Determinants of Households' Overdue Loans in Romania

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The paper's target is to identify macroeconomic and financial variables that are relevant for the evolution and forecassting of the household's overdue loans in Romania. By employing vector autoregression and systems of ecuations using the SUR methodology, the authors are trying to respond to the following questions: (1) Which are the lags and the individual intensities of the macroeconomic relevant indicators when affecting the household overdue loans rate?; (2) What are the characteristics of the loans reimbursement behavior in case of shocks on the labor, monetary, goods and services markets? The empirical analysis is based on monthly data which allows for assessing the quality of household loan repayment, both in terms of number of overdue loans and in terms of overdue loan volumes. The relevant explanatory variables were used in various configurations and lags for constructing several macroeconomic credit risk models.

Keywords: Overdue Loans, Money, FX Markets, Labor, Goods, Services, Financial Stability

1 Introduction

The financial stability has recorded a remarcable revival on the agenda of the economic policies reform at international level. The experience of excessive credit growth to household sector, stimulated by exuberant expectations regarding future rapid growth of household revenues, was brought to the extreme during the financial crisis, especially in the countries from Central and Eastern Europe. The following economic adjustment and the implementaion of severe measurements for fiscal consolidation overlapped over expensive monetary conditions for debtors and especially for households.

In this context, the aim of this paper is to identify the monetary and labour market factors relevant for modeling the dynamics of households' overdue loans in Romania. This paper is written from a macroprudential analysis standpoint, representing a part of the investigation of the mechanism through which the economic activity developments influence the evolution of the overdue loans rate within the Romanian banking system.

The comparative treatment of the determinants for the number of overdue loans and volumes of the overdue loans represents a new approach within the literature. The innovating feature of the paper is consolidated by the investigation of the importance of the developments in prices for food products, non-food products and energy on the reimbursing pattern of the debts. The interest for this subject has been increasing for the last years, the main exponents being presented within the central banks' studies papers (Jakubik and Schmieder 2008, Fiori at al, 2009, Aikman et al, 2009).

Jakubik and Schmieder (2008) give an overview of the macroeconomic factors weighing on credit risk in the Czech Republic, compared to Germany. The paper features different approaches to nonperforming loans generated by households and those by non-financial corporations, with empirical results showing some similarities between the two countries in terms of the set of exogenous variables. Both in the Czech Republic and Germany the annual GDP growth rate and the year-earlier financial indebtedness exert an influence on the default rate associated with corporate loans. In regard to households, one variable from either set of indicators for the labour market and the counterparties' financial burden are included in the function form of regressions estimated for the two countries. The major determinants identified in the paper are the year-earlier unemployment rate and the real interest rate recorded three

quarters before in the case of the Czech Republic and the current disposable income and the year-earlier financial indebtedness in the case of Germany. By checking the models' predictive power via out-of-time tests, the authors also found that modelling credit risk in households brings about stronger challenges for both countries, while apparently other variables than the economic ones explain the profile of developments in default rate across this sector.

The operational aim of this paper is to build a series of econometric models which responds to four strongly-related questions, namely:

(i) which are the components of the macroeconomic variables series able to predict the dynamics of the overdue household loans? (and within this framework, which are the differentiation elements among the determinants of the overdue loans rate determined as a numerical weight and that determined as a value weight from the standpoint of the developments of the monetary and labour market conditions?);

(ii) which are the lags and the individual intensities of the macroeconomic relevant indicators when affecting the household overdue loans rate?;

(iii) what is the hierarchy of the factors with impact on the dynamics of households overdue loans;

(iv) what are the characteristics of the loans reinburstment behaviour in case of shocks on the labour, monetary, goods and services markets? (or how can be characterised the households' credit discipline?).

The paper is composed aut of three sections and it concludes with the main findigs and future research objectives. In the first section we described the methodological framework for forecasting hoseholds' overdue loans, starting with the findings in the international literature. The second part comprises of both presentation of the data series that were used and the economic rational and statistical evidence which lead us in selecting the explanatory variables. In the third section we decribed main empirical findings derived by constructing and testing of the macroeconomic credit risk models.

2 Methodological framework

Methodological solutions used in evaluating the impact of macroeconomics conditions on households loans reinbursing capacity comprise in using multiple regressions with macroeconomic factors. In this context, the dependent variable is expressed either as a rate of volumes of nonperforming loans or as a rate of number of nonperforming loans (Aikman et al, 2009), while main econometrics techiques used are SUR regressions (Fiori at al, 2009) or VAR models (Jorda, 2005, Drehmann et al, 2006).

The assessment framework for households loans reinbursing capacity is based on struturing the financials flows of the debtors on types of income (v_l) and two kinds of expenses, namely financial (v_m) and non-financial (v_{gs}). The methodological solution used in the paper is based on the following system of equations, which shows the different profiles of the explaining factors between the rate of number of overdue loans (rnr_t) and rate of volume of overdue loans (rvr_t):

$$\begin{cases} d(rnr_t) = \alpha + \sum_{l=1}^{k} a_l \times d(v_l) + \sum_{m=1}^{n} a_m \times d(v_m) + \sum_{gs=1}^{r} a_{gs} \times d(v_{gs}) + \varepsilon_{rnr} \\ d(rvr_t) = \beta + \sum_{l=1}^{k} b_l \times d(v_l) + \sum_{m=1}^{n} b_m \times d(v_m) + \sum_{gs=1}^{r} b_{gs} \times d(v_{gs}) + \varepsilon_{rvr} \end{cases}$$

The individual impact of macroeconomic factors on the evolution of both rates of nonperforming loans is analysed using first diference (with monthly frequency) of the time series using SUR (*Seemengly Unrelated Regression*) econometric estimation technique. This econometric framework improves the efficiency of the estimation by adjusting the coefficients of both equations so that to reduce the errors correlation, as the

significant correlation between the dependent variables of the system can generate a high errors' correlation. The framework for identifying the determinant factors is improved by using autoregressive vectors that can better identify the persistence and impact in time of the macroeconomic variables on the evolution of number and volume of the nonperforming loans.

The relevance of the determinant factors was computed based on individual contribution to the adjusted R squared for systems of equations estimated using the SUR method and on variance decomposition for a 24 month time horison in case of VAR models. The models' acuracy was tested by ex-post forecasting technique.

3 Data

The dynamics of the overdue household loans was illustrated both as an overdue loans number weight and as an overdue loans value weight. A loan is considered overdue if the debt service is higher that 30 days.

The data used for the empirical analysis cover monthly information during the period of December 2004 – June 2010, while the testing data cover the period of July 2010 – December 2010. The beginning of the estimation period is determined by the availability of data for the dependent variables.

The economic variables included in the preliminary tests are, as the paper title suggests, indicators of the labour market (such as unemployment rate, unemployment gap, public sector employees number, private sector employees number, average gross income of workers for the whole economy, public sector average income, private sector average income), monetary variables (such as exchange rate, interest rate for local currency households loans, interest rate for euro households loans, Euribor interest rates for different maturities etc.) and indicators for the consumption prices evolution (consumer prices index and indexes of prices for food, non-food and energy). These data were drawn up from the reports of the Statistics National Institute and those of the National Bank of Romania.

The variables of the labor market were seasonally adjusted based on the *Tramo Seats* methodology in order to eliminate the impact of the seasonal factors on this market, especially of the public sector. Moreover, as all the data series were considered non-stationary and integrated of order one, based on their economic significance and statistical tests (*ADF* şi *Phillips-Perron)*, their stationalisation was ensured through first-diferentiation. Moreover, except nonperforming loans rates and interest rates, all the variables were considered in the econometrical analysis in natural logarithms.

4 Empirical analysis

Fo selecting the models' specifications, the starting point was the estimation of equations systems. Given the complexity of the analysis, the selection procedure for the determinant factors consisted in employing a reasonable number of models that used a large diversity of exogenous variables.

Models' specifications, including number of lags, was chosen so that to insure functional stability of the mechanism both form the economical and econometrical point of view, taking into account specific statistics as adjusted R squared, informational criteria, tests for regression errors. Empirical results lead to the selection of two (relatively) distinct specifications which were estimated both with SUR systems of equations (Table 1) and with VAR models.

Table 1. Systems of equations specifications for the dynamics of the default rates

Variable (month on month dynamic)	Rate of defaults number				Rate of defaults value			
	System 1		*System 2*		*System 1*		*yistem 2*	
	coef.	lag	coef.	lag	coef.	lag	coef.	lag
Average income	-0.0479***	1						
in public sector			-0.0059**	1				
in private sector							-0.007**	0

Unemployment rate	0.0248***	3						
Unemployment rate gap					0.0184**	5		
Employment in public sector			-0.085***	5				
Employment in private sector			-0.233***	0	-0.100***	3	-0.090***	3
EURRON exchange rate	0.0508***	2	0.0415***	2				
RON loans interest rate	0.1187***	1	0.0968**	1			0.01511*	3
Non-food inflation							0.0141**	1
Constant	0.0023		0.001757		0.0002		0.000277	
Adjusted R-squared	0.4493		0.5558		0.6421		0.6713	
Durbin Watson	2.3130		2.0607		2.264128		1.9450	

Results of the statistical tests show that the set of models comply with demands of a good econometrics performance, but their explanatory power is not better than the usual outcomes in ths field. The outcome is not a surprise, considering the similarity with the results presented in the literature (Jakubik şi Schmieder, 2008), as well as presence of operational risk events for which the data sample could not be adjusted for.

Structural investigation of the determinants set was followed by detailed investigation of the autoregressive profile, which emphasizes the importance of the second round effects. The autoregressive profile analyzed by using vector-auto-regression (VAR) models. These models evaluate the persistence of effects of shocks on different markets taken into account (labor market, money and FX markets, goods and services markets) on the dynamics of defaults.

Based on the results of the impulse-response functions of default rates (computed both as number and as volumes) to macroeconomic and financial variables indentified in the SUR systems of equations estimations procedure, five alternative VAR models were estimated. Thus each VAR model specification was consistent with final specification of each equations in the estimanted systems of equations, while the number of lags for each VAR was selected so that to insure its stability and in the same time to be consistent with economic theory and statistically relevant (Adjusted R-squared, Informational criteria). Out of those five candidate VAR configuration two specifications were selected, based on results of the impuls-response functions, variance decomposition and residulas tests.

The estimation of the VAR models was based on the optimal number of lags (Table 2).

Table 2. Number of lags in the VAR models specifications

	Rate of the number of defaults		Rate of the value of defaults	
	VAR 1	*VAR 2*	*VAR 1*	*VAR 2*
Number of *lags*	6	3	3	2

According to analysis of the Roots of Characteristic Polynomial, all the four VAR specifications fulfill the stability condition. Moreover, according to the residulas correlogram, there is no autocorrelation of the errors.

For generating the impuls-response functions the time horison taken into account was 24 months and the interpretation of the results was based on the cummulated impulse-response functions of the two rates of

defaults to a shock on variables in the system. Because the correlation of the residuals of the equations in some of the VARs was significant (as an example, the correlation in the residulas between the equation of the employment in the private sector and equation of the unemployment rate gap is -41%), the ordering of the variables in the Cholesky decomposition became elevant. As an example, in generating the impulse-response function

using Cholesky decomposition method for the first VAR specification, the following ordering of variables was used: employment in the private sector, unemployment rate gap, rate of the value of defaults.

According to the results of the cummulated impulse-response functions (Annex), for a 2 years time horizont the following conclusins result:

Rate of the number of defaults	**VAR 1**	*(1) the impact of a shock on the average income on the rate on the number of defaults lasts aproximately 7 months;* *(2) the unemployment rate has a statisticaly significant impact on the rate on the number of defaults after 6 months and it lasts for a quarter;* *(3) the impact of a shock of the EURRON exchange rate on the rate of the number of defaults its becoming statistically singnificant starting with the third month and last aproximately half a year.*
	VAR 2	*(1) a shock on the EURRON exchange rate has a statisticaly significant impact on the rate of the number of defaults after a quarter and the impact lasts aproximately an year;* *(2) a shock on teh employment in the privarte sector has an immediate impact on the rate of the number of defaults and lasts aproximately an year;* *(3) a shock on the employment in the public sector has a reduced impact on the rate of the number of defaults both a timing and persistence.*
Rata volumului restanţelor	**VAR 1**	*(1) a shock on the employment in the private sector has a strong impact on the rate on the value of defaults, which lasts for up to 20 months;* *(2) a shock on the unemployment rate gap has a statistically significant gap on the rate of the value of defaults which lasts for 3-6 months.*
	VAR 2	*(1) a shock of the employment in the private sector has a statistically significant impact on the rate of the value of defaults after aproximately half a year;* *(2) a shock of the nonfood inflation has an impact on the rate of the value of defaults for up to 9 months.*

The econometric tests in case of Romania confirm the economic common sense that the dynamics of the overdue loans number rate is negatively affected by the income evolution (especially in the public sector and the evolution of employees' number especially in the private sector). Simultaneously, the exchange rate depreciation and the increase of the interest rate for the local currency loans determine the increase of the overdue loans number rate (Table 3).

Likewise, the empirical results suggest that both the dynamics of the interest rates for foreign currency loans and the prices increases on the analyzed products and services markets are not statistically relevant for the evolution of the rate of overdue loans number.

A less expected result was registered for the functional form of the overdue loans volume rate. All the analyzed configurations based on the simultaneous equations systems method and autoregressive vectors method illustrate that the monetary factors developments had only a marginal influence on the overdue loans volume rate dynamics, comparable as importance to that of non-food inflation.

Table 3. Factorial decomposition

Explanatory varibles	Rate of overdue loans number (%)				Rate of overdue loans volume (%			
	Sist. 1	Sist. 2	VAR 1	VAR 2	Sist. 1	Sist. 2	VAR 1	VAR 2
Labour market	10.45	25.27	24.59	27.12	61.75	42.75	30.44	32.12
Average revenue	4.32		9.85					
Public sector revenue		2.52		2.11				
Privat sector revenue						2.36		2.00
Unemployment rate	6.13		14.74		1.33		21.43	
Public setor employees number		5.43		8.93				
Privat setor employees number		17.31		16.08	60.42	40.39	9.00	30.12
Monetary market	30.09	12.58	21.93	15.19		0.71	0.00	5.61
Exchange Rate	15.04	9.84	21.93	10.01				
Interest rate on domestic loans	15.04	2.74		5.18		0.71		5.61
Goods and services market						1.70	0.00	3.49
Non-food goods inflation						1.70		3.49
Overdue rate	55.07	44.42	53.48	57.69	35.78	32.87	69.56	58.77
Adjusted R2	44.93	55.58	42.77	43.28	64.22	67.13	57.20	80.48

The two specifications were tested out-of-sample for July 2010 – December 2010. The ex-post forecasted values and the effective values for two overdue loans measures are presented in the following graphs.

Back testing results

Rate of number of defaults
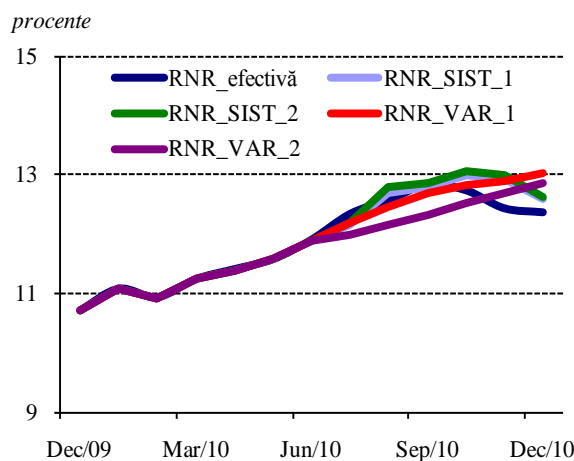
Rate of value of defaults
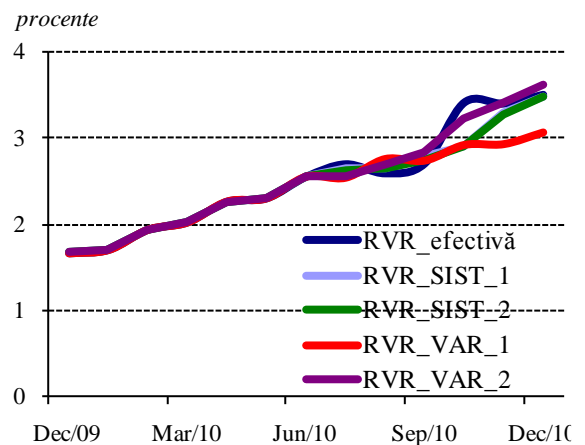
Although the results of the models accuracy tests do not show a systematic difference of the estimated data against the real data, there are significant reserves regarding the capacity of the explanatory functions to spot the tendency change which appears in case of overdue loans number rate. However, this is not confirmed by the dynamics of the overdue loans volume, a longer time period being necessary for clarifying the predictive capacity of the models described in this paper, especially due to the occurrence of structural events within the selected period different than those for the estimated period (such as restructuring of the public sector personnel and general spreading of sales of nonperforming banking portfolios).

5 Final remarks
The econometric results confirm the fact that the labor market dynamics represent the main factor of the evolution of the household

overdue loans both as number and volumes. The monetary conditions have an important role for the number of overdue loans, but not for their volume. The prices increase on the products and services market does not affect the dynamics of the overdue household loans. Some statistical correlations have been identified for the non-food goods which influence positively the volume of the overdue household loans, but not the frequency of the households' late payments. This result suggests a sound reimbursement discipline of the households which prefer the individual consumption adjustment in favour of banking instalments payment. The factorial breakdown identified the exchange rate as the most important factor for the number of overdue loans and the private sector employees number as the main factor for the overdue loans volume.

The impact ranges are generally low, the maximum effects being registered until six months: (i) the monetary conditions generate effects on the dynamics of the overdue loans number rate in a maximum period of two months; (ii) the evolution of the employment rate influences the overdue loans dynamics in a period of three months, the slower impact being generated by the public sector; (iii) although the contribution of the household income variables to the overdue loans rate's dynamics is low, the impact is happening in a maximum period of one month.

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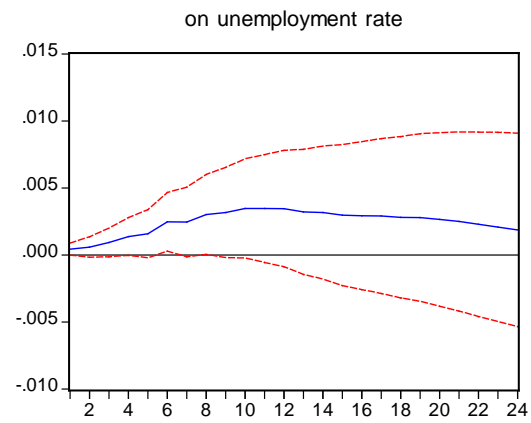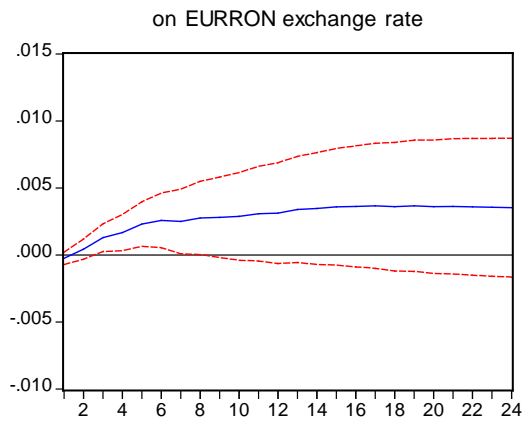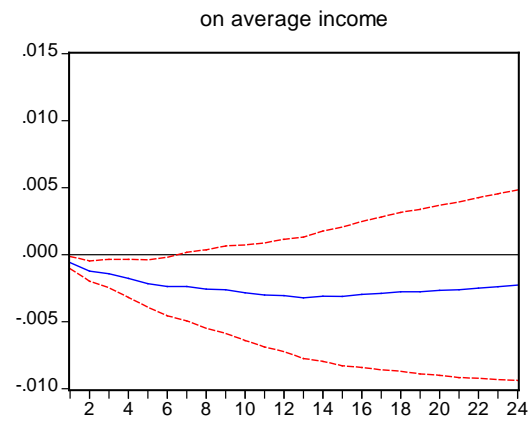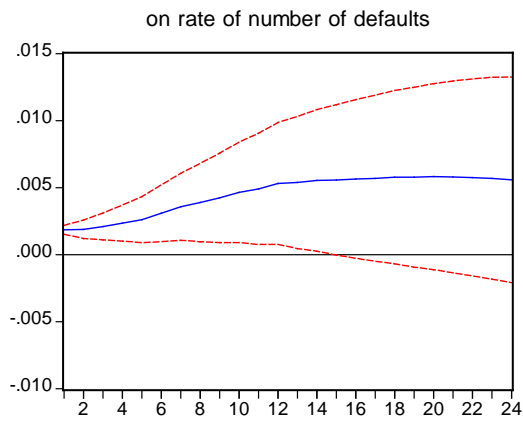
Annex - *Cumulated impulse-response functions*

Configuration 1

Accumulated Response of rate of values of defaults
to One S.D. Innovations ± 2 S.E.

on rate of values of defaults
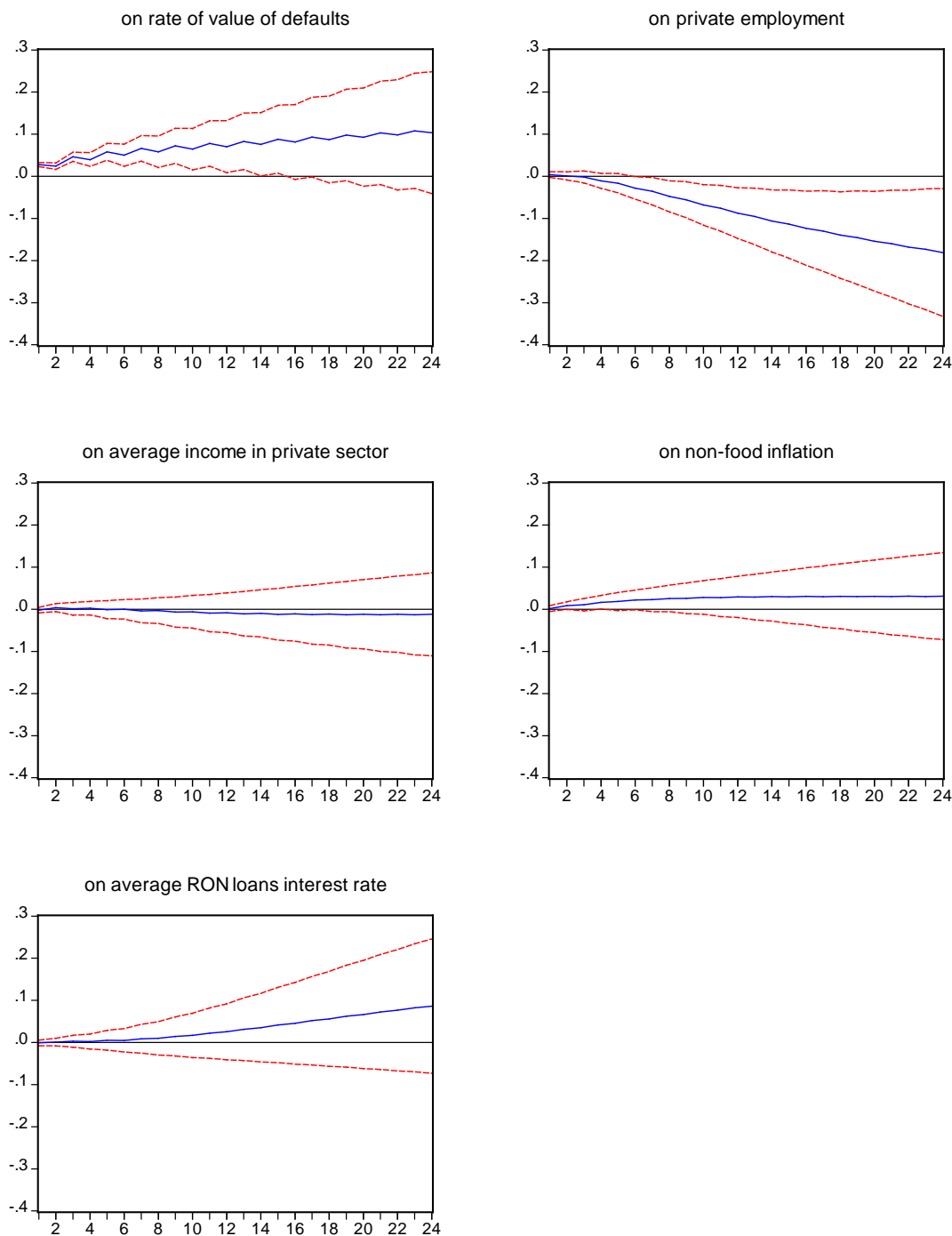
on private employment

on unemployment gap
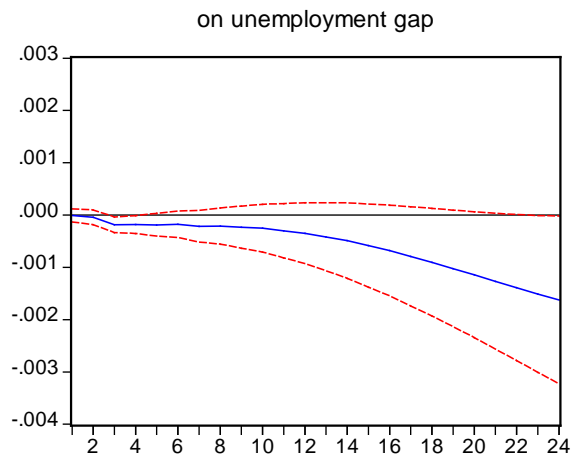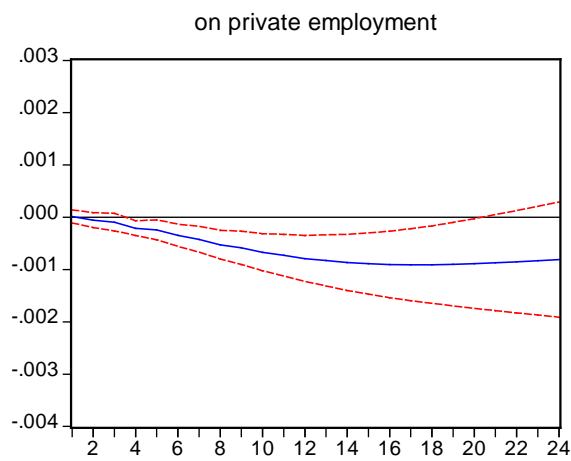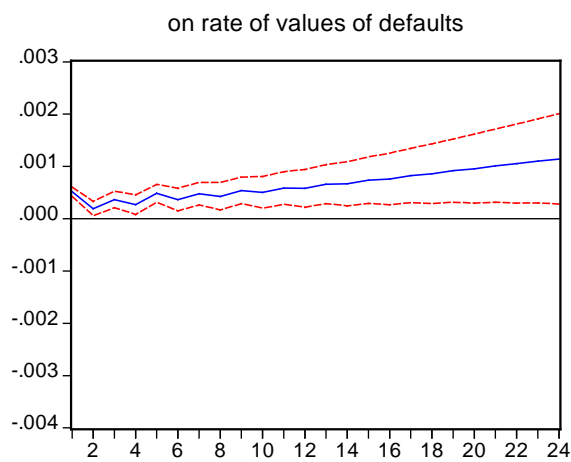
Accumulated Response of rate of number of defaults
to One S.D. Innovations ± 2 S.E.

on rate of number of defaults

on average income

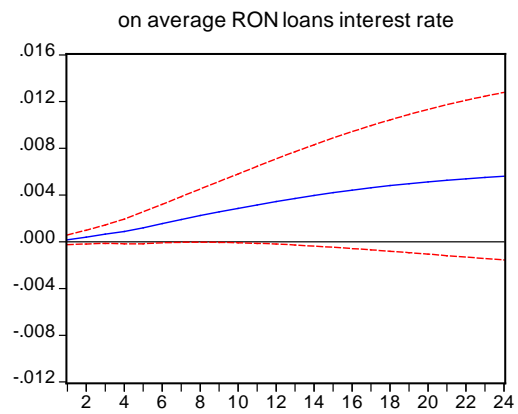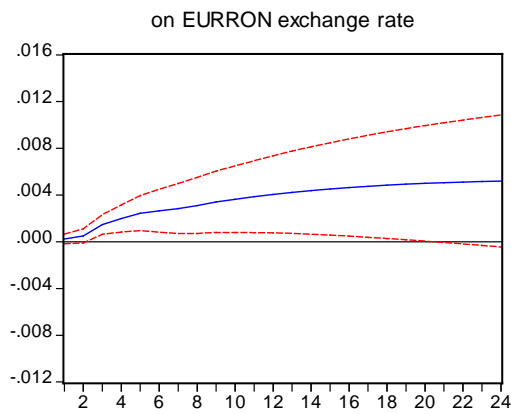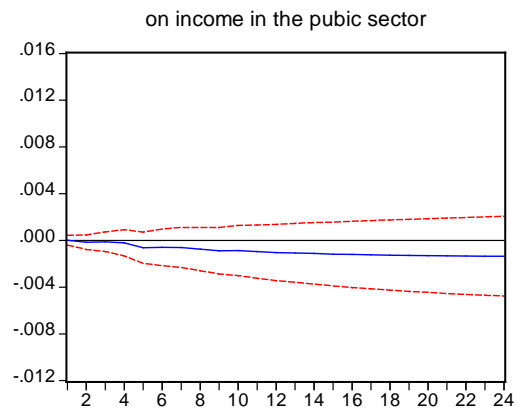on EURRON exchange rate

on unemployment rate

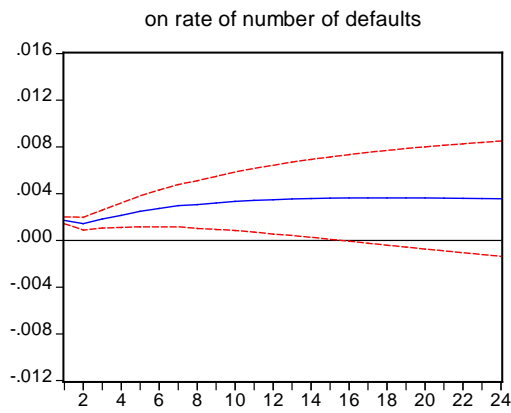## Configuration 2

Accumulated Response of rate of value of defaults
to One S.D. Innovations ± 2 S.E.

on rate of value of defaults

on private employment

on average income in private sector

on non-food inflation

on average RON loans interest rate

Accumulated Response of rate of numbers of defaults
to One S.D. Innovations ± 2 S.E.

on rate of number of defaults

on income in the pubic sector

on EURRON exchange rate

on average RON loans interest rate

on employment in the public sector

on employment in the private sector
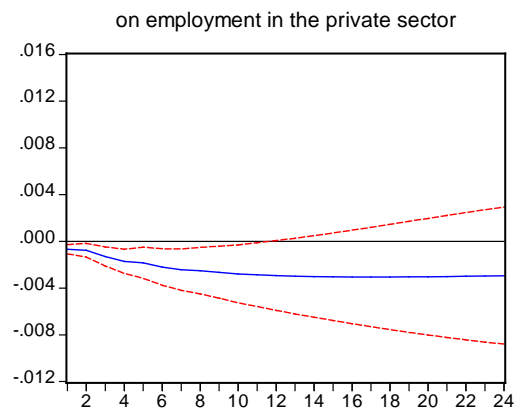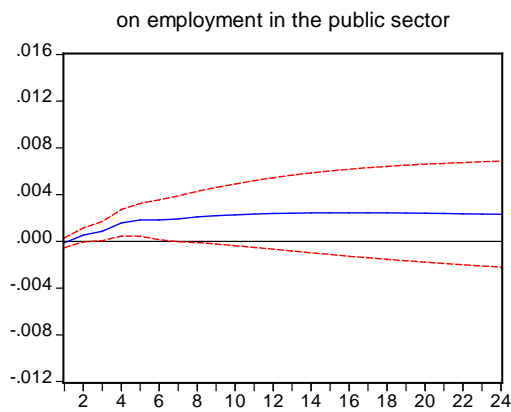
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