Deal in the United States, Erhard's post-war reforms in Germany, Cavallo's plan in Argentina, and Pinochet's reforms in Chile.

Research objectives

The objectives of the study are to conduct a correlation-regression analysis, identify cause and effect relationship between the effective (mortgage lending volume) and factor indicators (average interest rate on a loan), and also evaluate the quality of the linear regression equation, using various methods.

Research methodology

The study is based on scientific works and analyses on economic and mathematical modeling of Armenian and foreign scientists, and as an information basis - on official reports

published by the Statistical Service and the Ministry of Finance of the Republic of Armenia. Regression analysis was performed using programs installed on the site <https://math.semestr.ru/>, as well as the MS Excel Data Analysis tool, and the results have been summarized in the form of charts and tables.

Research results

Mortgage lending in the Republic of Armenia has been used as a financial instrument since 2004 when the Government of the Republic of Armenia adopted a resolution “On approving the concept of development of the mortgage lending market in the Republic of Armenia”, which states in particular: “There has been a transition to market relations in the Republic of Armenia and the systems of the former management, economic relations and infrastructure development, inherited almost in all sectors of the economy, have fallen into disrepair, which caused the need to study and apply the best practices of developed market economies, advanced approaches to solving economic problems and developments” [1].

In order to improve the conditions of mortgage lending on February 15, 2015, the Government of the Republic of Armenia adopted a decision according to which, in case of mortgage loans for apartments purchased in the primary market, the state reimburses the amount of income tax paid by citizens to the state budget paying interest on a mortgage loan[2].

Income tax refund from the state budget and the chain growth rates of the latter in the Republic of Armenia in 2015-2020 are presented in Fig. 1.

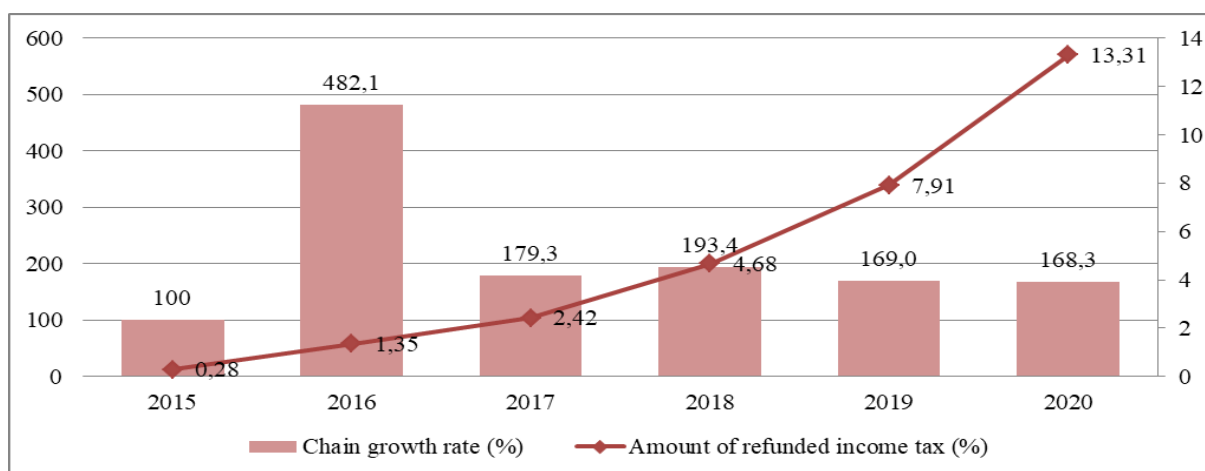


Fig. 1 Income tax refund and chain growth rate in Armenia in 2015-2020 [3]

During the given period about 30 billion drams were returned from the state budget of the Republic of Armenia for interest rates on mortgage loans of citizens. In 2020, compared to the previous year, the amount of returned income tax increased by 5.4 billion drams (68.3%).

In fact, this program has solved its tasks - promoting housing construction and ensuring the availability of mortgage loans. This is explained by the fact that the number of apartment buildings under construction has recently increased sharply in Armenia and real estate prices are rising year by year. However, if this rate continues, “bubbles” may form in the real estate market. We recall that the “bubbles” formed in the United States in 2007 led to the global financial and economic crisis. Currently, there is a steady increase in real estate prices in Armenia. However, when this market is saturated, prices in the real estate market will fall. In addition the increase of mortgage loans years has recently exceeded the increase of household

incomes. As a result, borrowers will not be able to repay their mortgages, leaving mortgaged property to lenders, exacerbating the fall in property prices. To solve this problem, the Government of Armenia approved the draft law “On Amendments to the Tax Code” on August 12.

In particular, the draft proposes to establish that the income tax refund system will not be applicable in the following cases [4]:

- for loans received after July 1, 2022, if the property is located in the first zone of the city of Yerevan,
- for loans received after January 1, 2023, if the property is located in the second zone of the city of Yerevan,
- for loans received after July 1, 2023, if the property is located in the third zone of the city of Yerevan,
- for loans received after January 1, 2025, if the property is located in other areas of the city of Yerevan.

In spite of the fact, that the volume of mortgage lending increased as a result of the application of the income tax privilege, a correlation-regression analysis is not possible through these indicators (data are available only for 7 years), so we have chosen another factor that affects the demand for mortgage lending - the average interest rate by mortgage.

It is known that two types of variables are used in the construction of the regression equation [5]:

1. output variable (y) - describes the result or efficiency of the economic system,
2. explanatory variables (x) - variables that describe the conditions for the functioning of a real economic system.

To get the linear multiple regression equation, we have chosen the following values:

- y - output variable - mortgage loans (billion drams)
- x_1 - independent variable - average mortgage interest rate (%)

The multiple linear regression equation looks like this [6]:

$$y_{1,2,3,\dots,k} = a_0 + a_1x_1 + a_2x_2 + \dots + a_kx_k \quad (1)$$

where $y_{1,2,3,\dots,k}$ are the theoretical values of the output indicator obtained by adding the corresponding factor properties to the regression equation, x_1, x_2, \dots, x_k are factor characteristics, a_1, a_2, \dots, a_k are model parameters: regression coefficients.

The initial data for regression analysis are presented in Fig. 2.

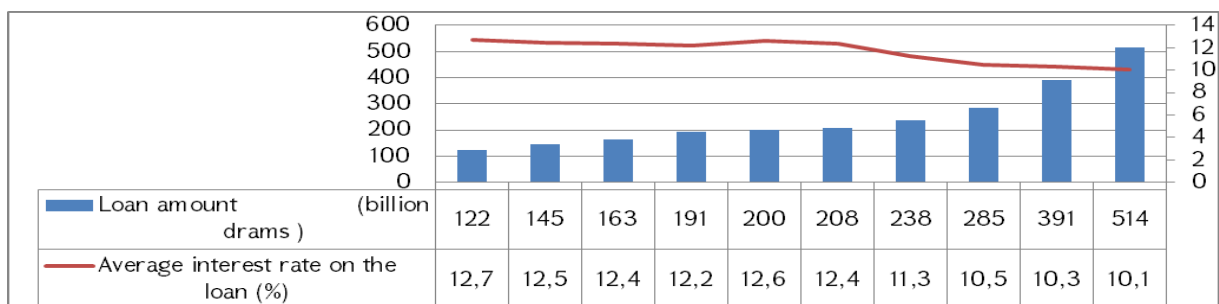


Fig. 2 Initial data for regression analysis in Armenia for 2010-2020 [7]

As a result of the calculations we have got a fairly high correlation indicator of -0.904: this means that the correlation between the volume of mortgage loans and the average interest rate is very strong.

As a result of the calculations we have obtained the following equation with linear regression:

$$y = 1480,75 - 105,55 * x_1 \quad (2)$$

Since a_1 regression coefficient is equal to -105.5, this means that an increase or decrease in the loan interest rate by one percent leads to a decrease or increase in the loan amount by 105.5 billion drams, respectively.

The evaluation of the significance of the regression equation is carried out on Fisher statistics, the statistical significance of the entire equation, as well as the presence or absence of a linear functional relationship between the variables is checked.

If $F > F_{stat.}$, then the coefficient of determination is statistically significant, and the regression equation is statistically reliable.

$$F = \frac{R^2}{1-R^2} \cdot \frac{n-m-1}{m} = \frac{0,817}{1-0,817} \cdot \frac{10-1-1}{1} = 35,714 \quad (3)$$

$$F_{stat.} = 5,32,$$

where n is the number of combination units, m is the number of factors in the regression equation. The number of freedom degrees will be: $df = n - m = 8$.

Since $F > F_{stat.}$, so the coefficient of determination of statistics is significant, the regression equation is statistically reliable.

If the autocorrelation coefficient is $r_{ei} < 0,5$, then there is a reason to assert that there is no autocorrelation.

Now we shall use Student's t-statistics and find the intersection point $\alpha = 0.05$, (95% probability) and $df = 8$: $t_{tab} = 2.306$ ($\alpha = 0.05, df = 8$).

According to t-Student criterion, if the first-order autocorrelation coefficient r_1 is in the following range, then it can be assumed that there is no autocorrelation:

$$-t_{tab} * S_{eY} < r_1 < +t_{tab} * S_{eY} \quad (4)$$

where S_{eY} is the standard error criterion.

The standard error criterion is determined by the following formula:

$$S_{eY} = \frac{1}{\sqrt{n}} = \frac{1}{\sqrt{10}} = 0.316 \quad (5)$$

As in our example $\ll -2,306 * 0,3166 < 0,191 < 2,306 * 0,316$, there is no autocorrelation.

The graph of the linear trend is shown in Fig. 3 (we have performed these and other regression analysis data using the programs installed on the website <https://math.semestr.ru/>, as well as the MS Excel Data Analysis tool).

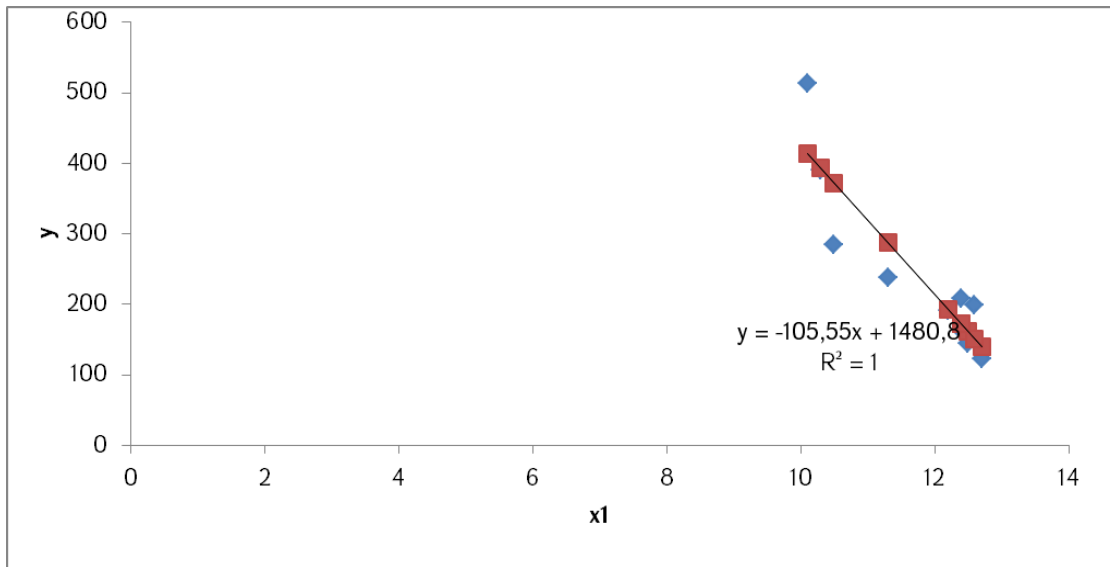


Fig. 3 Graph of the linear trend between the volume of mortgage loans and the average interest rate [7]

We have summarized the main results of the constructed model in the form of Table 1.

Table 1

The main results of the correlation-regression analysis equation

Indicator	Result
Multiple correlation coefficient	-0.904
Relationship between features	Very strong
Number of views:	10
Multiple determination adjusted index (R^2)	0,794
Multiple determination factor (R^2)	0.817
Multiple linear regression equation	$y = 1480,75 - 105,55 * x_1$
Mean approximation error (A)	14.5%
Standard Error Criterion (S_{ey})	0,316
Auto correlation coefficient (r_1)	0,191 (< 0.5), is absent
Fisher statistics (F_{stat})	5,32
Student t-statistics	2,306

Thus (2) the regression equation is estimated as good.

Now we shall make a forecast of the dependent variable for 2021-2026 (Fig. 4).

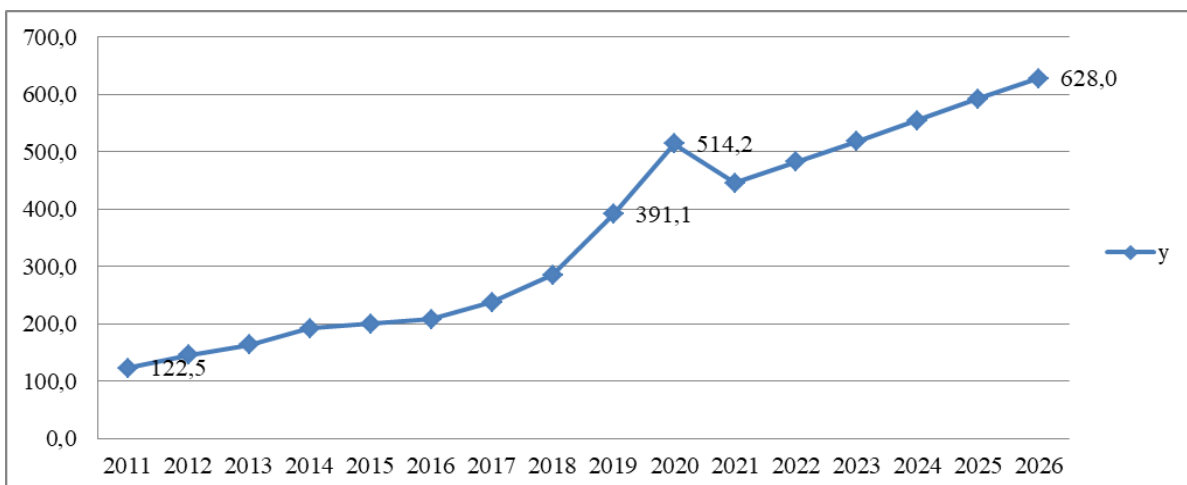


Fig. 4 Forecast of mortgage lending volumes for 2021-2026 (billion drams)

This means that in case of sustainable development of the financial system and economy of Armenia, the mortgage lending market will develop and show a growth trend: in 2026 compared to 2021 by 22.1%.

Conclusion

The analysis shows that the correlation and regression coefficients are quite high between the indicators of volumes on mortgage loans (y), and the average rate on mortgage loans (x), which means that an increase or decrease in interest rates leads to an increase or decrease in mortgage rates. The quality of the equation is evaluated as good, since the parameters of the latter are significant, besides the standard error criterion and the autocorrelation coefficients are within acceptable limits.

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ՀԱՅԱՍՏԱՆԻ ՀԱՆՐԱՊԵՏՈՒԹՅԱՆ ՀԻՓՈԹԵՔԱՅԻՆ ՎԱՐԿԱՎՈՐՄԱՆ ՇՈՒԿԱՅԻ ՑՈՒՑԱՆԻՇՆԵՐԻ ՓՈԽԿԱՊՎԱԾՈՒԹՅԱՆ ՎԵՐԼՈՒԾՈՒԹՅՈՒՆԸ

Ալեքսանյան Ա.Ա.

Հայ-ռուսական համալսարան

Արցախի պետական համալսարան

Ռեգրեսիայի վերլուծության էությունը կապի վերլուծական արտահայտման որոշումն է, երբ դիտարկվող կախյալ արդյունքային մեծության փոփոխությունը կապված է մեկ կամ

մի քանի անկախ գործոնների ազդեցությամբ, և որի դեպքում կախյալ մեծության վրա ազդող մյուս գործոնները ընդունվում են որպես հաստատուն և միջին մեծություններ: Հոդվածում իրականացրել ենք կոռելացիոն-ռեգրեսիոն վերլուծություն, ստացել գծային կապի ռեգրեսիայի հավասարում, որի նշանակալիությունը գնահատել ենք Ֆիշերի վիճակագրի հիման վրա՝ ստուգելով ամբողջ հավասարման վիճակագրական նշանակալիությունը, ինչպես նաև Սթյուդենտի չափանիշի հիման վրա՝ ստուգելով ավտոկոռելացիայի գործակիցը և ստանդարտ սխալը: Հոդվածում կառուցել ենք նաև գծային տրենդի գրաֆիկը և արդյունքային ցուցանիշի կանխատեսումների գրաֆիկը:

Բանալի բառեր. հիփոթեքային վարկավորման շուկա, անկախ փոփոխական, կախյալ փոփոխական, կոռելացիայի գործակից, ռեգրեսիայի գործակից, ստանդարտ սխալ, ապրոքսիմացիայի միջին սխալ, ավտոկոռելացիայի գործակից:

ВЗАИМОСВЯЗЬ МЕЖДУ ПОКАЗАТЕЛЯМИ РЫНКА ИПОТЕЧНОГО КРЕДИТОВАНИЯ РЕСПУБЛИКИ АРМЕНИЯ

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Суть регрессионного анализа заключается в определении аналитического выражения связи, в котором изменение рассматриваемой зависимой резульативной величины связано с влиянием одного или нескольких независимых факторов, а все другие факторы, влияющие на зависимую величину, принимаются за постоянные и средние значения.

В статье был проведен корреляционно-регрессионный анализ, получено уравнение линейной регрессии, значимость которого мы оценили на основе статистики Фишера, проверив статистическую значимость всего уравнения, а также на основе критерия Стьюдента, проверив коэффициент автокорреляции и стандартную ошибку. В статье мы также построили график линейного тренда и график прогнозирования результатов.

Ключевые слова: рынок ипотечного кредитования, независимая переменная, зависимая переменная, коэффициент корреляции, коэффициент регрессии, стандартная ошибка, средняя ошибка аппроксимации, коэффициент автокорреляции.

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