

STATISTICAL ANALYSIS OF CREDIT RISK FACTORS IN ROMANIA

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Abstract

The study presents the results of macroeconomic analysis on the credit risk and its influence factors. The credit risk study of a country is important to assess its economic development, determinants and specific actions, provide the necessary information to make decisions for national development. Lately, credit risk increased significantly and projections show it will increase further. The purpose of this paper is to identify determinants of the credit risk to Romania. In the paper we used data provided by the National Bank of Romania (www.bnro.ro) for the period 2007-2014. Data analysis was performed using SPSS and Eviews package. The study showed that the greatest influence on the risk of credit it has the rate of nonperforming loans.

Keywords: credit risk, regression analysis, stationary, financial stability, influencing factor

JEL Classification: C01, C19, C58, C87, E44, E51

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1. Introduction

The banking risks that are facing commercial banks in the Romanian banking system are multiple and complex.

In the speciality literature, but also in banking practice, there are known different instruments for measuring and restoration of bank performance, but one of the most effective is the system of indicators used for this purpose.

From the information of the credit risk and the analyzing of the main key indicators of prudent banking results that credit risk is the main risk that banks are facing.

The credit risk is an important indicator for assessing economic development of banking system. The credit risk can be used both for space studies (comparisons between countries and regions of a country) and for temporal analysis of spatial-temporal analysis (in order to identify whether the credit risk has registered different trends for different locations).

The purpose of this paper is to identify the determinants of credit risk for Romania for the period 2007-2014.

2. Data and methods

According to National Bank of Romania, the credit risk is the ratio of non-bank credit exposure related gross and interest under "doubtful" and "loss" to total loans and interest classified, non-bank loans.

The indicators used to assess the credit risk in the literature are divided into general and specific. General indicators are: rate of credit risk, the rate of overdue loans, the rate of nonperforming loans, rate loss reserves, loss provisions coverage ratio and profit provisions ratio and specific indicators are: return on assets, the solvency ratio, rate of return, return on equity and leverage ratio.

The used data are provided by National Bank of Romania for the period 2007-2014, quarterly data. To assess which of these indicators are risk factors of influence and their effect on its lending to Romania, a database was conducted in SPSS and Eviews software packages and perform regression analysis.

In this study we used a threshold of 0.05 to determine the level of significance. The regression analysis is a statistical method that quantifies the relationship between two or more variables, estimating mathematical relationships between variables.

The equation is built on variable regression model: $Y = f(X) + e$, where Y is the dependent variable and X is the independent variable. As variables were used rate of credit risk (RRC) - dependent variable and the rate of nonperforming loans (RCN), the rate of return (RRAB), leverage ratio (EP), the solvency ratio (IS), return on assets (REC) and return on equity (RCP) - independent variables.

3. Results

Kolmogorov-Smirnov test applied to the variables (see Table 1) revealed that their distribution is not significantly different from normal distribution for all variables. For all the variables were obtained Sig. values greater than 0.05.

Table 1: Kolmogorov – Smirnov test

		rata riscului de creditare	rata creditelor neperformante	rata rentabilitatii activitatii de baza	efectul de parghie	indicatorul de solvabilitate	rentabilitatea economica	rentabilitatea capitalului propriu
N		26	19	25	26	26	25	25
Normal Parameters ^{a,b}	Mean	19.5033	15.0025	167.4911	7.7792	14.2621	.3368	3.5749
	Std. Deviation	9.52466	4.82352	12.12670	.50713	.94769	.64422	6.91955
Most Extreme Differences	Absolute	.108	.082	.156	.163	.174	.148	.187
	Positive	.106	.082	.143	.087	.132	.148	.187
	Negative	-.108	-.074	-.156	-.163	-.174	-.118	-.122
Kolmogorov-Smirnov Z		.549	.356	.782	.833	.886	.740	.934
Asymp. Sig. (2-tailed)		.923	1.000	.574	.491	.412	.644	.347

a. Test distribution is Normal.

b. Calculated from data.

Source: Data processed using the statistical program SPSS

Before estimating the regression model, it is testing stationarity variables. For testing stationary variables it requires the Augmented Dickey-Fuller test.

Table 2: Testing stationarity variables using Dickey-Fuller test

Variable\Tested model	Intercept	Trend and intercept	None
RRC			
ADF	-1.424964	-1.068683	1.954179
Probability	0.5531	0.9138	0.9850
Akaike	2.851005	2.897140	3.196326
Schwarz	2.998262	3.093482	3.294497
EP			
ADF	-1.982623	-3.152191	0.555480
Probability	0.2919	0.1175	0.8290
Akaike	1.317317	1.168630	1.411338
Schwarz	1.464574	1.364972	1.509509
IS			
ADF	-1.320836	-2.862813	0.922948
Probability	0.6028	0.1908	0.8995
Akaike	2.367323	2.177205	2.369971
Schwarz	2.514580	2.373547	2.468142
RCN			
ADF	-1.096565	-2.862971	2.180968
Probability	0.6917	0.1968	0.9895
Akaike	1.344460	0.998492	1.667761
Schwarz	1.491497	1.194542	1.765786
RCP			
ADF	-2.726139	-2.350952	-2.634889

Probability	0.0850	0.3928	0.0109
Akaike	1.620255	1.705833	1.570903
Schwarz	1.768363	1.903310	1.669641
REC			
ADF	-2.750258	-2.392242	-2.689287
Probability	0.0812	0.3734	0.0095
Akaike	6.307851	6.390831	6.254609
Schwarz	6.455959	6.588308	6.353348
RRAB			
ADF	-1.766772	-1.853283	0.217976
Probability	0.3865	0.6454	0.7405
Akaike	7.788234	7.835467	7.848943
Schwarz	7.936342	8.032944	7.947682

Source: Data processed using the statistical program EView

Testing stationarity variables using Dickey-Fuller test (results obtained in Table 2) confirms that all the analyzed variables are non-stationary and at least integrated of order I. Therefore, for the stationarity variables order it resort to differentiation of order I and then testing for stationarity of them with the same Dickey-Fuller test.

Table 3: Testing stationarity differentiated variables using Dickey-Fuller test

Variable\Teseted model	Intercept	Trend and intercept	None
DRRC			
ADF	-2.711668	-3.165746	-1.131128
Probability	0.0873	0.1157	0.2268
Akaike	2.917406	2.857373	3.084438
Schwarz	3.065514	3.054850	3.183177
DEP			
ADF	-4.137558	-3.992919	-4.153904
Probability	0.0042	0.0240	0.0002
Akaike	1.498166	1.584963	1.433313
Schwarz	1.646273	1.782440	1.532052
DIS			
ADF	-4.146227	-4.031051	-3.983166
Probability	0.0041	0.0222	0.0004
Akaike	2.421534	2.507315	2.403892
Schwarz	2.569642	2.704792	2.502631
DRCN			
ADF	-2.812717	-2.793971	-1.317662
Probability	0.0786	0.2187	0.1658
Akaike	1.432147	1.530666	1.695928
Schwarz	1.577008	1.723813	1.792502
DRCP			
ADF	-4.455224	-5.078464	-4.478442
Probability	0.0022	0.0027	0.0001
Akaike	1.898314	1.807992	1.828119
Schwarz	2.047092	2.006363	1.927305
DREC			
ADF	-4.505653	-5.158178	-4.508174
Probability	0.0019	0.0022	0.0001

Akaike	6.578474	6.481095	6.513176
Schwarz	6.727253	6.679466	6.612362
DRRAB			
ADF	-3.033542	-3.147942	-3.112617
Probability	0.0472	0.1204	0.0034
Akaike	7.901458	7.942224	7.810708
Schwarz	8.050237	8.140595	7.909893

Source: Data processed using the statistical program EView

Because three of the analyzed variables, the differentiated credit risk ratio (DRRC), the differentiated nonperforming loans ratio (DRCN) and the differentiated rate of return (DRRAB), don't provide results which confirm to us the stationarity of them, we require at the other two tests, Philips-Perron and KPSS. Therefore for testing the link between the variables mentioned are taken into account, the I order differented variables because they are stationary variables.

Because it is estimated a linear regression, it is being studying the link between the independent variables to see if it shows there the multicollinearity phenomenon.

Table 4: The estimated correlation coefficient between independent variables of the model of the estimated regression

		Correlations					
		DEP	DIS	DRCN	DRCP	DREC	DRRAB
DEP	Pearson Correlation	1	,752*	-,196	,542*	,556*	,210
	Sig. (2-tailed)		,000	,436	,006	,005	,326
	N	25	25	18	24	24	24
DIS	Pearson Correlation	,752*	1	-,454	,139	,152	-,121
	Sig. (2-tailed)	,000		,059	,517	,477	,572
	N	25	25	18	24	24	24
DRCN	Pearson Correlation	-,196	-,454	1	,024	,022	,469*
	Sig. (2-tailed)	,436	,059		,925	,931	,050
	N	18	18	18	18	18	18
DRCP	Pearson Correlation	,542*	,139	,024	1	,997*	,319
	Sig. (2-tailed)	,006	,517	,925		,000	,128
	N	24	24	18	24	24	24
DREC	Pearson Correlation	,556*	,152	,022	,997*	1	,303
	Sig. (2-tailed)	,005	,477	,931	,000		,150
	N	24	24	18	24	24	24
DRRAB	Pearson Correlation	,210	-,121	,469*	,319	,303	1
	Sig. (2-tailed)	,326	,572	,050	,128	,150	
	N	24	24	18	24	24	24

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Source: Data processed using the statistical program SPSS

According to Table 4, it can be said that between variables, differentiated return on assets (DREC) and differentiated return on equity (DRCP) there is a very strong relation. Therefore, the introduction of these two variables into the a regression model determines the failure hypothesis on absence of multicollinearity independent variables.

It will be estimated two regression models. On the first model it will be introduced all the variables, except the variable differentiated return on assets (DREC) and in the second model it will exclude the differentiated return on equity (DRCP).

Analyzing the values of correlation coefficients between the fourth quarter of 2007 – second quarter of 2014, it appears that differentiated return on assets (DREC) is strongly correlated with differentiated return on equity (DRCP), recording a coefficient of 0.997.

Another strong relation is between the differentiated solvency ratio (DIS) and differentiated leverage ratio (DEP), recording a coefficient of 0.752

Between variables, differentiated solvency ratio (DIS) and differentiated nonperforming loans ratio (DRCN) there is an inverse correlation, registering a coefficient of - 0.454.

To estimate regression models we rely on SPSS and Backward procedure that allows identifying the best regression model by phasing variables without a significant explanation of the dependent variable.

Table 5 contains summary statistics, correlation matrix of variables under study.

Table 5: Summary patterns (f)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df 1	df 2	Sig. F Change	
1	,740 ^a	,548	,360	,70887	,548	2,913	5	12	,060	
2	,712 ^b	,506	,354	,71199	-,042	1,115	1	12	,312	
3	,636 ^c	,404	,276	,75392	-,102	2,697	1	13	,124	
4	,607 ^d	,369	,285	,74951	-,035	,825	1	14	,379	
5	,578 ^e	,334	,292	,74558	-,035	,833	1	15	,376	2,410

a. Predictors: (Constant), DRRAB, DIS, DRCP, DRCN, DEP

b. Predictors: (Constant), DRRAB, DIS, DRCN, DEP

c. Predictors: (Constant), DIS, DRCN, DEP

d. Predictors: (Constant), DIS, DRCN

e. Predictors: (Constant), DRCN

f. Dependent Variable: DRRC

Source: Data processed using the statistical program SPSS

For the first model was introduced all variables except the variable differentiated return on assets (DREC):

- in the first stage they are encompassed all influencing factors: differentiated nonperforming loans ratio (DRCN), the differentiated rate of return (DRRAB), differentiated leverage ratio (DEP), the differentiated solvency ratio (DIS) and differentiated return on equity (DRCP);
- in the 2nd stage was removed variable differentiated return on equity (DRCP);

- in the 3rd stage was removed, besides the variable differentiated return on equity (DRCP) and variable differentiated rate of return (DRRAB);
- in the 4th step was removed, besides the variable differentiated return on equity (DRCP), the variable differentiated rate of return (DRRAB) and variable differentiated leverage ratio (DEP);
- in the 5th stage was removed, besides the variable differentiated return on equity (DRCP), the variable differentiated rate of return (DRRAB), variable differentiated leverage ratio (DEP) and variable differentiated solvency ratio (DIS), remaining only variable differentiated nonperforming loans ratio (DRCN).

By regression using the method Backward, they were removed one by one, the independent variables that influence credit risk models to determine which variation contributes significantly to credit risk.

The report of determination, R^2 , shows the proportion of variance of the dependent variable in the regression model and is used to determine which model is the best regression. In the example, the values of determination reports, R^2 , indicates that the first model explains 54.8% of the variance in the dependent variable rate of credit risk and in the models, 2, 3, 4 and 5, it is noted that the coefficient R^2 begins to fall and explained 50.6% (model 2) of the variance in the dependent variable.

Table 6: Summary patterns (f)

Model Summary ^f										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df 1	df 2	Sig. F Change	
1	,735 ^a	,540	,349	,71523	,540	2,819	5	12	,066	
2	,712 ^b	,506	,354	,71199	-,034	,883	1	12	,366	
3	,636 ^c	,404	,276	,75392	-,102	2,697	1	13	,124	
4	,607 ^d	,369	,285	,74951	-,035	,825	1	14	,379	
5	,578 ^e	,334	,292	,74558	-,035	,833	1	15	,376	2,410

a. Predictors: (Constant), DRRAB, DIS, DREC, DRCN, DEP

b. Predictors: (Constant), DRRAB, DIS, DRCN, DEP

c. Predictors: (Constant), DIS, DRCN, DEP

d. Predictors: (Constant), DIS, DRCN

e. Predictors: (Constant), DRCN

f. Dependent Variable: DRRC

Source: Data processed using the statistical program SPSS

For the 2nd model was introduced all variables, except variable differential return on equity (DRCP):

- in the first stage are all influencing factors included: the differentiated nonperforming loans (DRCN), the differentiated rate of return (DRRAB), the differentiated leverage ratio (DEP), the differentiated solvency ratio (DIS) and differentiated return on assets (DREC).
- in the 2nd stage was eliminated the variable differentiated return on assets (DREC);

- in the 3rd stage was removed, besides differentiated return on assets (DREC) also the variable differentiated rate of return (DRRAB);
- in the 4th stage was removed, besides differentiated return on assets (DREC) also the differentiated rate of return (DRRAB) and differentiated leverage ratio (DEP);
- in the 5th stage was removed, besides economic profitability differential (DREC), also the variable differentiated rate of return (DRRAB), differentiated leverage ratio (DEP) and variable differentiated solvency ratio (DIS), remaining only the variable the differentiated nonperforming loans (DRCN).

The values reports of determination, R^2 , indicates that the first model explains 54% of variation in the dependent variable rate of credit risk, and in models 2, 3, 4 and 5, it is noted that the coefficient R^2 begins to decline and explains 50 6% (model 2) of the variance in the dependent variable.

The estimation of the two regression models by the Backward method ultimately lead to the same result, that the explanatory variable for the credit risk remains only differentiated nonperforming loans (DRCN).

According to the results in Table 5 and Table 6, the exclusion of the variables in the regression model initially not cause a significant change in the correlation ratio, therefore withheld the last model estimated.

Table 7: Testing regression models estimated with Backward method

ANOVA^f

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,211	5	1,442	2,819	,066 ^a
	Residual	6,139	12	,512		
	Total	13,350	17			
2	Regression	6,760	4	1,690	3,334	,044 ^b
	Residual	6,590	13	,507		
	Total	13,350	17			
3	Regression	5,392	3	1,797	3,162	,058 ^c
	Residual	7,958	14	,568		
	Total	13,350	17			
4	Regression	4,923	2	2,462	4,382	,032 ^d
	Residual	8,426	15	,562		
	Total	13,350	17			
5	Regression	4,456	1	4,456	8,015	,012 ^e
	Residual	8,894	16	,556		
	Total	13,350	17			

- a. Predictors: (Constant), DRRAB, DIS, DREC, DRCN, DEP
- b. Predictors: (Constant), DRRAB, DIS, DRCN, DEP
- c. Predictors: (Constant), DIS, DRCN, DEP
- d. Predictors: (Constant), DIS, DRCN
- e. Predictors: (Constant), DRCN
- f. Dependent Variable: DRRC

According to Table 7, the final model estimated is statistically significant because (Sig. = 0.012) < assumed significance threshold of 5%.

Table 8: Estimated indicators of correlation regression models

		Coefficients ^a										
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics		
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF	
1	(Constant)	,093	,498		,186	,856						
	DEP	-1,645	1,019	-,681	-1,614	,132	-,091	-,422	-,316	,215	4,642	
	DIS	,880	,482	,697	1,827	,093	-,095	,467	,358	,263	3,795	
	DRCN	,995	,528	,492	1,887	,084	,578	,478	,369	,564	1,773	
	DREC	-,040	,043	-,216	-,939	,366	-,110	-,262	-,184	,724	1,382	
	DRRAB	,046	,025	,583	1,836	,091	,406	,468	,359	,380	2,635	
2	(Constant)	,037	,493		,075	,941						
	DEP	-1,809	,999	-,749	-1,811	,093	-,091	-,449	-,353	,222	4,505	
	DIS	,924	,477	,732	1,937	,075	-,095	,473	,377	,266	3,759	
	DRCN	1,072	,519	,530	2,066	,059	,578	,497	,403	,578	1,731	
	DRRAB	,039	,024	,498	1,642	,124	,406	,415	,320	,414	2,418	
	3	(Constant)	-,294	,476		-,617	,547					
DEP		-,717	,790	-,297	-,908	,379	-,091	-,236	-,187	,398	2,510	
DIS		,581	,454	,460	1,279	,222	-,095	,323	,264	,329	3,038	
DRCN		1,474	,484	,728	3,042	,009	,578	,631	,628	,743	1,346	
4	(Constant)	-,210	,464		-,453	,657						
	DIS	,265	,291	,210	,913	,376	-,095	,229	,187	,794	1,259	
	DRCN	1,362	,466	,673	2,924	,010	,578	,603	,600	,794	1,259	
5	(Constant)	-,003	,403		-,007	,994						
	DRCN	1,169	,413	,578	2,831	,012	,578	,578	,578	1,000	1,000	

a. Dependent Variable: DRRC

Source: Data processed using the statistical program SPSS

In conclusion, the last model remembered is the most effective prediction, consisting of the independent variable, the nonperforming loans (DRCN).

Therefore, the estimated model is:

$$DRRC_t = - 0,003 + 1,169 DRCN_t + \varepsilon_t$$

The variation of the nonperforming loans has the strongest contribution to explaining the dependent variable (variation of credit risk rate).

The residues of regression model estimated comply assumption of normality, the lack of autocorrelation, homoscedasticity and is not statistically significantly different from 0.

The model consisting of the independent variable the nonperforming loans is effective, meaning the credit risk rate is influenced by the nonperforming loans.

4. Conclusions

In Romania, the commercial banks from the system face multiple and complex risks. From the category of banking risks that is facing the Romanian banking system, the most

representative is the credit risk. It is constantly monitored by the National Bank of Romania, both by prudential indicators and through publication of information relating to credit risk.

The credit risk analysis of the dynamics in Romania for the period under review describes an increasing trend and continues to grow (according to the forecasts for Romania and UE). Using regression analysis, we found that from the indicators used to assess the credit risk in Romania, the factor with the biggest influence is the nonperforming loans.

Starting with the second quarter of 2014 there are no longer calculated indicators, the rate of credit risk and nonperforming loans, only the nonperforming loans determined on reporting by all banks: both those using the standardized approach to credit risk assessment and those using internal ratings.

In this context, the equation that describes the relation between credit risk and nonperforming loans has a great impact because offers us information on credit risk values.

The result reached in this analysis is consistent with other studies on credit risk, for the organization and management of preventive credit risk, taking into account the values of the prudential indicators. When all banks will take into account these indicators, the performance of the entire national banking system will be improved.

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