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Determinants of household loans

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Abstract. *Although, with the onset of the global financial and economic crisis, there have been significant changes in the activity of banks in Romania, the level of household indebtedness has remained high until today. This is why this paper analyzes the influence of unemployment rate and Consumer Price Index on household loans in Romania. The analysis is based on monthly time series data during 2008-2015 of loans to households, unemployment rate and Consumer Price Index. To study this dependence, we have opted for a model with an ARMA component, where the influence of unemployment rate and Consumer Price Index manifests itself with a delay (lag) and is expressed by a linear relationship. The model shows that these factors have a significant influence on household loans.*

Keywords: household loans, unemployment rate, Consumer Price Index, determinants of loans.

JEL Classification: E51, D14, C58.

1. Introduction

From 2007 until September 2008, along with the onset of the financial and economic crisis, the amount of household loans increased much to the detriment of the amount of public savings (kept in deposits) and this was accentuated over time during the period. Additionally, in the period between 2008 and 2015, household indebtedness was very high, reaching alarming levels in 2013, when 4.5 million individuals, that is about 50% of Romania's active population, had contracted about 6 million consumer loans and mortgage loans (Mihăiţeanu, 2014). Starting with the Romanian economy's recession, public confidence in the economic situation declined and uncertainty about future incomes increased (Dumitru et al., 2011, p. 16). Therefore, households seek to reduce their indebtedness by placing their savings in deposits, despite deposit interest rates that continue to decrease. Other factors that have stimulated such behavior are: the improvement of the macro-economic environment, the increase of the average nominal wage net, the slight decrease in the unemployment rate, low inflation and the increasing payments to individuals from European funds (FGDB, 2014, p. 35).

In the Romanian specialty literature, there are not many studies that highlight factors influencing household loans. Muraru (2013) has shown that the Consumer Confidence Index, the absolute change calculated with the base chained in the interest rates of loans in Lei, the absolute change calculated with the base chained in the interest rates of loans in Euro and the absolute change calculated with the base chained in the exchange rate are factors affecting the demand for loans to households. Luca (2013) points out that among the factors that have influenced the restriction of the demand for loans, the important ones are: the decreased incomes, the uncertainty of job prospects and high interest rates. Luca (2014) shows that the global financial crises can change the borrowing plans of the population and the high levels of foreign currency loans are due to both banks supply and customer demand. Also, she adds that foreign currency loans were still preferred by households in 2010 in Romania, which was due to favorable interest rate and friendly loan terms for foreign currency loans compared with the local currency ones. Mitroi and Oproiu (2013) emphasize the dependence of the monthly variation of consumption loans on the monthly variation of household income, previous month variation of the loans value and eventually the previous month variation of the population income.

Among the scientific works in foreign literature reflecting on the issue of the article, we mention those that study: factors influencing household access to formal and informal credit in Malawi (Diagne, 1999), determinants of household loans in Spain (Nieto, 2007), determinants of household credit in Italy, separately analyzing credit market supply and demand (Magri, 2007), macroeconomic factors that influence the quality of loans to households in Italy in the last twenty years (Bofondi and Ropele, 2011), determinants of household credit in transition countries by a cross-country analysis (Kraft, 2007), determinants of non-performing loans in the Greek banking sector for consumer loans (Louzis et al., 2012), factors influencing borrowing by urban households in north-eastern Greece (Pastrapa and Apostolopoulos, 2009), determinants of formal and informal rural credit in Vietnam (Barslund and Tarp, 2008), factors affecting loans to households by analyzing a sample of 45 developed and developing countries (Beck et al., 2012), factors

influencing non-performing loans of the household sector by analyzing a sample of countries of the Euro area (Rinaldi and Sanchis-Arellano, 2006).

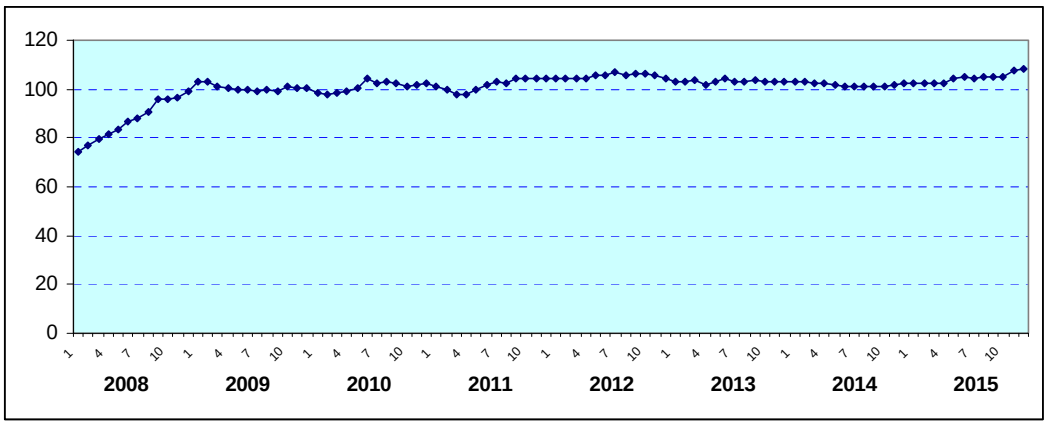
Rubaszek and Serwa (2012) use a life-cycle model with individual income uncertainty to investigate the factors influencing loans to households. They have shown that the determinants of loans are: real interest rate, GDP, interest rate spread (the difference between the lending rate and deposit rate), individual income uncertainty, individual productivity persistence (measured by the coefficient of AR (1) model followed by the logarithm of the idiosyncratic component of productivity) and the generosity of the pension system, and that the implications of the theoretical model are to some degree confirmed by the data for OECD and EU countries.

2. Testing time series stationarity

A time series is stationary if the properties of one section of the data are the same as those of any other section, i.e. if there is no systematic change in mean and variance, and strictly periodic variations have been removed (Chatfield, 2016, p. 13). If a time series is non-stationary, i.e. it exhibits a trend, in order to remove this trend, the difference operator is applied to the original time series to get a new time series (Montgomery et al., 2015, pp. 50-51). In order to study stationarity, the Augmented Dickey-Fuller and Phillips-Perron tests have been used. For data processing, Eviews 9.0 software has been used.

Time series of monthly household loans in Romania for the period 2008-2015 has generally fluctuated (Figure 1). If during January 2008-September 2008 loans to households had a permanent increase, from October 2008 to December 2015, periods of contraction alternated with periods of growth for these loans, period sizes and differences between extreme values being variables. This is due largely to the national and global economic situation (economic crisis, slight economic recovery), and the monetary policy, political factors etc.

Figure 1. *Dynamics of* monthly household loans *in Romania for the period 2008-2015 (billion lei)*



Source: prepared by the authors according to the data in Annex.

To test the stationarity of loans series (CRED), we use the Augmented Dickey-Fuller test that provides us the following information:

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.051247	0.0000
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

*MacKinnon (1996) one-sided p-values.

For the time series of monthly loans, the test value is less than the critical values corresponding to each of relevance levels of 1% , 5% and 10 % , which means that the series is stationary (with a probability greater than 0.99).

By using the Phillip-Perron test, we get the following information on the time series of monthly unemployment rate (R_SOM):

Null Hypothesis: R_SOM has a unit root
Exogenous: Constant
Bandwidth: 5 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.797975	0.3795
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

*MacKinnon (1996) one-sided p-values.

As the probability for the Phillips-Perron test exceeds 5% (0.3795), the series of monthly unemployment rate R_SOM is not stationary. Therefore, the stationarity of the DR_SOM series obtained by its differencing will be tested. After applying the Phillips-Perron test, the software gives the following results:

Null Hypothesis: DR_SOM has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West using Bartlett kernel)

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.495764	0.0004
Test critical values:	1% level	-3.501445	
	5% level	-2.892536	
	10% level	-2.583371	

*MacKinnon (1996) one-sided p-values.

Hence, the first difference of the time series of unemployment rate is stationary.

To test the stationarity of the series of monthly Consumer Price Index in Romania for the period 2008-2015 (IPC), the Augmented Dickey-Fuller test is used, for which we obtain the following information:

Null Hypothesis: IPC has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.439118	0.0119
Test critical values:	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

*MacKinnon (1996) one-sided p-values.

According to the output, the probability associated with this test is 0.0119, below the 0.05 threshold, which means that the series of the monthly Consumer Price Index is stationary.

3. The econometric model

It is believed that the volume of loans during a period (month) depends on the volume of loans during several periods in the recent past (several months earlier) and that dependence is linear, so we have an autoregressive process (AR). Also, the occurrence of sudden and unexpected changes in the external factors correlated with the resultative variable requires a moving average process (MA) to highlight the gradual assimilation of shocks (accidental deviations). Thus, the ARMA component of the model is emerging. An AR model would have been preferred, but the econometric tests and attempts have led to the more general version of this model, namely the ARMA model, whose parameters can be unstable, so it is used in forecasts with some reservations. At the same time, unemployment rate and Consumer Price Index during a period (month) influence the household loans during a subsequent period. As a result of the above, the model form is

$$CP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i CP_{t-i} + \gamma_1 IPC_{t-h_1} + \gamma_2 DRs_{t-h_2} + \varepsilon_t + \sum_{j=1}^{q} \beta_j \varepsilon_{t-j} \quad (1)$$

where:

t = the time expressed in months;

CP_t = the volume of household loans in month t;

IPC_t = the Consumer Price Index in month t;

$DRs_t = Rs_t - Rs_{t-1}$;

Rs_t = the unemployment rate in month t;

h_1 = the delay (lag) in displaying the influence of the Consumer Price Index on household loans;

h_2 = the delay (lag) in displaying the influence of the difference between unemployment rates in two consecutive months on household loans;

α_i = the coefficients of the AR component of model that must be determined, $i = 0,1,\ldots, p$;

β_j = the coefficients of the MA component of model that must be determined, $j = 1,2,\ldots, q$;

γ_1 = the coefficient of Consumer Price Index that must be determined;

γ_2 = the coefficient of the difference between unemployment rates in two consecutive months, that must be determined;

ε_t = the residual variable that has a normal distribution with mean 0 and variance σ^2.

As we have seen before, the time series used in the model are stationary. After analyzing the autocorrelation coefficients and partial correlation coefficients have been identified several types of models. Next, the coefficients of these models have been estimated and tests have been performed on: significance of individual regression coefficients, overall significance of the regression model, autocorrelation in residuals, homoskedasticity, invertibility of ARMA component. Finally, in order to select the best model, the analysis criteria: adjusted R-square, Akaike and Schwartz information criteria have been used.

By proceeding this way, we have chosen a model that has $p = 2$ (AR component order), $q = 1$ (MA component order), $h_1 = 5$ (lag of Consumer Price Index) and $h_2 = 4$ (lag of difference between unemployment rates in two consecutive months):

$$CP_t = \alpha_0 + \alpha_1 CP_{t-1} + \alpha_2 CP_{t-2} + \gamma_1 IPC_{t-5} + \gamma_2 DRs_{t-4} + \varepsilon_t + \beta_1 \varepsilon_{t-1} \quad (2)$$

Estimation of econometric models coefficients is usually performed by the least squares method and the method of maximum likelihood. The model in this study has been estimated by the least squares method.

4. Results and analyses

Using the above mentioned software, has been obtained the following information about the estimation of coefficients and the statistical tests for the model:

Dependent Variable: CRED
Method: Least Squares
Date: 05/10/16 Time: 22:52
Sample (adjusted): 6 96
Included observations: 91 after adjustments
Convergence achieved after 500 iterations
MA Backcast: 5

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3726991.	1302285.	2.861885	0.0053
DR_SOM(-4)	-278017.6	131409.2	-2.115664	0.0373
IPC(-5)	-3805.697	1936.872	-1.964868	0.0527
CRED(-1)	1.734667	0.054449	31.85866	0.0000
CRED(-2)	-0.766886	0.049616	-15.45642	0.0000
MA(1)	-0.980708	0.012754	-76.89603	0.0000

R-squared	0.908818	Mean dependent var	1.02E+08
Adjusted R-squared	0.903455	S.D. dependent var	3531662.
S.E. of regression	1097350.	Akaike info criterion	30.71835
Sum squared resid	1.02E+14	Schwarz criterion	30.88391
Log likelihood	-1391.685	Hannan-Quinn criter.	30.78514
F-statistic	169.4407	Durbin-Watson stat	1.826156
Prob(F-statistic)	0.000000		

Inverted MA Roots	.98

By taking the estimates of the coefficients in the table above, we rewrite the equation (2) as follows:

$$CP_t = 3726991 + 1.7347CP_{t-1} - 0.7669CP_{t-2} - 3805.697IPC_{t-5} - 278017.6DRs_{t-4} +$$

$$+ \varepsilon_t - 0.9807\varepsilon_{t-1} \qquad (3)$$

Since only the probability associated with coefficient $\hat{\gamma}_1 = -3805.697$ (Prob.) does not satisfy the condition of being less than 0.05, but this relevance threshold is exceeded slightly (0.0527), we can accept that the model parameters are significantly different from zero.

The coefficient of determination (R-squared), which has a high value (0.908818), indicates that 90.88% of the endogenous variable variation is determined by the factorial variables in the model, which shows that the factors taken into account are essential. The adjusted coefficient of determination (Adjusted R-squared), which has almost the same meaning, but penalizes the introduction of exogenous variables that have little influence on the endogenous variable (Ohtani, 2000), is also high (0.903455).

The calculated value of the Snedecor-Fisher test (F-statistic) is 169.4407, and the associated probability (Prob(F-statistic)) has a very low value, below the significance threshold of 0.01, so we reject the null hypothesis that all the regression coefficients are zero (excluding constant). Therefore, there is a statistically significant relationship between the endogenous variable and at least one of the exogenous variables.

Also, the ARMA component of the model is invertible, because the roots of the MA characteristic polynomial have modulus less than 1, as shown in the following information:

Inverse Roots of AR/MA Polynomial(s)
Specification: CRED C DR_SOM(-4) IPC(-5) CRED(-1) CRED(-2) MA(1)
Date: 05/10/16 Time: 22:55
Sample: 1 96
Included observations: 91

MA Root(s)	Modulus	Cycle
0.980708	0.980708	

No root lies outside the unit circle.
ARMA model is invertible.

We must also verify that there is no autocorrelation in the errors, and for this purpose we can use the LM test. The test output is the following:

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.358428	Prob. F(2,83)	0.6998
Obs*R-squared	0.608403	Prob. Chi-Square(2)	0.7377

Since the p-value of the chi-square statistic (Prob. Chi-Square) is 0.7377, higher than 0.05, we cannot reject the null hypothesis that there is no serial correlation, which means that no autocorrelation exists in the errors.

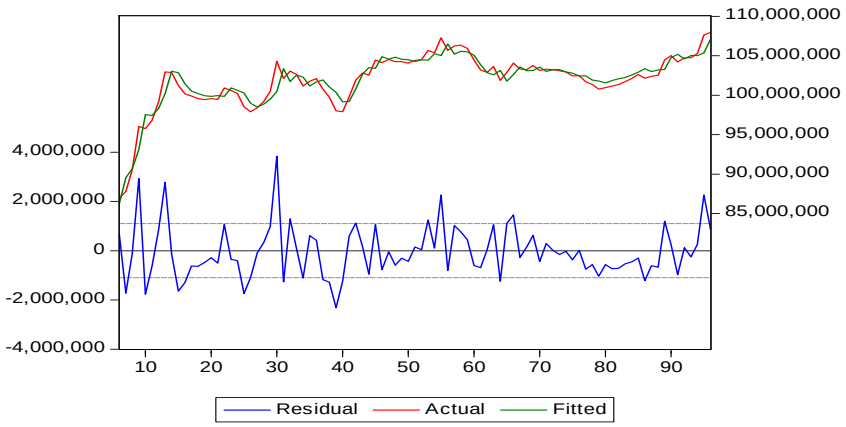
Finally, we must verify that the errors exhibit constant variance (homoskedasticity), and for this we will use the Breusch-Pagan-Godfrey test. The software gives us the following test output:

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	2.175959	Prob. F(4,86)	0.0784
Obs*R-squared	8.363430	Prob. Chi-Square(4)	0.0791
Scaled explained SS	12.57779	Prob. Chi-Square(4)	0.0135

Since the probability of F-statistic (Prob. F) is greater than 0.05 (0.0784), we cannot reject the null hypothesis of homoskedasticity, which means that errors manifest constant variance.

The actual and estimated values of monthly household loans as well as the residual variable values are represented in the figure below:



The statistical analysis performed validates the model and leads to its acceptance. The model shows that the volume of household loans in a month is determined, in a large proportion (over 90 %), by the variation of unemployment rate from 4 months ago, by the Consumer Price Index from 5 months ago and by the volumes of loans to households in the previous two months.

Coefficient estimates of the econometric model (3), $\hat{\gamma}_1 = -3805.697$ and $\hat{\gamma}_2 = -278017.6$, show that there are inverse relationships with both factors, which means that increases in the Consumer Price Index and/or in the absolute change calculated with the base chained in the unemployment rate cause decreases in loans to households. Indeed, an increase in the Consumer Price Index means an increase in prices of the goods purchased and the tariffs for services used by the population, which, while the income remains the same or slightly increases, causes some restraint with regard to loans, in terms that once these loans have been contracted, there could be difficulty in paying the installments. In this situation, a decrease in the volume of loans to households is expected. Also, an increase in the absolute change calculated with the base chained in the unemployment rate means, at least on long-term, a rise in the unemployment rate, and in these circumstances, there is an increase in the number of unemployed, which makes these loans less affordable. Therefore, there is a decrease in the volume of loans to households.

The coefficient estimate of Consumer Price Index ($\hat{\gamma}_1 = -3805.697$) shows that a 1% increase in this economic indicator, i.e. an increase in prices of goods and services consumed by the population by one percent in a month against the previous month, results in a decrease of 3,805,697 lei in loans to households in a month against the previous month, but this occurs with a delay of five months. The other estimate, $\hat{\gamma}_2 = -278017.6$, indicates that an increase of one percent in the monthly variation of the unemployment rate in a month against the previous month produces a decrease of 278,017,600 lei in loans to households in a month against the previous month, but it occurs with a delay of four months.

5. Conclusions

The model shows the dependence of loans to households on Consumer Price Index and the absolute change calculated with the base chained in the unemployment rate. The conditions for validating the correlation between household loans and factorial variables are satisfied: the equation as a whole is significant (the p-value of the F-statistic is very small), the model coefficients are significantly different from zero (only the significance level of a coefficient slightly exceeds the threshold of 0.05), a goodness of fit of the model (the adjusted coefficient of determination is 0.90), the ARMA component of the model is invertible, the errors are not autocorrelated (chi-square statistic probability is greater than 0.05), the error term has the same variance across all values of the independent variables (F-statistics probability is greater than 0.05).

The econometric model of the paper examines the influence of only two macroeconomic factors. To take into account a larger number of determinants of loans to households, one must take into consideration both banks supply and customer demand. A more complex model should also show, in addition to Consumer Price Index and unemployment rate, the influence of other factors, such as: population income (Mitroi and Oproiu, 2013), interest rates of loans in Lei, interest rates of loans in Euro, exchange rate (Muraru, 2013). There are also other influence factors that are harder to quantify, such as the conditions relating to good standing, the range of banking products and services. These issues are brought to our attention and will be the subject of future research.

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Annex

Monthly households loans, monthly unemployment rate and monthly Consumer Price Index in Romania for the period 2007-2015

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2008 - January	74,146,013.5	4.20	132.22
2008 - February	76,672,985.2	4.20	131.30
2008 - March	79,641,976.6	4.10	130.42
2008 - April	81,735,011.6	3.90	129.75
2008 - May	83,251,407.8	3.70	129.12
2008 - June	86,918,173.2	3.70	128.76
2008 - July	87,822,742.9	3.70	127.88
2008 - August	90,558,587.4	3.80	127.99
2008 - September	96,047,389.2	3.90	127.48
2008 - October	95,765,174.2	4.00	126.14
2008 - November	96,825,249.8	4.10	125.74
2008 - December	99,204,665.6	4.40	125.45
2009 - January	102,975,268,5	4.90	123.91
2009 - February	102,889,142.8	5.30	122.84
2009 - March	101,226,625.4	5.60	122.22
2009 - April	100,176,331.9	5.70	121.89
2009 - May	99,900,038.8	5.80	121.87
2009 - June	99,587,066.6	6.00	121.64
2009 - July	99,453,464.9	6.30	121.72
2009 - August	99,571,472.2	6.60	121.94
2009 - September	99,454,957.3	6.90	121.48
2009 - October	100,928,122.8	7.10	120.95
2009 - November	100,599,225.6	7.50	120.15
2009 - December	100,218,043.2	7.80	119.77
2010 - January	98,539,144.6	8.12	117.79
2010 - February	97,901,838.4	8.36	117.56
2010 - March	98,400,302.7	8.39	117.30
2010 - April	99,222,927.2	8.09	116.89
2010 - May	100,493,163.9	7.70	116.72
2010 - June	104,296,343.1	7.46	116.54
2010 - July	102,109,279.3	7.45	113.61
2010 - August	103,042,103.8	7.41	113.35
2010 - September	102,636,167.5	7.35	112.72
2010 - October	101,173,303.9	7.08	112.11
2010 - November	101,784,881.3	6.95	111.53
2010 - December	102,099,828.5	6.87	110.94
2011 - January	100,773,343.9	6.83	110.09
2011 - February	99,756,884.1	6.67	109.25
2011 - March	98,033,419.1	6.00	108.60
2011 - April	97,915,851.1	5.48	107.89

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2011 - May	99,793,159.6	5.04	107.66
2011 - June	101,911,045.1	4.84	107.97
2011 - July	102,825,765.9	4.84	108.36
2011 - August	102,546,572.3	4.87	108.73
2011 - September	104,452,642.8	4.89	108.96
2011 - October	104,121,270.5	4.93	108.27
2011 - November	104,537,909.0	5.06	107.82
2011 - December	104,256,083.2	5.12	107.56
2012 - January	104,261,769.3	5.37	107.18
2012 - February	104,070,091.7	5.37	106.49
2012 - March	104,423,718.0	5.15	106.05
2012 - April	104,526,547.5	4.82	105.98
2012 - May	105,690,267.9	4.64	105.77
2012 - June	105,377,852.0	4.58	105.82
2012 - July	107,281,082.0	4.86	105.20
2012 - August	105,686,990.3	5.00	104.67
2012 - September	106,234,805.3	5.01	103.45
2012 - October	106,342,591.6	5.17	103.15
2012 - November	105,937,172.0	5.40	103.11
2012 - December	104,460,691.0	5.59	102.49
2013 - January	103,194,340.1	5.66	101.14
2013 - February	102,909,047.8	5.63	100.80
2013 - March	103,649,517.9	5.43	100.76
2013 - April	101,892,342.0	5.15	100.65
2013 - May	102,901,135.0	4.90	100.43
2013 - June	104,066,665.5	4.83	100.42
2013 - July	103,315,365.8	5.15	100.76
2013 - August	103,245,946.5	4.89	100.96
2013 - September	103,765,793.3	4.73	101.54
2013 - October	103,125,545.0	5.40	101.25
2013 - November	103,297,409.9	5.60	101.26
2013 - December	103,244,221.3	5.65	100.93
2014 - January	103,093,352.0	5.85	100.08
2014 - February	102,937,695.1	5.84	99.74
2014 - March	102,444,226.6	5.57	99.72
2014 - April	102,468,630.7	5.14	99.45
2014 - May	101,702,233.1	4.92	99.49
2014 - June	101,357,095.8	4.88	99.76
2014 - July	100,767,108.5	5.10	99.81
2014 - August	100,987,153.9	5.13	100.12
2014 - September	101,139,694.1	5.11	100.00
2014 - October	101,359,727.9	5.13	99.81
2014 - November	101,717,537.0	5.18	99.90

Period	Households loans (thousand lei)	Unemployment rate (%)	Consumer Price Index (%)
2014 - December	102,117,070.0	5.29	99.90
2015 - January	102,637,372.5	5.46	100.43
2015 - February	102,140,460.1	5.51	100.33
2015 - March	102,393,523.9	5.37	100.41
2015 - April	102,534,776.8	5.12	100.13
2015 - May	104,486,679.6	4.93	100.47
2015 - June	105,017,472.9	4.94	97.05
2015 - July	104,211,667.4	4.99	99.83
2015 - August	104,730,186.6	4.91	99.49
2015 - September	104,776,021.7	4.89	100.26
2015 - October	105,280,484.5	4.88	100.28
2015 - November	107,620,822.0	4.88	100.31
2015 - December	107,960,160.4	4.90	100.11

Source: National Institute of Statistics, http://www.anofm.ro/statistican and http://www.bnr.ro/Credite-acordate-gospodariilor-populatiei-5771.aspx#