
Aspects of the impact of interest rate development on the probability of default

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Abstract

The acceptance of banking risks and their control is one of the key moments in banking activity. Success in banking management is possible only if the risks accepted by banks are reasonable, can be controlled and do not exceed the financial resources and their expertise.

The occurrence of the interest rate risk is due to the holding a portfolio of assets and liabilities with fixed interest, different in terms of maturities and price and in terms of ownership of assets and liabilities with variable interest that adapts differently to interest rate fluctuations.

The estimation of the probability of default is the first step to determine and assess risk. The major issues in the estimation of PD are generated by the limitation of the required information.

This work captures the impact of interest rate on the PD at maturity of loans. The analysis covers the period January 2013 - December 2015 using data on interest rates in the interbank market, the type of loans granted and the number of people that recored outstanding loans.

Keywords: *Probability of default (PD), interest rate, credit risk, financial institutions, interest rate risk*

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Introduction

The policy of interest rate risk management lies in following closely with a relatively high frequency the present and projected financial impact that the implementation of the strategy or of the program in question.

The interest is the price of the capital used or the “rent” to be paid by the debtor for the right which is granted, that of using the borrowed capital. Generally, the interest rate level is correlated with the profit rate obtained by the entrepreneur. Quantification of the interest is achieved by using the interest rate, which is an instrument for influencing the demand and supply of credits.

A low interest rate leads to an increased demand for credits, resulting in favourable effects on production and economy, just as a high cost of credit generates lower demand.

This article attempts to capture the impact of interest rate on the probability of default upon maturity of loans. The analysis covers the period January 2013 – December 2015 using data on interest rates in the interbank market, the type of loans (treasury, for equipment) and the number of people who registered outstanding loans.

1. Literature review

This paper aims to highlight the role that interest rate development has on the interbank market and the destination of the loans granted by credit institutions on the probability of default at maturity of loans, given the prudential rules for credit risk.

An important part of the research literature is devoted to macroeconomic credit risk models following the methodology proposed by Wilson (1998). In his work “Portfolio Credit Risk”, he proposes a new methodology for determining the distribution of loss resulting from related events of credit risk, in case of credit portfolios chosen arbitrarily for non-financial companies, both regionally and across the sector. An improvement to this approach is the creation of a link between the loss distribution, and the state of economy, as opposed to the approach based on historical averages, unconditioned by the macroeconomic framework, which does not accurately reflect the credit risk in the current economic conditions.

Chen, Cheng and Wu (2013) developed a class of dynamic models analysing the LIBOR rate and the SWAP rates by using three interest rate factors. They start from the idea that the impact of the interest rate on each industrial sector and the rating class are governed by one or two dynamic factors. The authors reached the conclusion that enterprises in different industries present a different dynamic regarding the credit risk but, in all the cases, the credit risk is influenced by the interest rate dynamics. More than that, the evolution of the interest rate doesn't offer only information regarding the credit risk for the current credits, but it also predicts the future dynamic of the credit risk.

In the same time, Gambacorta and Mistrulli (2014) reached the conclusion that the interest rate of the short term credits is strongly correlated with the evolution of the three months interest rate on the interbanking market. The authors noticed that the interest rate during the economic crisis was negatively correlated with the percentage of the credits granted by the banks to the corporate sector and the number of years between the first registration of a debtor in the Credit bureau is negatively correlated with the change of the crediting conditions. In the same time, certain characteristics of the banks affect the evolution of the interest rate. Thus, the banks which have less liquidities and are poorer capitalised were less willing to protect their corporate customers as to the increase of the interest rate.

Dell'Ariccia (2014) shows that the maintenance of a low interest rate can contribute to the growth of taking bank risks. When the banks adjust the capital's structure, the reduction of the interest rate generates a stronger gear effect and assuming a higher risk.

Landier, Sraer and Thesmar (2013) showed, using a sample made up of the trimester data of a sample of USA holdings during 1986-2013, that the banks present a significant exposure to the interest rate risk. In the same time, the authors reached the conclusion that it is difficult for a company confronted with a reduction of the credits to find quickly alternative financing sources. This leads to a decrease of the investments and of the jobs, as well as to financial difficulties.

Koh, Wei and Chwee (2015) concluded that the use of credit-scoring can help the credit institutions to determine the interest rate that they should ask from their customers and to determine the prices of the consumers' portfolios that present a risk of not being reimbursed higher because of a higher interest rate applied.

According to Jimenez et al. (2014) whenever the monetary politics interest rates are smaller, the banks offer a bigger number of credits to the companies which present a higher risk.

Pesola (2001) proposed a dynamic panel approach for the study of banking crisis that affected the Nordic countries in the 1990s. The results of the study identify the indebtedness of borrowers as the most important explanatory variable that can approximate the level of financial fragility.

The integration of macroeconomic indicators in analyzing the credit risk was addressed, among others, by Castro (2013), who captured the link between macroeconomic indicators and credit risk, for a number of countries – Greece, Ireland, Portugal, Spain, and Italy (GIPSI), affected by the economic and financial crisis. Using a dynamic panel approach he notes that the credit risk is significantly affected by the macroeconomic environment: the credit risk increases when the gross domestic product (GDP) decreases, but the unemployment rate or interest rate increase, and are positively influenced by an appreciation of the real exchange rate .

Statistical techniques were used extensively in the construction of the classifying and credit-scoring model. Dănilă (2012) produced a scoring model to quantify the probability of default based on quantitative information and the determination of the power of predictivity of situations of default, given the determination of qualitative variables with regard to the impact on the repayment capacity of loan applicants.

Egami (2013) highlights a number of precautions measures to credit risk management using Levy processes and Sunet (2011) applied the multivariate exponential distribution Marshall-Olkin on credit risk. Meanwhile, Santoso et al. (2005) investigated bank failures in Japan and Indonesia using the logit model, while Canbas, Cabuk and Kilic (2005) proposed an integrated prediction system combining discriminant analysis, logit, probit and the analysis of main components.

2. Research methodology

The assessment of the default probability is the first step to determine and assess the credit risk. The major problems in the assessment of the default probability are generated by the limited available information.

To study the impact of interest rates on the number of debtors we have used the daily data of the reference rates ROBOR for a month¹, as they appear on the website of the National Bank of Romania, as well as the monthly series representing the total amount of treasury loans, of the loans for equipment and the number of debtors with overdue payments to the credit institutions for the period January 2013 – December 2015.

The research aims to determine the connection between the evolution of the interest rate and the probability of default of the persons asking for credits, but also is the credit's destination (financing current activity/treasury of equipment purchase/investment) influences the decisions of the persons asking for credits regarding the payment of the contracted credits at the due date.

For an objective approach, we used:

- the dependent variable *Number of distressed debt (DR)* – Y, and
- the independent variables:
 - Interest rate on the interbank market at one month (ROBOR1M) – X₁
 - Treasury loans – X₂
 - Loans for equipment – X₃;

as they appear on the internet page of the National Bank of Romania.

The research hypothesis is: The number of debtors with overdue credit payments depends on the evolution of the interest rate and the destination of the granted credits (treasury or equipment purchase).

In order to make the analysis we made empirical correlations between the dependent variable and the independent variables.

The variables subject to the analysis were worked so that they could generate a correlation matrix. It reflects the degree of influence of each independent variable on the default probability (Table 2).

In order to determine the correlation between the number of debtors with overdue payments and the dependent variables we analysed the data series with the EViews software package. We made the econometric analysis with logarithmic series, in order to facilitate the interpretation of the results obtained.

¹ For the analysis purpose, these were transformed in data series with month frequency

We estimate that an increase of the reference interest rate value generates an increase of the default value, while the increase in the credits granted for the treasury's financing or for the equipment purchase is associated with a decrease of the default probability.

3. Research results

After finalizing the information's collection process for each variable analysed we obtained a database structured in Table 1.

Table 1. Database with the values of the main variables

	ROBOR1M	Owed amounts; treasury credits	Owed amounts; equipments credits	Number of debtors with overdue payments (companies)
	(% p.a.)	(mil. RON)	(mil. RON)	(pers.)
	X ₁	X ₂	X ₃	Y
December 2015	0.72	77,366	34,983	40,695
November 2015	0.87	77,228	35,140	43,189
October 2015	1.21	76,682	34,795	42,516
September 2015	1.41	76,267	33,982	42,842
August 2015	1.14	76,373	34,007	42,379
July 2015	1.01	75,404	33,824	41,604
June 2015	1.07	75,413	34,071	43,342
Mai 2015	1.27	74,090	33,792	43,615
April 2015	1.44	74,290	33,661	42,852
March 2015	0.91	68,013	30,348	42,890
February 2015	0.71	67,818	30,397	44,130
January 2015	0.72	67,947	30,335	43,803
December 2014	0.85	67,679	30,837	44,197
November 2014	1.10	67,614	31,237	45,196
October 2014	2.54	67,575	31,239	44,599
September 2014	2.85	67,170	30,873	45,650
August 2014	1.96	66,726	31,023	46,145
July 2014	1.79	66,596	30,875	45,425
June 2014	2.00	66,572	30,490	47,468
May 2014	2.56	66,480	30,553	47,753
April 2014	2.62	66,162	30,184	47,922
March 2014	2.43	65,571	30,167	47,604
February 2014	3.48	65,636	30,268	48,392
January 2014	1.63	65,901	30,172	48,011
December 2013	2.00	65,749	30,163	47,781
November 2013	1.98	65,620	29,448	49,723
October 2013	2.95	66,089	29,909	48,911
September 2013	3.50	65,611	30,213	50,488
August 2013	3.81	66,036	30,247	48,632
July 2013	4.53	65,556	30,096	48,045
June 2013	4.41	66,288	30,297	49,761
Mai 2013	3.82	65,437	29,877	48,499
April 2013	4.40	64,995	29,881	48,773
March 2013	5.27	66,166	30,397	49,170
February 2013	5.84	65,791	30,220	49,715
January 2013	5.97	65,670	30,533	48,104

Source: <http://www.bnr.ro> and authors' processing

The correlation matrix of the variables analysed (Table 2) shows the fact that the high values of the interest rate are associated with high values of the default probability. This fact is emphasized by the positive value of the correlation between the default value and the evolution of the interest rate (0.776457985).

In the same time, the negative values of the correlations between the default value and the treasury credits (-0.839065268) or the credits for the equipment purchases (-0.809370191) show that the high values of the independent variables are associated with small values of the default value. In the same time, the small values of the independent variables are associated with high values of the default probability.

Table 2. Correlation matrix of the analysed variables

	Number of debtors with overdue payments (companies)	ROBOR1M	Owed amounts; treasury credits	Owed amounts; equipments credits
Number of debtors with overdue payments (companies)	1			
ROBOR1M	0.776457985	1		
Owed amounts; treasury credits	-0.839065268	-0.59165719	1	
Owed amounts; equipments credits	-0.809370191	-0.53445578	0.983583041	1

Source: authors' processing, 2016

In order to show the dependence between the selected variables in the chosen time frame we estimated the regression model in Excel (Table 3).

Table 3. Estimation of the regression model in EXCEL

SUMMARY OUTPUT	
Regression Statistics	
Multiple R	0.908505008
R Square	0.825381349
Adjusted R Square	0.809010851
Standard Error	1217.305525
Observations	36

Source: authors' processing, 2016

We can notice that the evolution of the number of debtors with overdue payments (companies) is influenced in proportion of 82.54% by the interest rate and the destination of the granted credits (R Square = 0.82538135).

Next, we made the analysis of the data series with EViews in order to determine the correlation between the number of debtors with overdue payments

(companies) and the independent variables which were subject to analysis.

The check the hypothesis of the normality of the errors we used the Jarque-Berra test. This is based on the hypothesis that the normal distribution has an asymmetry coefficient equal with zero and a aplatisation coefficient equal with three. If the probability associated with the computed value of the test is low enough (the probability associated with the test doesn't exceed the table value), the hypothesis of errors' normality can be accepted.

The analysis of series histograms highlighted that these show characteristics of abnormal distribution having an *Kurtotic excess (distribution is leptokurtotic)*, which reveals the existence of a great possibility to record extreme events (large variations in the interest rate or in the number of creditors that record overdue payments).

With the help of the linear regression we can determine the impact of the independent variables on the evolution of the number of debtors with overdue payments (companies).

The econometric results regarding the impact of interest rates and of the destinaton of loans granted on the probability of default at maturity of loans is as follows:

Table 4. Research results in relation to independent variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	14.03511	0.468392	29.96444	0.0000
L_X1	0.078321	0.004148	18.88015	0.0000
L_X2	-0.048632	0.051414	-0.945899	0.3455
L_X3	-0.122599	0.029612	-4.140125	0.0001
Fixed Effects (Cross)				
_X1--C	4.56E-16			
_X2--C	4.56E-16			
_X3--C	4.56E-16			
_X4--C	4.56E-16			
_Y--C	4.56E-16			
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.842403	Mean dependent var	12.27860	
Adjusted R-squared	0.835989	S.D. dependent var	0.064041	
S.E. of regression	0.025935	Akaike info criterion	-4.422994	
Sum squared resid	0.115694	Schwarz criterion	-4.281085	
Log likelihood	406.0694	Hannan-Quinn criter.	-4.365456	
F-statistic	131.3412	Durbin-Watson stat	1.819591	
Prob(F-statistic)	0.000000			

Source: authors' processing, 2016

As the probability associated with the t test is lower than the most restrictive relevance level (1%) for the variables X_1 (interest rate) and X_3 (credits for the equipments), but is above this level for the variable X_2 (treasury credits), the null hypothesis is rejected in the case of the variables X_1 and X_3 (the coefficients associated with these variables are significant from the statistical point of view) and is accepted in the case of the variable X_2 (the coefficient associated with this variable is not significant from the statistical point of view).

In the same time, the probability associated with the F test shows that at least one of the regression coefficients is significant from the statistical point of view.

Considering that the dependent and the independent variables are expressed in natural logarithms, the independent variables coefficients shows with what percentage is changing the dependent variable at a change with one percent of the independent variables. Thus, an increase of 1% of the value of the interest rate will determine an increase of 7.8321% of the number of bad debtors. In the same time, an increase of 1% of the treasury credits will determine a decrease of 4.8632% of the number of bad debtors. An increase of 1% of the credits for the equipment purchases will determine a decrease of 12.26% of the number of bad debtors.

According to the econometric results the number of debtors to credit is influenced by the interest rate,

meaning that an increase in interest rates on the interbank market determines an increase in the probability of default at maturity of loans contracted, while the destination of loans contracted (equipment, treasury) does not significantly influence PD.

Conclusions

The financing by banks of certain activities in the field of industry, construction, agriculture, services or trade enables companies to increase the quality and volume of products and services provided. Also, a better orientation of these companies to the requirements of domestic and foreign markets takes place with beneficial effects on the reduction of macroeconomic imbalances inherent in an economy which is in full process of recovery of gaps as compared to the standards of developed countries.

The banks are confronted with the interest risk because of the exposure to unfavourable fluctuations of the interest rates on the market. As the interest bearing assets and liabilities become due, the market value of the assets and liabilities is influenced by the variance of the interest rate. The interest rate changes in different moments and in different percentages.

Under the circumstances of the economic crisis, banks have become more selective in providing financing to companies. Interbank liquidity maintenance below the high level recorded before the outbreak of the international economic crisis, and the financial difficulties registered by certain clients, will lead to a strategic reorientation of corporate lending, as follows:

- Financing mainly of investment projects along with a European partner (BERD, BEI) or by the government. This strategic shift will take place in the context of decrease of the indebtedness of the private sector and of the increase of the government indebtedness in the long term.
- Carefully analyzing the phases of the economic cycle and avoiding as far as manageable, the concentration of funding in sectors with a growth rate far too high at present and untenable in the long term.
- Focusing on the safety of investments made and diminishing the probability of materialization of credit risk by requiring additional securities or government securities.

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