



STRUCTURE EVALUATION OF CREDIT TO HOUSEHOLDS FROM ROMANIA DURING 2013-2014 USING ANOVA: TWO-FACTOR WITH REPLICATION

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Abstract

This article analyzes the fluctuation of loans to households in Romania, during 2013-2014, according to the changing lending standards and net demand volume, using two major currencies as reference - Ron and Euro. Anova Two - Factor with Replication is the ideal model to highlight significant differences occurred between the amount of loans, both currencies (EUR and USD) and the period in which they were granted to population. The results of this analysis showed that there is a strong link between the amount of credit, the currency and the period in which the various types of loans were granted to population, due to changes in credit standards, the volume of net demand and credit terms.

Keywords

ANOVA, amount of credit, loans to households, crediting period, bank lending standards

JEL Codes:

M31, M37, G21

1. Introduction

In the Romanian banking sector, different levels of the value of loans to households are recorded monthly, quarterly or annually. Generally, these values of loans are influenced by factors characteristic to banking products and services (in our case, credits for households) and other factors particular to banking sector in Romania¹, such as: credit standards, the volume of net demand and lending terms. Loans to households are grouped as follows: consumer loans, housing loans and loans for other purposes.

1.1. Purposes and objectives

In this study we aimed to identify whether there is a strong link between aggregate credit values obtained from three categories - consumer loans, housing loans and loans for other purposes, and the period in which they were granted to population in two different currencies - Ron and Euro. This link is analyzed in terms of the impact of some factors particular to the present Romanian banking sector, such as lending standards, net demand volume and lending terms.

2. Literature review

In this study, ANOVA Two-Factor with Replication model is used to assess the value of loans granted quarterly to population, during the period 2013-2014, in two distinct currencies – Euro and Ron, and to identify whether there is an interaction between these variables. Also, we aimed to identify all the factors that

generate these significant differences on loans granted to population households in Romania, in lei and euro, during each quarter of the 2 years, studied for three distinct categories of loans granted to population such as: consumer loans, housing or other purposes.

The variables to be considered are²:

A - amount of loans to population households;

B - time (the period when the credit was granted – split into the 4 quarters of each year);

X - the currency in which the loan was granted - Ron and Euro.

2.1. ANOVA Two – Factor with Replication Model

ANOVA Two-Factor with Replication allows the examination of the influence of two categories of independent variables on a dependent variable. This analysis allows the assessment of the main effect of each independent variable on the dependent variable and it indicates whether there is an interaction between them.

In 1925, American specialist Ronald Fisher presents in his book - "Statistical methods of research works" an example of bidirectional analysis model - ANOVA. Later on, in 1934, Frank Yates disseminates new procedures of variant bidirectional analysis - ANOVA.

In 1993, Fujikoshi brings new amendments to ANOVA model after several evaluations of the calculation procedure.

¹ Odobescu, E., Marketingul bancar modern, Ed. Sigma, Bucureşti, 2007, p.51

²Constantin, C.: Sisteme informatice de marketing – Aplicatii in SPSS, Ed. Infomarket, Brasov 2006, p.25

In 2005, a new model appears ANOVA - variant bidirectional analysis, designed on multilevel by specialist Andrew Gelman³.

3. Methodology of research

We denote by A and B independent variables (factors) and the dependent variable X (as determined by comparing the levels groups factors)⁴.

Independent variables (factors) are as follows:

- A -the different types of loans (consumer loans, loans for housing and loans for other purposes);
- B- the time when the loan was purchased (in Ron or Euro);

Dependent variable (X) is represented by the currency in which they were issued loans – Ron and Euro, after comparing the levels of the two groups caused by the factors.

Table 1 presents the structure of loans to households in Romania, during 2013-2014. The loans are grouped separately in the two years analyzed, depending on their destination, the currency in which they were issued and the four quarters of each year.

3.1. The tested hypotheses

There are three sets of hypotheses corresponding to the two factors⁵ and their interaction. They were marked by such factors involved:

(AB) H_0 : interaction of factors A and B is not significant (effect of A does not change the level of B)

H_1 : interaction is significant factors A and B (the effect depends on the level of factor B)

(A) H_0 : A factor is not significant (classification after lines is not significant or not significantly different environments lines)

H_1 : A significant factor is (classification after significant lines, lines environments differ significantly)

(B) H_0 : factor B is not significant (classification after column, column is not significant or not significantly different environments)

H_1 : factor B is significant (classification after significant columns, columns environments differ significantly)

3.1. ANOVA Two – Factor whit Replication stages

In Table 2, it can be seen that the value of consumer loans and the value of loans for other purposes acquired by the population exceeds the value of housing loans for loans in Ron. At the same time the value of housing loans acquired in Euro (Ron 387 043

088 thousand) is higher than the value of loans in Ron (Ron 76,016,550 thousand).

Therefore, Romania's population preferred to purchase housing loans in Euro and consumer loans or credit for other purposes in Ron.

Using average values for lines and columns, and cells for all values is shown that decomposition occurs relationship of total variation due to variation factor A (credits to households), factor B (the time when the loan was purchased) variation due to variation due to interaction AB and residual variance⁶:

$$SP_g = SP_A + SP_B + SP_{AB} + SP_{resz} \quad (1)$$

Where:

$$SP_g = \sum_{i=1}^h \sum_{j=1}^q \sum_{k=1}^n (X_{ijk} - \bar{X})^2 \quad (2)$$

$$SP_A = qn \sum_{i=1}^h \left[\frac{(\bar{X}_{i\cdot})^2}{q} - (X) \right]^2 \quad (3)$$

$$SP_B = hn \sum_{j=1}^q \left[\frac{(\bar{X}_{\cdot j})^2}{h} - (X) \right]^2 \quad (4)$$

$$SP_{AB} = n \sum_{i=1}^h \sum_{j=1}^q \left[(\bar{X}_{ij}) - \bar{X}_{i\cdot} - \bar{X}_{\cdot j} + \bar{X} \right]^2 \quad (5)$$

$$SP_{resz} = h \sum_{i=1}^q \sum_{j=1}^n \sum_{k=1}^n (X_{ijk} - \bar{X}_{ij})^2 \quad (6)$$

Degrees of freedom for sums of squares are⁷:

$$V_g = hqn - 1$$

$$V_A = h - 1$$

$$V_B = q - 1 ; V_{AB} = (h - 1)(q - 1)$$

$$V_{resz} = hq(n - 1)$$

³ Ionescu, L.: Elemente de marketing bancar, Institutul Bancar Roman, București, 2001, p.67

⁴ Stan, R.F.: Statistica de la A la Z, Ed. Universitara, Bucharest, 2014, p.37

⁵ Stan, R.F.: Statistica de la A la Z, Ed. Universitara, Bucharest, 2014, p.37

⁶ Curteanu, S., L.: Excel prin exemple, Ed. Polirom, Bucharest, 2004, p.45

⁷ Stan, R.F.: Statistica de la A la Z, Ed. Universitara, Bucharest, 2014, p.37

Table 1. Structure of credit to households during 2013-2014

Year	Currency	Credit to households consumer, (thousands ron)	Credit to households housing loans, (thousands ron)	Credit to households for other purposes, (thousands ron)
2014	RON	70,614,896	26,481,294	22,557,692
	RON	70,673,034	21,129,639	22,963,008
	RON	70,007,158	16,206,763	23,169,847
	RON	69,091,088	12,198,854	23,473,202
	EUR	58,449,667	94,742,250	2,442,594
	EUR	60,003,498	95,472,056	2,498,263
	EUR	63,330,245	97,007,938	2,430,444
	EUR	66,711,779	99,820,844	2,445,361
2013	RON	69,539,666	9,416,264	24,950,532
	RON	70,111,725	6,935,541	25,167,298
	RON	70,924,054	6,103,660	24,708,308
	RON	71,595,672	5,683,832	25,001,443
	EUR	68,102,720	100,030,491	2,567,647
	EUR	69,851,400	99,820,858	2,637,674
	EUR	72,185,402	95,955,309	2,662,227
	EUR	73,628,994	93,503,654	2,827,287

Source: <http://www.bnr.ro/Loans-to-financial-corporations-other-than-MFIs,-to-general-government-and-to-non-residents--6376.aspx>

Table 2. The summary output from the analysis of credit to households in 2014

SUMMARY	Credit to households consumer, (thousands ron)	Credit to households housing loans, (thousands ron)	Credit to households for other purposes, (thousands ron)	Total
<i>RON</i>				
Count	4	4	4	12
Sum	280,386,176	76,016,550	92,163,749	448,566,475
Average	70,096,544	19,004,137	23,040,937	37,380,540
Variance	5.39987E+11	3.81876E+13	1.4769E+11	5.97385E+14
<i>EUR</i>				
Count	4	4	4	12
Sum	248,495,187	387,043,088	9,816,662	645,354,938
Average	62,123,797	96,760,772	2,454,166	53,779,578
Variance	1.35E+13	5.05345E+12	906234856.3	1.66008E+15
<i>Total</i>				
Count	8	8	8	
Sum	528,881,363	463,059,638	101,980,411	
Average	66,110,170	57,882,455	12,747,551	
Variance	2.41785E+13	1.74599E+15	1.21154E+14	

It demonstrates that, accepting the null hypothesis for each test, ANOVA statistical picture F calculated F is a distribution with degrees of freedom as the numerator and denominator numbers attached.

If the calculated F value corresponding to the test, ANOVA⁸ read in the picture, is greater than or equal to quantila Fisher-Snedecor distribution that then will reject the null hypothesis H_0 in favor of the alternative hypothesis H_1 .

⁸⁸ Constantin, C.: Sisteme informatice de marketing – Aplicatii in SPSS, Ed. Infomarket, Brasov 2006, p.48

Test	The rule of rejecting the null hypothesis
(AB)	$F_{AB} \geq F_{1-\alpha; VAB; Vrez}$
(A)	$F_A \geq F_{1-\alpha; VA; Vrez}$
(B)	$F_B \geq F_{1-\alpha; VB; Vrez}$

Table 3. The rest of summary output from the analysis of credit to households in 2014

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Sample	1.61357E+15	1	1.61357E+15	168.579	0.000000000014	4.41387
Columns	1.32065E+16	2	6.60323E+15	689.877	0.000000000000	3.55456
Interaction	1.14534E+16	2	5.72669E+15	598.300	3.4479E-17	3.55456
Within	1.72289E+14	18	9.57161E+12			
Total	2.64457E+16	23				

Since the p-value (credit) = .0000000000001 < .05 = α , we reject the Factor A null hypothesis, and so conclude (with 95% confidence) that there are significant differences between the period of the year when the loans was purchased and the different types of loans (consumer loans for housing or other purposes) (see table 3).

Since the p-value (currency) = .000000000014 < .05 = α , we reject the Factor B null hypothesis, and conclude that: from one quarter to another the loans take different values depending the time when the loan was purchased that is statistically different.

We also see that the p-value (interactions) = .000000000000034 < .05 = α , and so conclude there

are significant differences in the interaction between the different types of loans and the time when the loan was purchased, in both currency - Ron and Euro.

In Figure 1 it can be observed the downward trend of loans for housings recorded during the four quarters of 2014. The lines which are approximately parallel are indications of a lack of interaction in terms of consumer loans and loans for other purposes granted to population.

In the second graph we can see a slight improvement in the situation of loans in euro, purchased for consumption and housing loans in the last two quarters of 2014.

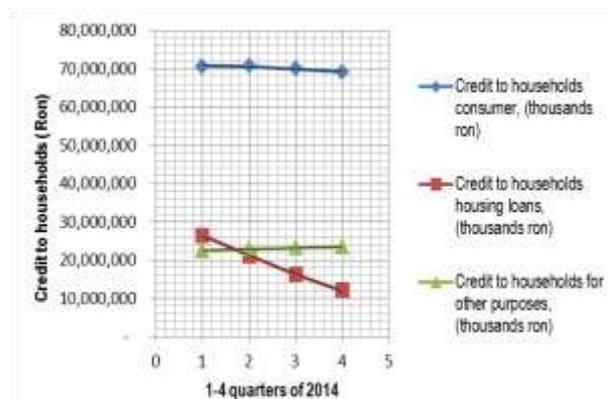


Figure 1. Evolution of household loans in Ron in the four quarters of 2014

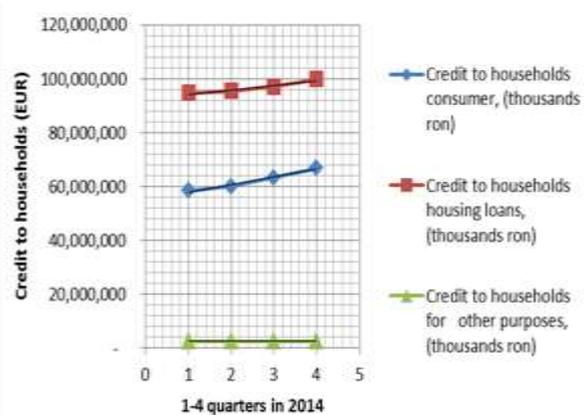


Figure 2. Evolution of household loans in Euro in the four quarters of 2014

In Table 4 it can be seen that the value of consumer loans in Ron and Euro is almost similar in the past two years, reaching over 280.000.mil Also, the value of housing loans in Ron grew from 28,139 million in 2013 to 76,016 million in 2014.

In 2013 the Romanians equally purchased consumer loans both in Ron and in Euro, while for the housing loans they preferred the one sin Euro.

Table 4. The summary output from the analysis of credit to households in 2013

SUMMARY	Credit to households			Total
	Credit to households consumer, (thousands ron)	housing loans, (thousands ron)	Credit to households for other purposes, (thousands ron)	
<i>RON</i>				
Count	4	4	4	12
Sum	282,171,117	28,139,297	99,827,581	410,137,995
Average	70,542,779	7,034,824	24,956,895	34,178,166
Variance	8.15332E+11	2.79112E+12	36029923481	7.80694E+14
<i>EUR</i>				
Count	4	4	4	12
Sum	283,768,516	389,310,311	10,694,836	683,773,663
Average	70,942,129	97,327,578	2,673,709	56,981,139
Variance	6.00564E+12	1.00092E+13	12088559686	1.73966E+15
<i>Total</i>				
Count	8	8	8	
Sum	565,939,633	417,449,608	110,522,417	
Average	70,742,454	52,181,201	13,815,302	
Variance	2.96884E+12	2.33485E+15	1.41889E+14	

Table 5. The rest of summary output from the analysis of credit to households in 2013

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Sample	3.11985E+15	1	3.12E+15	951.69	0.000000000000	4.4139
Columns	1.34858E+16	2	6.743E+15	2,056.86	0.000000000000	3.5546
Interaction	1.41791E+16	2	7.09E+15	2,162.61	0.000000000000	3.5546
Within	5.90083E+13	18	3.278E+12			
Total	3.08437E+16	23				

Since the p-value (credit) = .000000000000 < .05 = α , we reject the Factor A null hypothesis, and so conclude (with 95% confidence) that there are significant differences between the period of the year when the loans was purchased and the different types of loans (consumer loans for housing or other purposes) (see table 3).

Since the p-value (currency) = .000000000000 < .05 = α , we reject the Factor B⁹ null hypothesis, and conclude that: from one quarter to another the loans take different values depending the time when the loan was purchased that is statistically different.

We also see that the p-value (interactions) = .000000000000 < .05 = α , and so conclude there are significant differences in the interaction between the different types of loans and the time when the loan was purchased, in both currencies - Ron and Euro.

In Figure 3, the downward trend of loans for housing in 2014 can be observed. Lack of interaction is again obvious by the almost parallel lines which present developments of the three categories of loans reviewed.

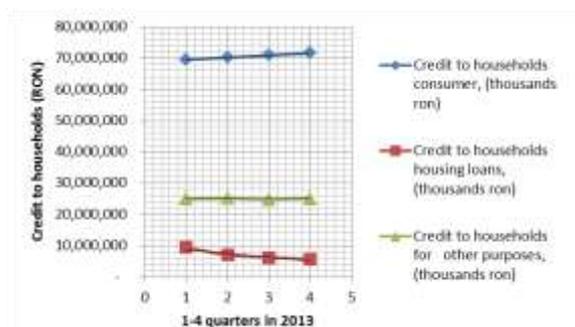


Figure 3. Evolution of household loans in Ron in the four quarters of 2013

⁹ Constantin, C.: Sisteme informatice de marketing – Aplicatii in SPSS, Ed. Infomarket, Brasov 2006, p.49

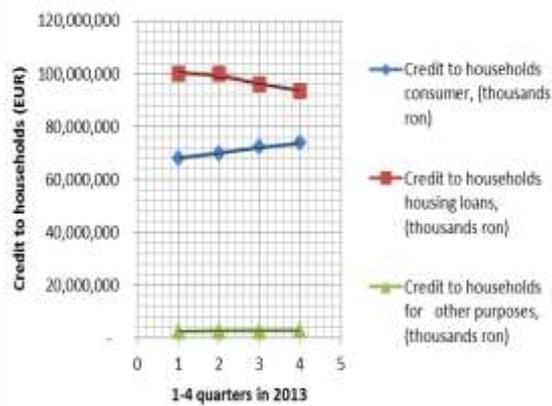


Figure 4. Evolution of household loans in Euro in the four quarters of 2013

In Figure 4 we can see that in 2013, the volume value of housing loans recorded a downtrend while the value volume of consumer loans had an upward trend, which continued in 2014.

3. Conclusions

In Q₄/2014 in the case of consumer credit there is an increase of 2.2% compared to Q₁/2014 amid an easing of credit conditions.

In 2014, the situation has improved substantially compared to 2013 when, due to the spread increase of the average interest rate of the loan compared to 1M ROBOR and lending costs, the volume of consumer loans granted to the population fell from 71,595 million in Q₁/2013 to 69,539 million in Q₄/2013.

Amid the change of the lending standards and the increase of the demand for housing loans at the aggregate level, there was a doubling of the volume value of loans. Thus, the volume of household loans increased significantly by 114% compared to Q₁/2013.

Contrary to the expectations forecasted by banks at the end of 2013, the volume of housing loans reached

26,481 million ron in Q₄/2014, 181% higher than Q₄/2013, a significant contribution to this development being caused by the revaluation of guarantees.

The evolution of household credits for other purposes has remained constant at aggregate level; there was a downward trend with 9.6% for loans in Ron in Q₄/2014 compared to Q₄/2013 and with 4.8% for loans in Euro in Q₄/2014 compared to Q₄/2013.

The volume of loans granted for consumption in euro fell in the 4 quarters of the two years between 9.9% -14.1% due to tighter risk associated with various banking sector events, the spread increase of the average interest rate of the loan compared to ROBOR 1M and the lending costs other than the interests.

The analysis results indicate that the value of housing loans registered a growth trend in euro due to the increase in demand for housing loans amid the decrease of housing prices on the real estate market.

In 2014, the tougher credit conditions and the increase in the housing prices led to a decrease in the value of housing loans in euro from 99.820 million ron in Q₁/2014 to 94,742 million ron in Q₄/2014.

Bibliography

- [1] Curteanu, S., L. Excel prin exemple, Ed. Polirom, Bucharest, 2004
 - [2] Constantin, C. Sisteme informatice de marketing – Aplicatii in SPSS, Ed. Infomarket, Brasov 2006
 - [3] Ionescu, L. Elemente de marketing bancar, Institutul Bancar Roman, București, 2001
 - [4] Odobescu, E., Marketingul bancar modern, Ed. Sigma, București, 2007
 - [5] Stan, R.F. Statistica de la A la Z, Ed. Universitara, Bucharest, 2014
- ***www.bnr.ro