QUANTIFYING THE EFFECTS OF THE MACROECONOMIC VARIABLES ON THE LOAN PORTOFOLIO QUALITY FOR THE ROMANIAN BANKING SYSTEM USING THE VAR MODEL

Prof. Marin OPRIŢESCU, PhD
Assist. Prof. Alina Georgiana MANTA, PhD
Mircea PERPELEA, PhD
University of Craiova

1. General considerations

Over time, banking crises have affected many countries and they led to bankruptcy or restructuring of several credit institutions. Solvency of credit institutions lies in the loan portfolio quality and risk exposure is thus a key indicator of financial vulnerability of a bank.

Before starting our research, we must make some assessments about the latest developments in the loan portfolio quality in the banking system operating in Romania in terms of minimizing risks.

In recent years, lending was the most aggressive segment, with banks focusing mainly on increasing their market share by expanding the range of products and territorial networks. In a new competition-driven environment, in 2008, the Romanian banking system switched from excess liquidity to liquidity shortfall, from aggressive lending in 2008 Q1-Q3 (up 11.1 percent in Q1, 8.2 percent in Q2, 9.0 percent in Q3, compared to 2,0 percent in Q4 2008), to promotions aimed at attracting deposits in 2008 Q4.

At end-2008, banking system-wide indicator illustrating the share of loans to customers in total gross assets stood at 62.50 percent, up 3.4 percentage points from the prior year's figure.

According to monetary balance sheet data of credit institutions that are found in the NBR Annual Report, in 2008, the dynamics of non-government credit slowed down versus the previous year (by 33.7 percent in nominal terms or 25.8 percent in real terms, compared to 60.4 percent in nominal terms or 50.5 percent in real terms), as well as the change in the lei/foreign currency structure of loans in favor of foreign currency-denominated loans (their share in total non-government credit stepped up to 57.8 percent in 2008 from 54.3 percent a year earlier.

Loans to households remained the fastest growing segment; at end-2008, the NFC sector posted a 38.7 percent rate[1] of increase versus 29.7 percent year on year. Moreover, it is noteworthy the larger share of foreign currency-denominated loans to households, up 53.6 percent, while RON-denominated loans rose by merely 22 percent in 2008. Against this background, the NBR moved to improve the loan classification framework in order to contain currency risk and the worsening of the loan portfolio quality, imposing credit institutions additional provisioning requirements for loans granted in a currency other than the income currency (NBR Regulation No. 4/2008 on amending and supplementing NBR Regulation No. 5/2002 on the classification of loans and placements, as well as the setting-up, adjustment and use of specific provisions for credit risk

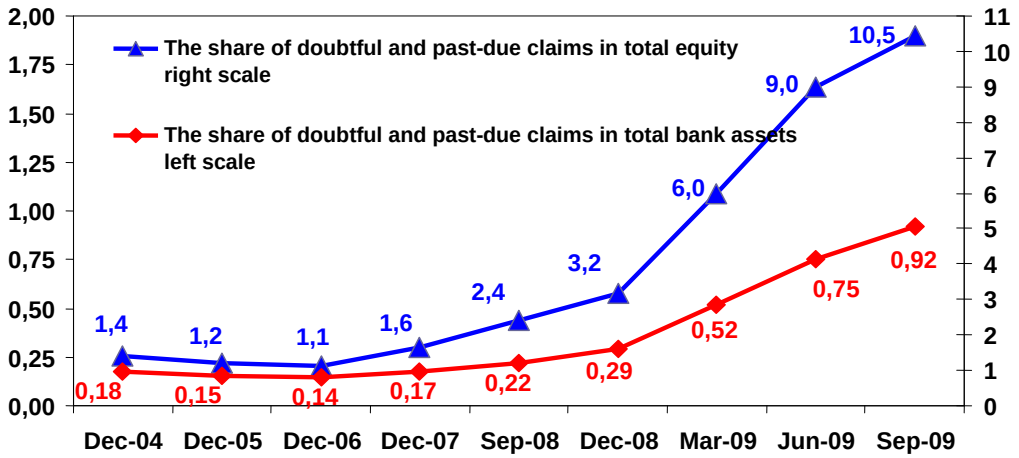
[1] According to the Annual Report of NBR 2008, pp. 68

and NBR Methodological Norms No. 12/2002 on the enforcement of NBR Regulation No. 5/2002, which came into force in March 2008).

As expected, on the retail credit segment, housing loans destined to the purchase of houses or building materials recorded, in 2008, a growth rate (47.2 percent) faster than that of consumer loans (33.7 percent). Nevertheless, in absolute terms, consumer loans held the largest share in 2008.

According to the Annual Report of NBR, after a period during which lending was banks' main option for increasing their market share, signs appeared of a gradual deterioration of the indicators measuring the loan portfolio quality, manifest especially in 2008 H2. Accordingly, although below par, it is noteworthy the steady rise in the share of doubtful and overdue loans in the portfolio of loans to customers (net) from 0.22 percent at end-2007 to 0.32 percent at end-2008. Moreover, the same indicator (gross) saw a faster rise during the said interval, from 0.77 percent to 1.37 percent. The share of doubtful and past-due claims in total bank assets moved up 0.12 of a percentage point in 2008 (from 0.17 percent to 0.29 percent) and 0,92% in September 2009 (see graphic no. 1).

Graphic no. 1.



Source: Florin Georgescu - "The banking system and prudential policy of the National Bank of Romania, Bucharest, December 11, 2009

2. Research methodology

The paper focuses on quantifying the effects of Romania's macroeconomic performance over the quality of credit portfolio of the banking sector.

More specifically, the paper seeks to discover those interrelated macroeconomic factors (such as interest rate, GDP growth, exchange rates) that influence the development of quality loan portfolio for commercial banks. To achieve these correlations we use the VAR model.

Therefore, we apply the VAR model and impulse - response analysis to determine causal relationships between economic variables and the credit quality.

In addition, similar to the model proposed by Baboucek and Jancar[2], scenario analysis and stress testing can also be applied to examine their impact on quality of credit portfolios of banks in Romania. Stress tests are carried out

[2] Baboucek and Jancar, "Effects of Macroeconomic Shock to the Quality of the Aggregate Loan Portfolio", Czech National Bank, Working Paper Series, No. 1, p. 1-62

under exceptional circumstances, both hypothetical but plausible and historically to assess the vulnerability of the loan portfolio against the negative macroeconomic factors. The idea of these simulations is to provide a forward looking assessment of the banking sector-level exposure to credit risk in order to maintain financial stability.

VAR model uses a system of linear equations to capture dynamic feedback relationship between two or more endogenous variables.

VAR treats all variables as symmetric, without implying that one variable is independent or dependent. All endogenous variables are affected by current and past achievements of other variables. The structural form of the model is as follows [Marlon Tracey, 2008, pp. 9]:

$$\begin{bmatrix} 1 & b_{12} & \dots & b_{1n} \\ b_{21} & 1 & \dots & b_{2n} \\ \dots & \dots & \dots & \dots \\ b_{n1} & b_{n2} & \dots & 1 \end{bmatrix} \begin{bmatrix} y_{1t} \\ y_{2t} \\ \dots \\ y_{nt} \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \\ \dots \\ a_n \end{bmatrix} + \begin{bmatrix} \Gamma_{11}(L) & \Gamma_{12}(L) & \dots & \Gamma_{1n}(L) \\ \Gamma_{21}(L) & \Gamma_{22}(L) & \dots & \Gamma_{2n}(L) \\ \dots & \dots & \dots & \dots \\ \Gamma_{n1}(L) & \Gamma_{n2}(L) & \dots & \Gamma_{nn}(L) \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \\ \dots \\ y_{nt-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \dots \\ \varepsilon_{nt} \end{bmatrix} \quad (1)$$

or in a more compact form:

$$B_{y_t} = A + \Gamma(L)_{y_{t-1}} + \varepsilon_t \quad (2)$$

where B is a $n \times n$ matrix of coefficients of n endogenous variables in y_t vector. A designs the constant vector $n \times 1$, $\Gamma(L)$ is the $n \times n$ matrix of the polynomial lags which captures the lags of the endogenous variables and ε_t is the $n \times 1$ vector, $\varepsilon_t \sim N(0, \Omega)$. The model in the equation (2) can be adjusted in order to include the exogenous variables:

$$B_{y_t} = A + \Gamma(L)_{y_{t-1}} + \Pi x_t + \varepsilon_t \quad (3)$$

In this case, Π is a $n \times p$ matrix of the coefficients and x_t is the vector $p \times 1$ for the exogenous such as weather or/and a random variable[3].

Therefore, the VAR model avoids this problem estimating the model in a simplified form, depending on the predetermined variables and the residual ones. By multiplying the equation (3) to B^{-1} we obtain a reduced VAR in this form:

$$y_t = C_0 + C_1(L) y_{t-1} + C_2 x_t + e_t \quad (4)$$

where $C_0 = B^{-1}A$, $C_1(L) = B^{-1}\Gamma(L)$ $C_2 = B^{-1}\Pi$ and $e_t = B^{-1}\varepsilon_t$.

As e_t is a function of ε_t, this is composed of uncorrelated residual values but that will be correlated in the equations.

3. Results of the research and discussions

The study considers the period 2000 - 2009 and there were used data from the European Central Bank and National Bank of Romania. These data are represented in the Table no. 1. Endogenous variables used for the VAR model are non-performing loans / total loans * 100 (NPL), interest rate (Rd), Gross Domestic Product (GDP) and real exchange rate (Ex_r). Exogenous variable is considered the constant.

For accurate results, data entered into the statistical program EViews were previously logarithm.

[3] Marlon Tracey, *A VAR Analysis of the Effects of Macroeconomic Shocks on Banking Sector Loan Quality in Jamaica,* Bank of Jamaica, 2008, pp. 9

In scenario no. 1 there are presented the results of the estimates embodied in the credit risk indicator responses (non-performing loans / total loans * 100) to GDP shocks, real exchange rate shocks, interest rate shocks for our country.

From scenario no. 1 and Figure 1 we can see that, in the case of credit institutions', improving the quality of their loan portfolio is due to real exchange rate depreciation, while higher interest rates increase the likelihood of default risk.

However, GDP growth will only increase public revenues and thus this will minimize credit risk.

Table no. 1

	Npl	Rd	GDP	Ex_r
2000	0,65	32,95	40651,25	113,61
2001	0,72	26,69	45356,83	115,55
2002	0,43	20,5	48614,86	116,53
2003	0,31	20,8	52576,48	114,05
2004	0,28	17,64	61063,95	116,9
2005	0,26	6,97	79801,87	137,26
2006	0,2	8,23	97751,04	146,7
2007	0,22	7,6	124728,5	159,35
2008	0,35	12,8	139752,9	151,57
2009	1,46	9,56	115869,2	140,17

Source: European Central Bank Statistical Data Warehouse and National Bank of Romania

Scenario no. 1

Estimating VAR model for Romania

Estimation Proc:
==========
LS 1 1 NPL LGDP LEX_R RD @ C

VAR Model:
==========
NPL = C(1,1)*NPL(-1) + C(1,2)*LGDP(-1) + C(1,3)*LEX_R(-1) + C(1,4)*RD(-1) + C(1,5)

LGDP = C(2,1)*NPL(-1) + C(2,2)*LGDP(-1) + C(2,3)*LEX_R(-1) + C(2,4)*RD(-1) + C(2,5)

LEX_R = C(3,1)*NPL(-1) + C(3,2)*LGDP(-1) + C(3,3)*LEX_R(-1) + C(3,4)*RD(-1) + C(3,5)

RD = C(4,1)*NPL(-1) + C(4,2)*LGDP(-1) + C(4,3)*LEX_R(-1) + C(4,4)*RD(-1) + C(4,5)

VAR Model - Substituted Coefficients:
==========
NPL = 1.119012864*NPL(-1) + 2.289901638*LGDP(-1) - 3.322507436*LEX_R(-1) + 0.04064666419*RD(-1) - 10.04268293

LGDP = - 0.6596891*NPL(-1) + 0.3138032413*LGDP(-1) + 1.141559654*LEX_R(-1) - 0.004395924251*RD(-1) + 2.547301504

LEX_R = - 0.1565454423*NPL(-1) - 0.0681869633*LGDP(-1) + 0.6328637345*LEX_R(-1) - 0.004972319156*RD(-1) + 2.712812029

RD = - 6.690734111*NPL(-1) - 21.27260747*LGDP(-1) + 77.0414875*LEX_R(-1) + 0.8719649286*RD(-1) - 135.0433581

Vector Autoregression Estimates

Vector Autoregression Estimates
Date: 05/20/10 Time: 23:46
Sample (adjusted): 2001 2009
Included observations: 9 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	NPL	LGDP	LEX_R	RD
NPL(-1)	1.119013	-0.659689	-0.156545	-6.690734
	(0.97944)	(0.45436)	(0.34660)	(17.2854)
	[1.14250]	[-1.45191]	[-0.45167]	[-0.38708]
LGDP(-1)	2.289902	0.313803	-0.068187	-21.27261
	(0.68383)	(0.31723)	(0.24199)	(12.0683)
	[3.34864]	[0.98921]	[-0.28178]	[-1.76268]
LEX_R(-1)	-3.322507	1.141560	0.632864	77.04149
	(2.33980)	(1.08542)	(0.82798)	(41.2931)
	[-1.41999]	[1.05172]	[0.76434]	[1.86572]
RD(-1)	0.040647	-0.004396	-0.004972	0.871965
	(0.02673)	(0.01240)	(0.00946)	(0.47170)
	[1.52076]	[-0.35454]	[-0.52572]	[1.84858]
C	-10.04268	2.547302	2.712812	-135.0434
	(5.87807)	(2.72681)	(2.08007)	(103.737)
	[-1.70850]	[0.93417]	[1.30419]	[-1.30179]
R-squared	0.865497	0.974940	0.843875	0.865571
Adj. R-squared	0.730995	0.949879	0.687750	0.731142
Sum sq. resids	0.174827	0.037623	0.021892	54.45092
S.E. equation	0.209061	0.096983	0.073980	3.689543
F-statistic	6.434793	38.90378	5.405121	6.438879
Log likelihood	4.964886	11.87774	14.31434	-20.87078

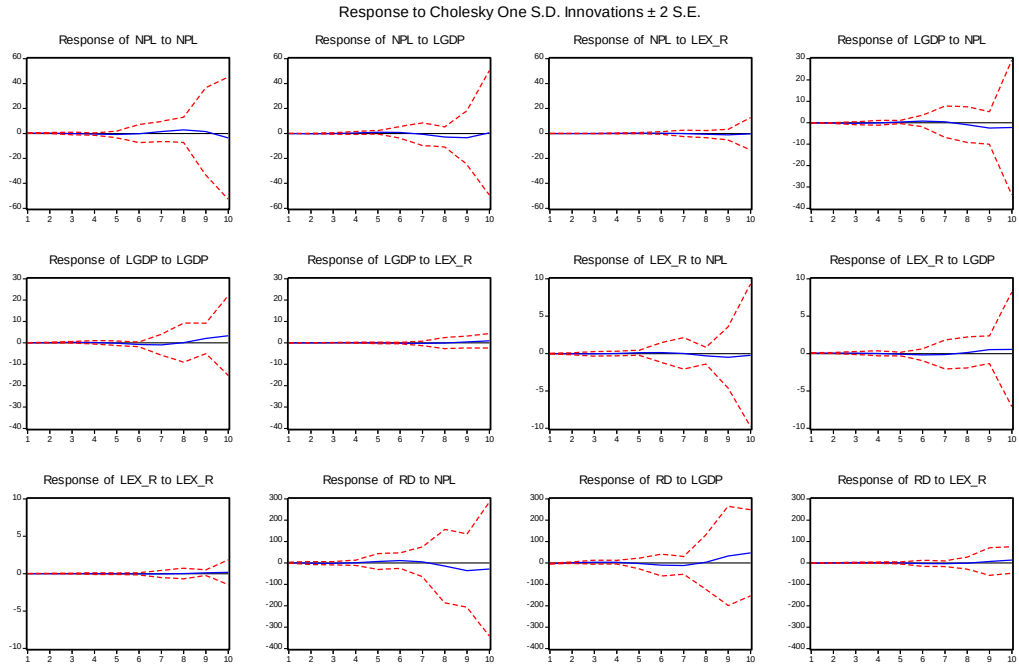
Akaike AIC	0.007803	-1.528387	-2.069852	5.749063
Schwarz SC	0.117372	-1.418818	-1.960283	5.858632
Mean dependent	0.470000	11.26921	4.883453	14.53222
S.D. dependent	0.403082	0.433198	0.132393	7.115597

Determinant resid covariance (dof adj.)	4.38E-12
Determinant resid covariance	1.71E-13
Log likelihood	81.21190
Akaike information criterion	-13.60264
Schwarz criterion	-13.16437

Source: own calculations in Eviews Statistical Software

Figure no. 1.

Responses of the credit risk indicator to the shocks of GDP, interest rate and real exchange rate



Source: own calculations in Eviews Statistical Software

In Figure no. 1 we represent the response functions of the indicator of credit risk at the shocks of GDP, interest rate and real exchange rate. Thus, a positive shock of GDP is associated with an increase in population's incomes and thus implicitly with a decline of credit risk.

On the other hand, a negative shock of real exchange rate is associated with an increase in loan portfolio quality as it grows the purchasing power of the debtor.

However, a positive interest rate shock also has a negative impact on quality of loan portfolio so that rates paid

by the borrowers are higher and therefore the risk of default increases.

4. Conclusions

The paper highlights the impact of moderate and extreme macroeconomic shocks on banks' loan portfolio quality. VAR methodology gives us useful research results.

Therefore, monetary and structural influences are highlighted by using the cumulative function of impulse - response. Monetary factors have contributed greatly to the intensity of financial crises. Beyond these results, it is clear that the interest rate and real exchange rate play an important role in sizing quality loan portfolio in the banking system.

Consequently, the monetary authorities must take care when using the exchange rate as an instrument of monetary policy given the fact that the impact on exposure to credit risk is not uniform across all credit institutions.

Increasing of the interest rate and a high inflation are like early warning systems for deteriorating loan portfolio quality.

In conclusion, the government and banks need to effectively manage risk in favorable economic conditions.

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